

Abstracts Presented at the Twenty-Ninth Annual International Neuropsychological Society Conference

February 14–17, 2001
Chicago, Illinois

Wednesday Afternoon, February 14, 2001

Paper Session 1/4:45–6:15 p.m.

OLFACTION/VISUO-SPATIAL FUNCTIONS

D.A. KAREKEN, D.M. MOSNIK, R.L. DOTY, & G.D. HUTCHINS.
The Higher Cortical Function of Olfaction.

Functional imaging shows that human orbital and medial temporal (piriform) cortex responds to olfactory stimulation, but less is known about odor discrimination and identification. We imaged these olfactory functions in 6 healthy participants (age 26.7 ± 4.9) with normal phenyl ethyl alcohol sensitivity thresholds (-6.00 ± 1.3) and University of Pennsylvania Smell Identification Test scores (36.3 ± 1.2). *Methods:* Participants underwent $H_2[^{15}O]$ positron emission tomography during baseline sniffing (BS), odor sensory stimulation (OS), odor discrimination (OD), and odor identification (OI) scans. *Z*-maps of changes in regional cerebral blood flow (rCBF) relative to whole brain were created, transformed into stereotactic space, and analyzed using the threshold $Z > 3.0$. Image subtractions compared OS to BS, while OD and OI were assessed relative to both BS and OS. *Results:* OS (OS minus BS) activated classical olfactory regions (right piriform, left amygdala, right gyrus rectus, left lateral orbital cortex). OD minus BS activated similar regions. Relative to OS, OD showed increased rCBF in dorsomedial thalamus and visual cortex, and decreased rCBF in medial orbital cortex. OI minus BS was also very similar to OS. Relative to OS, OI showed the greatest increases in rCBF in dorsomedial thalamus, and in left dorsolateral prefrontal, anterior cingulate, and primary visual cortex. Significant reductions in rCBF occurred in medial orbital and right piriform cortex. *Conclusions:* Conscious odor discrimination and identification carry no added activity in olfactory cortex, and a possible shift away from these areas. Some discrimination and identification likely occur spontaneously in olfactory cortex. Consciously executed, these functions require a broader neocortical network, possibly including lexical-semantic code in left prefrontal cortex.

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V.W. MARK. Neglect versus Disorganization on Cancellation Following Stroke.

The cancellation test is commonly used in stroke patients to report the extent and distribution of spatial inattention (neglect). In contrast, other cognitive functions on cancellation are rarely measured, perhaps because they have not been standardized. Nonetheless, studies have occasionally

reported that stroke patients, particularly with neglect, are disorganized on the cancellation test, unlike healthy individuals. Therefore, disorganized search may be fundamental to neglect. The present study evaluated whether spatial neglect and disorganized cancellation are correlated. *Method:* The 56-target Star Cancellation Test was video recorded in 20 acute right hemisphere stroke patients and 22 healthy, age-similar controls, all right-handed. Video playback allowed reconstructing the cancellation sequences. Several measures of search organization were used: number of cancellation path intersections, total cancellation path distance divided by number of cancelled targets, and the highest correlation coefficients of the cancelled targets' sequential horizontal (*x*) or radial (*y*) coordinates. Normal values were defined by control mean scores $\pm 2 SD$. Only stroke patients who marked at least half the targets were assessed, since severe neglect could limit demonstrating disordered search. *Results:* 18 patients marked at least half the targets. Of these, 9 patients showed neglect, while 13 patients were abnormal on at least one search organization variable. Eight patients had both neglect and disorganized search, while 6 patients had either neglect or disorganized search but not both. Neglect severity did not correlate with any of the search organization measures (Pearson's 2-tailed $p > .5$). *Conclusion:* Neglect and significantly disorganized cancellation are independent disorders.

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G.P. CRUCIAN, A.M. BARRETT, D.W. BURKS, A.R. RIESTRA, H.L. ROTH, R.L. SCHWARTZ, W.J. TRIGGS, D. BOWERS, W. FRIEDMAN, M. GREER, & K.M. HEILMAN. Object Orientation in Parkinson's Disease.

Although visual-spatial deficits have been reported to be associated with Parkinson's disease (PD), these findings are inconsistent, and these deficits may be related to other forms of cognitive dysfunction. To assess visual-spatial ability in individuals with PD, we administered the Mental Rotations Test (MRT). The MRT is a standardized, psychometrically sound measure of object spatial orientation which is thought to be generally representative of visual-spatial ability. Nondemented PD patients were significantly less accurate in spatial orientation ability than control subjects similar in age and education, indicating that PD is associated with visual-spatial deficits. MRT performance in the PD subjects was not affected by other factors, such as symptom laterality, symptom severity, symptom type, disease duration, medication status, or mood status. Men with PD appeared to exhibit the largest decrement in object spatial orientation ability, suggesting that men and women with PD perform object spatial orientation tasks differently, possibly engaging different neuropsychological processes in

making the necessary mental transformations. A correlational analysis showed that the MRT performance of male PD participants was correlated with measures of executive function and visual–spatial memory, whereas the MRT performance of female PD participants was correlated with a measure of verbal memory. These findings suggest that PD may be associated with a “mental akinesia” in which the spatial computations and transformation necessary to complete the mental rotation are incomplete.

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J. SHEER, K.A. KERNS, & R. GRAVES. Imagery and Mental Rotation in Unilateral Spatial Neglect.

While the literature suggests that patients with unilateral spatial neglect (USN) have difficulty with visual imagery, there have been few studies documenting the types of imagery processes that are affected. The goal of this study was to explore the impact of USN on mental representation. Six patients with USN were given a battery of mental representation tasks including visual imagery for color, visual imagery for objects (animals), spatial imagery (geographic representation), mental rotation for 2-D objects (L-shapes) and mental rotation for 3-D objects (cubes). To measure impairment, cut-off scores were calculated from the performance of a control group on each task ($N = 17$; cut-off score = 5th percentile of sample). The results revealed that patients were able to perform the visual color imagery task (5 patients above cut-off), the visual shape task (6 patients above cut-off) and the spatial imagery task within normal limits (4 patients above cut-off; 2 excluded based on a geographic knowledge requirement). Furthermore, 3 of the patients were also able to perform the 2-D rotation task, but none of the patients were even able to comprehend the goal of the 3-D rotation task. *Conclusions:* (1) While USN patients have difficulty attending to their own images and manipulating complex stimuli (3-D rotation), the abilities to generate images and to manipulate simple images are independent of the neglect syndrome. (2) In addition, the patients' strong performance on the spatial imagery task suggests that they may be able to scan mental images appropriately depending on the nature of the task.

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L. COLE & M. HISCOCK. Auditory and Manual Asymmetry: Correlated Dimensions of Laterality?

Despite claims that dichotic listening asymmetries vary with hand preference and other aspects of manual asymmetry such as writing posture and familial handedness, positive findings have been sporadic. One can conclude only that the right-ear advantage (REA) usually is somewhat smaller or less frequent in samples of left-handers than in samples of right-handers. In two experiments involving a total of 341 normal adults, we used measures of familial handedness, writing hand, writing posture and strength of handedness to predict ear-asymmetry on dichotic tests of known reliability. In Experiment 1, 88 right-handers and 89 left-handers were administered 480 dichotic pairs from the Halwes Fused Dichotic Words Test (FDWT), which yielded a significant REA and ear-difference scores with a reliability coefficient of .96. In Experiment 2, 83 right-handers and 81 left-handers listened to 528 pairs of words that were arranged into lists of 3 pairs per trial. This test yielded a significant REA and a reliability coefficient of .76. Results from both experiments were similar. Even though strength of handedness predicted ear asymmetry on the FDWT ($p < .05$) and writing hand predicted ear asymmetry on the word-list test ($p < .005$), in neither case did the full regression model account for more than about 8% of the variance in ear-difference scores. In neither experiment was the proportion of variance accounted for by the full model statistically significant. Given the relatively large samples, the moderate to high reliability of the ear differences, and the comprehensive nature of the manual assessment, we are led to conclude that there is only a weak population-level association between manual asymmetry and dichotic-listening asymmetry.

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Poster Session 1/4:45–6:15 p.m.

AWARENESS AND ANOSOGNOSIA

K.A. HANSELL, A.M. BARRETT, P.J. ESLINGER, J.K. BRUBAKER, & K.M. HEILMAN. Unawareness of Cognitive Deficit (Cognitive Anosognosia) in Aged Subjects.

Unawareness of cognitive deficit (cognitive anosognosia) is a disabling condition that often occurs with neurological disorders. We wished to learn whether cognitive anosognosia occurs in normal aging. Using Likert scales, 15 participants (M age 74.67 years) rated their memory, praxis, attention, visuospatial operations, naming ability, mood and uncorrected vision. Subjects then completed standard testing (Hopkins Verbal Learning Test, Florida Apraxia Battery, Florida Mental Status Exam, Judgment of Line Orientation, Boston Naming Test, Geriatric Depression Scale, near card visual acuity) before rating performance in each domain again. We calculated an awareness ratio (AR) for each domain, $AR = (E - P)/(E + P)$ where E = subject's performance estimate and P = actual task performance. Accurate estimate of abilities yields $AR = 0$, while anosognosia could result in a positive AR, and a negative AR indicates underestimation of abilities. Participants accurately estimated (AR not significantly different from zero, one-sample t tests) memory, naming, mood and vision before testing. Participants overestimated praxis (M AR = .10, $p = .044$) and visuospatial ($AR = .04$, $p < .001$) abilities, but underestimated attention (mean AR = $-.13$, $p = .043$). Posttesting, participants became accurate at estimating visuospatial abilities and attention, but overestimate of praxis ability increased compared with pretesting (M AR = .16, paired t test, $p = .019$). Aged participants may demonstrate cognitive anosognosia, particularly for functions mediated by frontal–parietal, dorsal stream, cortical systems. Actually attempting cognitive tasks may increase awareness of attention and visuospatial ability, but not awareness of praxis.

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G. RISSE. Insight and Memory Performance in the Intracarotid Amobarbital Procedure.

The Intracarotid Amobarbital Procedure (IAP) is the primary method for estimating memory capacity in each hemisphere prior to temporal lobe surgery. The present investigation explores the relationship of conscious awareness to memory performance during the IAP. Sixty-one candidates for focal cortical resection to treat chronic epilepsy or brain tumor underwent bilateral amobarbital injections on the same day. All cases were left-hemisphere dominant for language. Only memory items presented prior to first motor recovery were included. Insight or conscious awareness of the procedure was rated as positive if patients demonstrated either free recall of any memory item, recall of aphasia or hemiparesis, or spontaneous recall of any specific event during maximum drug effect. Memory scores were compared for patients with positive versus negative insight ratings for each injection using a one-way ANOVA. Thirteen patients (21%) had positive insight following left injection, while 18 (29%) were lucid for right injection. Patients with insight obtained higher memory scores following both injections ($p < .01$). Full scale IQ was not significantly different for positive versus negative insight groups. Despite failure to consciously recall the procedure, intact memory performance ($\geq 75\%$ correct) was recorded in 21% of injections with negative insight. Conscious awareness of events during the IAP is associated with higher memory scores for items presented during maximum drug effect in both hemispheres. Cases of negative insight associated with intact memory performance suggest a possible dissociation of episodic memory and semantic learning. Relationship to lesion lateralization will be discussed.

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R. SCHWARTZ & R. SEABROOK. Unawareness of Impaired Action Imagery in Parkinson's Disease.

Objective: An action image is a conscious representation of a purposeful act. Action images may be important for estimation of time or degree of

movement needed to complete tasks. Imagining self-performance of tasks may also involve action imagery. Since imagery and act may involve similar neural circuitry and since Parkinson's disease (PD) impairs motor acts, we want to learn if action imagery is impaired in PD and if patients are aware of this deficit. *Design/Methods:* We tested nondemented, nondepressed PD ($n = 9$, M age = 72.3), age-matched controls ($n = 8$), and younger controls ($n = 8$, M age = 53.4). Participants were asked to estimate the time or degree of action required for themselves or another person to complete a series of tasks. Then, given a start cue, subjects were instructed to imagine themselves performing the same series of tasks and signal the investigator when finished. The same method was used for non-human object-oriented actions. Participants rated the accuracy of their performance on a 10-point scale. Unawareness is reflected in higher ratings with slower, less efficient, or equivalent action knowledge. *Results:* On action estimation, both PD and older controls were less aware than younger controls ($p = .018$, $.0015$, respectively). On action imagery, PD was less aware than older controls ($p = .02$), while both groups were less aware than younger controls ($p = .0042$, $.0001$, respectively). *Conclusions:* Action estimation and action imagery may tap into distinct components of higher order motor processing. Anosognosia for impairment in action knowledge may reflect basal ganglia dysfunction in normal and pathological aging. Correspondence: Ronald L. Schwartz, Saint Barnabas Institute of Neurology and Neurosurgery, 101 Old Short Hills Road, Suite 415, West Orange, NJ 07052.

T. HART, M. SHERER, T.A. NOVACK, J. WHYTE, & M. POLANSKY. Impaired Self-Awareness in TBI: Injury Severity and Discrepancy Score Methods.

Impaired self-awareness (ISA) is common after traumatic brain injury (TBI) and negatively affects rehabilitation/social outcomes. ISA can be quantified using discrepancy scores, i.e., differences between ordinal self-ratings by persons with TBI and ratings by a collateral. ISA measured in this fashion is correlated with the severity of TBI but may also be confounded with severity: More severely injured persons receive lower collateral ratings, providing greater opportunity for discrepancy and higher possible ISA scores. We analyzed data from an ongoing prospective study of ISA in acute TBI ($N = 73$) in an attempt to study the effects of severity on ISA with this confound removed. Subjects (Ss) with primarily moderate/severe TBI were tested as rehabilitation inpatients (mean 40 days post-injury). Ss and treating clinicians completed the 17-item Awareness Questionnaire, rating cognitive skills, activities of daily living (ADL), emotional control, and motor function. To control for strong correlations between TBI severity indices and clinician ratings, patient self-ratings were compared between groups rated as impaired to a similar degree by clinicians in each item domain. Ss rated lower on motor function also rated themselves as significantly worse, consistent with previous research suggesting less ISA for physical deficits. In contrast, significant differences were not found for emotional control, ADL or cognitive impairment groups, although there were trends in the direction *opposite* to the motor pattern (more favorable self-ratings, hence greater ISA, for more severely injured Ss). Results are discussed with respect to effects of injury acuity and item domain, as well as the interpretive and data analytic challenges of discrepancy scores.

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M. SHERER, T. HART, T.A. NOVACK, R.N. THOMPSON, & T.G. NICK. Measurement of Impaired Self-awareness After TBI.

Impaired self-awareness (ISA) of deficits is common in patients with traumatic brain injury (TBI). Assessment of ISA is important as degree of ISA has been shown to be a powerful predictor of employment outcome. The present study compared 4 methods of assessing ISA. Participants were 73 patients with TBI who were undergoing inpatient rehabilitation. Injury severities were 43 severe, 12 moderate, 17 mild and 1 unknown. The 25th, 50th, and 75th percentiles for age and education level were 22.5, 34.3, 45.6 and 11, 12, 13, respectively. There were 60 male and 13 female par-

ticipants. ISA was assessed with the Awareness Questionnaire (AQ). The AQ has 3 forms each consisting of 17 items that assess the patient's functional abilities. Discrepancies between the patient's self-ratings and ratings by family (PF-dif) and clinicians (PC-dif) result in 2 measures of ISA. Another measure (NP-dif) is derived by calculating the discrepancy between patient self-ratings and performance on neuropsychological tests. A fourth measure of ISA (C-rate) is obtained by having the clinician rate the patient's degree of ISA. The PF-dif, PC-dif, NP-dif, and C-rate methods differed in the percentages of patients determined to have ISA. These percentages were 79.7, 91.7, 86.3, and 98.5, respectively. PC-dif was strongly associated with PF-dif, NP-dif, and C-rate while a moderate association was found between PF-dif and NP-dif. Associations between C-rate and PF-dif and NP-dif were weaker but significant. Findings indicate that ISA is common in persons with TBI undergoing inpatient rehabilitation. Convergence among the 4 measures of ISA was good.

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L. DUKE & A. KASZNAK. Impaired Self-Monitoring of Episodic Memory in Alzheimer's Disease.

Underawareness of memory impairment in Alzheimer's disease (AD) was examined using the feeling-of-knowing (FOK) paradigm. Thirty-two AD patients and their age- and education-comparable spouses were given an episodic memory task, during which they were asked to read and remember a series of 10 sentences. Following presentation, participants were shown each sentence, missing the final word, and were asked to recall the ending and to make retrospective confidence judgements about the correctness of their recall attempts. In addition, for failed items, participants rated their likelihood of correctly recognizing the ending from among several incorrect alternatives, i.e., their FOK, by rank-ordering sentences according to likelihood of future recognition. Each participant's retrospective and prospective memory judgements were compared to his/her actual recall or recognition scores, using Goodman-Kruskal gamma coefficients. If a participant failed all recall/recognition items or used only one category for all ratings, gamma scores could not be computed. Gammas for the recall task could not be computed for 11 participants (8 AD, 3 spouses), while recognition gammas were not obtained for 13 participants (9 AD, 4 spouses). Results from remaining participants revealed that AD patients were much less accurate than their non-demented spouses in making retrospective recall confidence judgments and prospective FOK ratings [respectively, $U(1,51) = 195.5$, $p < .004$ and $F(1,49) = 12.7$, $p < .002$]. The finding of impaired on-line memory monitoring in AD is consistent with previous research suggesting that anosognosia for dementia is associated with impairments on executive function tasks and with frontal lobe hypoperfusion. Correspondence: L. Duke, Mental Health Service Line (COS-6), Veterans Affairs Medical Center, 1601 Perdido Street, New Orleans, LA 70112.

L. DUKE & A. KASZNAK. Is Anosognosia for Memory Impairment a Risk Factor for Potentially Dangerous Behaviors in AD Patients?

While a growing line of research has examined the neuropsychological and neuroanatomical correlates of anosognosia in patients with Alzheimer's disease (AD), the practical implications of anosognosia have not been well-studied. It has been suggested that AD patients who deny or minimize memory problems may not anticipate impairments in daily activities. Thus, it was hypothesized that underaware AD patients may be more likely to engage in behaviors that are risky or dangerous, given their cognitive and behavioral impairments. A novel caregiver interview was designed in order to assess risky behaviors in dementia patients. Thirty-one spouses of AD patients were administered the interview, in the context of a larger study of underawareness of memory impairment in AD patients. For each of 17 potentially dangerous activities, caregivers were asked to rate how likely the patient would be to attempt the behavior *if he/she was unsupervised*, as well as how risky that behavior would be, given his/her impairments. Riskiness X likelihood products were computed and then summed to produce a total "Riskiness" score. The interview showed good internal consistency reliability ($\text{Alpha} = .82$). In contrast to expectation,

however, riskiness was not significantly correlated with underawareness of memory impairment, measured using three different experimental paradigms. Increased riskiness was associated with greater caregiver-reported impairments of AD patients on activities of daily living ($r = -.49, p < .006$) and with increased reports by caregivers of safety precautions taken in the home ($r = .59, p < .001$). As anosognosia has been shown to vary across domains, perhaps underawareness of ADL impairments would better predict riskiness.

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T. GIOVANNETTI, D. LIBON, & T. HART. Awareness of Naturalistic Action Errors in Dementia.

Awareness and correction of errors during naturalistic tasks, such as making toast and gift-wrapping, were explored in 54 mild-moderate dementia patients and 10 elderly controls. All participants were asked to perform a series of naturalistic tasks under several conditions (e.g., with distractors present; Multi-Level Action Test-Short Form). Awareness and correction of errors was coded "on-line" during the course of performance. Awareness for everyday and cognitive functioning was also assessed with questionnaire discrepancy scores, and a neuropsychological protocol was administered. Dementia participants were aware of and corrected a significantly smaller proportion of errors compared to controls ($Z = -4.59, p < .001$). Awareness and correction of action errors was not significantly correlated with age, education, total errors, or questionnaire discrepancy scores. Correlations with neuropsychological tests revealed a statistical trend (after Bonferroni correction) between on-line error awareness and a test of concept formation (WAIS-R Similarities; $r = .34, p = .015$). Furthermore, a significant difference in awareness was observed across different error types, with greater awareness for substitution and sequence errors compared to omissions, perseverations, and action addition (i.e., utilization behavior) errors ($Z \leq -3.2, p \leq .002$ for all analyses). In sum, on-line error awareness and correction is seriously impaired in dementia. On-line error awareness and correction may be distinguished from error production and awareness measured via questionnaire discrepancy scores and appears to be associated with impairment in concept formation, rather than dementia severity or other cognitive functions.

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S. SAUTTER & R. HART. Prediction of Clock Drawing Performance in Dementia Assessment.

Impaired awareness presents in varying degrees in persons with dementia, although not routinely assessed in dementia evaluations. Dementia screening could be improved by using a prediction of clock drawing compared to their actual performance. We hypothesized that the patient's prediction of their clock drawing compared to their actual performance would be related to level of dementia or depression. Dementia patients were predicted to overrate their ability and depressed patients to underrate it. Ninety-five (45 M and 50 F) patients referred for neuropsychological assessment with probable dementia, had an average age of 68 years ($SD = 12$) and 13 years of education ($SD = 3$). They were administered the Modified-Mental State (3MS, $M = 79, SD = 16$), MMSE ($M = 24, SD = 4$), Geriatric Depression Rating Scale (GDRS, $M = 10, SD = 6$), and incidental recall of WAIS-R Digit Symbol items ($M = 4, SD = 2$). A difference score was obtained by subtracting the patient's rating from the examiner's rating, which served as the dependent variable in a regression analysis. Ninety percent of the variance in difference scores (actual minus predicted) was predicted by scores on the 3MS and the patient's own clock drawing prediction scores ($R = .907, F = 123.06, p < .001$). Digit Symbol incidental recall and GDRS were not found to be predictive. Including a clock drawing prediction paradigm in dementia screening is cost effective and adds meaningful information to the diagnostic formulation. Illustrative examples of actual drawings and prediction scores are provided.

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INCIPIENT AD, RISK FACTORS, AND COURSE OF DECLINE IN AD

E. HOLKER, T. FERMAN, J. LUCAS, R. IVNIK, G. SMITH, B. BOEVE, R. PETERSEN, & J. HARDY. ApoE e4 and Rate of Decline in Alzheimer's Disease Using the MMSE and DRS.

Objective: The apolipoprotein e4 allele is a risk factor for Alzheimer's disease (AD). Studies addressing whether the e4 allele is associated with rate of cognitive decline have yielded mixed results, with most studies finding no effect when the Mini Mental Status Exam (MMSE) is used to quantify rate of cognitive decline. One limitation to these studies may be the restricted range inherent in the MMSE. This study examines whether e4 is associated with rate of cognitive change using the Dementia Rating Scale (DRS) relative to the MMSE. *Methods:* Data from patients with clinically diagnosed AD, followed longitudinally across at least 2 evaluations using the DRS ($N = 167$) or MMSE ($N = 145$) were analyzed. AD progression was characterized as rapid or slow for those scoring one or more standard deviations above or below the mean annualized rate of change, respectively. *Results:* Using the DRS annualized rate of change, the e4 allele was present in 70% of the rapid decliners while it was present in only 33% of the slow decliners ($\chi^2 = 6.53, p = .01$). Based on the MMSE annualized rate of change, the e4 allele was present in 55% of rapid decliners and 52% of slow decliners ($\chi^2 = .02, p = .90$). *Conclusions:* The apoE e4 allele was significantly more frequent in participants with rapid versus slow progression of AD based on change in DRS scores, but this pattern was not observed with the MMSE. The restricted range of possible scores on the MMSE may decrease the likelihood for changes in performance to be identified when present.

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W. BEATTY, D.P. SALMON, A. TROSTER, & R. TIVIS. Predicting Cognitive Decline in AD Using Measures of Semantic Memory.

Although large groups of patients with probable Alzheimer's disease (AD) exhibit steady deterioration in cognition, there are substantial differences in rates of decline for individual patients. Several previous studies suggest that poor initial performance on measures of language-semantic memory may forecast imminent cognitive deterioration, but the findings are inconsistent. In the present study we examined the ability of several primary (total correct on naming and verbal fluency) and supplementary (e.g., cluster size, switches, error rate) measures of semantic memory to distinguish between deteriorated patients ($N = 105$) whose performance on the Dementia Rating Scale declined by at least seven points in the following year and "stable" patients ($N = 75$) who showed a smaller drop on the DRS over the same interval. Regression analysis showed that the combination of total correct on the Boston Naming Test, cluster size on the Supermarket task, and percent errors on the Animals task accounted for 15.8% of the variance in predicting deterioration status. Overall classification accuracy was 68–69% by all methods used (multiple regression, logistical regression, discriminant analysis) and using other cutoffs to define deterioration (i.e., greater than 5, 10, or 15 DRS points did not improve the accuracy of prediction). Although the measures of semantic memory examined in this study are not sufficiently accurate predictors of future cognitive status for general use, receiver operating characteristic curve analyses indicated how these measures might be useful for predicting cognitive changes for certain patients under special circumstances.

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T. ATCHISON, M. BRADSHAW, P. MASSMAN, & R. DOODY. Test Profile Differences Between Fast Declining and Slow Declining AD Patients.

The rate at which Alzheimer's disease (AD) progresses is believed to be highly variable. Some recent studies have analyzed early patterns of deficit to predict the rate of decline in AD patients but their results have been

inconsistent. Two hundred twenty-four participants from the ADRC at Baylor College of Medicine diagnosed with probable AD were grouped into 3 categories slow (SD) moderate (MD) and fast (FD) declining based the rate at which their MMSE scores declined from baseline to follow-up assessments. Initial MMSE scores were equivalent for groups as was age, education, estimated premorbid IQ, and gender. A multivariate profile analysis revealed that the groups level and shapes of group profiles differed on neuropsychological tests (WAIS-R, BNT, VSAT Time & Errors) with the SD group's overall performance being better than the MD group's which was better than the FD group's performance. The groups profiles differed with FD patients and SD patients being most divergent on tests requiring attention, processing speed and visual spatial skills. These findings indicate FD patients are more neuropsychologically impaired at initial assessment and exhibit a different pattern of impairment than SD patients, MD patients performance fell between the SD and the FD groups. Issues involved in for the prediction of rate of decline are discussed.

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C. BRADSHAW, R. DAVIS, A. SHRIMPTON, P. HOLOHAN, C. REA, D. FIEGLIN, P. KENT, & G. COLLINS. Cognitive Deficits Associated With a Newly Reported Familial Degenerative Disease.

We describe the neuropsychological changes associated with a recently reported familial neurodegenerative disease designated familial encephalopathy with neuroserpin inclusion bodies (FENIB). The disease is characterized as autosomal dominant and is associated with a point mutation, S49P in the neuroserpin gene PI12 that has been mapped onto chromosome 3q26. The mutation is expressed by excess axonal secretion of neuroserpin that accumulates over time in neuronal inclusion bodies and is neurotoxic. Autopsies of affected patients reveal neuroserpin inclusion bodies throughout the cerebral hemispheres with significant concentration in the cortex and the substantia nigra. Subjects carrying the gene demonstrated cognitive changes with the greatest changes demonstrated by subjects over age 40. Cognitive changes included reduced controlled oral fluency (word list generation), deficits in attention and response regulation functions and impaired visuospatial organization. In general, recall memory was not as affected as other cognitive domains. The most severely affected subject demonstrated global dementia with prominent "frontal-lobe" features. SPECT showed anomalies limited to frontal areas in the less affected subjects and more global, patchy areas of hypoperfusion in more severely affected subjects. The most affected subjects demonstrated global slowing on EEG. MRI findings were noncontributory except in the 2 most severe cases, which showed global cortical atrophy. We concluded that cognitive changes in mildly to moderately affected subjects were characterized by deficits associated with frontal-subcortical area involvement. Progressive deterioration of cerebral functions with relative sparing of recall memory indicated a unique dementia associated with this disease.

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E. SMERNOFF, M. EPKER, & C.M. CULLUM. Cognitive Functions in Healthy Adults With Parental History of Alzheimer's Disease.

As palliative and potentially preventative interventions for Alzheimer's disease (AD) are developed, early detection of symptoms is of increasing importance. To determine if cognitive precursors are evident in individuals at increased risk for AD, this study examined performance on standard measures of global cognition (MMSE, WAIS-R Vocabulary/Block Design IQ estimate), premorbid IQ (NART-R), episodic memory (WMS-R Logical Memory and multiple variables from the CVLT), and semantic memory (letter and category fluency) in 40 asymptomatic offspring of AD patients (M age = 53, educ. = 16.5 years) and 40 controls without a family history of dementia (M age = 55, educ. = 15.5). Performance on all measures was nearly identical across groups. Interestingly, even prototypical neuropsychological findings that can typify early-stage AD (e.g., inefficient learn-

ing, rapid forgetting, intrusion errors during recall, decreased verbal fluency) were not demonstrated by the AD offspring. Overall, we did not detect any cognitive difficulties amongst our group of AD offspring, suggesting that cognitive precursors to AD may not be present in at-risk individuals in the 40-to-70-year-old age range.

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N. JOHNSON, G. KAPTANOGLU, A. CORTES, S. WEINTRAUB, & M-M. MESULAM. Recognition Certainty: A Measure of Increased Sensitivity to Early Memory Loss.

Memory confidence ratings are correlated with measures of recall and level of recognition both in amnesic and nonamnesic subjects. In the present study, certainty for choices on a recognition memory task were compared in participants with probable Alzheimer's disease (PRAD), a group with mild cognitive impairment (MCI) and a group of cognitively intact controls (NC); ($N = 21$ in each). The Consortium to Establish a Registry for Alzheimer's disease (CERAD) word list was taught and following a 10-min delayed recall trial, participants were shown targets and foils individually and asked to correctly identify each type. They also rated the certainty of each response on a scale from 1 (*very certain*) to 5 (*very uncertain*). Accuracy of recognition for both targets and foils was significantly lower in PRAD participants than in the other 2 groups, but MCI and NC groups did not differ from each other. All three groups differed significantly from one another in their average certainty score for correct answers (either targets or foils). PRAD participants were the least certain, the NC were the most certain, and the MCI group performance was between PRAD and NC groups. These results show that MCI subjects have diminished confidence in their ability to recognize previously learned information even though their recognition accuracy is normal. Reduced "certainty" of preserved recognition may be another way of demonstrating early memory dysfunction, prior to the onset of clinical dementia.

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ASSOCIATED DEMENTIAS: SUBCORTICAL, LBV, CJD, HIPPOCAMPAL SCLEROSIS

M. CAMPBELL, S. WYLIE, & J. STOUT. Effect of Delay Interval on Accuracy in a Continuous Performance Test in Huntington's Disease.

Working memory requires maintenance of prior information over time to guide future responses. In one version of the Continuous Performance Test (AX-CPT), participants are asked to respond to 'X' but only when it is preceded by 'A.' The AX-CPT is used to determine whether the response context can be maintained during a delay interval to guide response selection. Incorrect responses on longer delays between the cue ('A') and target ('X') have been interpreted as a failure to maintain response context. In this pilot study, we examined 5 patients with early stage Huntington's disease (HD) and 5 healthy controls (HC) in the AX-CPT at short (1 s) and long (5 s) delay intervals. Based on findings of impaired working memory in HD, we hypothesized that HD would: (1) have greater increases in errors from short to long delays relative to HC; and (2) more false alarm responses at short and long intervals when the 'X' was presented without the preceding 'A.' However, we found neither of these effects (all $p > .08$). Instead, HD had lower hit rates [$t(4.1) = 3.17, p = .03$] and more false alarms [$t(5.4) = 2.67, p = .04$] at the short delay. Thus, HD participants were more impaired at the short than at the long delay, suggesting that for early HD, accuracy of responding benefits from having more time to process the response demands. Results of the study will be discussed with respect to comparisons between groups on error types and delay intervals.

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K. GOLDEN, G. PEAVY, M. JACOBSON, S. JERKINS, & J. COREY-BLOOM. The Validity of the Odd-Man Out Test in Patients With Huntington's Disease.

Impairment of executive functions such as planning, conceptual reasoning, and cognitive flexibility is common in Huntington's disease (HD). Tests purporting to measure executive dysfunction often measure other cognitive domains such as memory, language or motor skills. We tested the construct validity of the odd-man out (OMO) test, which is commonly considered a test of executive dysfunction and does not rely on motor dexterity or spoken language, skills often impaired in HD. The examiner administered the OMO, as well as measures of visuospatial ability (WISC-R Block Design), learning and memory (California Verbal Learning Test), response inhibition (Stroop test), and conceptual reasoning (Conceptualization subtest of the Mattis Dementia Rating Scale) to 19 mildly impaired HD patients. The OMO is a brief test requiring the subject to use a specific rule to choose the 1 item that is different from the other 2 on each stimulus card. The examiner then asks the subject to continue to use this rule or to switch to a new one. We entered age, education, and scores on tests of visuospatial abilities, learning and memory, response inhibition, and conceptual reasoning in a stepwise multiple regression analysis to predict the total OMO score. Only the conceptual reasoning score was significant [$F = 19.5; p < .001$], predicting approximately 60% of the variance ($R^2 = .62$; adjusted $R^2 = .59$). In mildly impaired HD patients, the results support the validity of the odd-man out test as primarily a measure of an important aspect of executive functioning—conceptual reasoning.

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S. WYLIE, M. CAMPBELL, & J. STOUT. Effects of Interference on Working Memory Capacity in Parkinson's Disease.

People with Parkinson's disease (PD) demonstrate reduced capacity to maintain information over a delay while simultaneously performing an interference task. Thus far, working memory capacity reductions have been demonstrated when items to be remembered are similar to items in the interference task (e.g., remembering words while reading sentences or remembering numbers while performing math problems). We examined whether capacity reductions in PD would also be apparent when items to be remembered were more distinct from the items in the interference task. We tested 28 PD and 20 healthy controls (HC) on a dual task working memory test that uses mathematical equation-word stimuli (e.g., 'Is $(2 \times 3) + 4 = 10$? bear'). After each stimulus presentation, subjects responded 'yes' or 'no' to indicate the correctness of the math equation and then read the word. After responding to a set of 2–6 stimuli, subjects were required to recall the list of words for that set. The PD group tended to recall fewer words per set size than HC (2.3 and 2.9, respectively, $p < .10$) and recalled fewer total words across the task (34.4 and 40.0, respectively, $p < .05$). This finding of shorter word spans suggests reduced working memory capacity in PD, may be a direct reflection of the alterations in dopamine input to the frontostriatal system. The findings are also consistent with electrophysiological and neuroimaging studies revealing associations between frontostriatal dopaminergic activity and working memory task performance.

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T. FERMAN, B. BOEVE, J. LUCAS, E. HOLKER, G. SMITH, R. IVNIK, N. GRAFF-RADFORD, R. UTTI, Z. WSZOLEK, D. DICKSON, & R. PETERSEN. Neurocognitive Differences Between DLB and PD With Dementia.

Background: DLB (dementia with Lewy bodies) and PD (Parkinson's disease) are part of the spectrum of Lewy body disease. It is not known whether the dementia associated with PD actually reflects the development of DLB. The purpose of this study is to determine if cognitive features of PD with dementia differs from DLB of similar dementia severity. **Methods:** Clinically diagnosed patients with DLB ($n = 30$) and PD with dementia ($n = 33$) were included if total score on the Dementia Rating Scale (DRS) ranged from 100–123. DRS total score ($M = 113$), age ($M = 73.7$ years), and

education ($M = 13.2$ years) did not differ between groups. Separate ANOVAs compared neurocognitive measures between DLB and PD. **Results:** DLB showed significantly greater impairment than PD with dementia ($p < .01$) on tasks of visual processing (WAIS-R Picture Completion, Picture Arrangement, Block Design, Judgement of Line Orientation), and WAIS-R Mental Arithmetic. Boston Naming Test performance was normal, but lower for the DLB group ($p < .01$). Both groups showed similar impairment on Verbal Fluency, Trail Making and WMS-R Logical Memory, and performed normally on WAIS-R Digit Span, Information and Vocabulary. **Conclusions:** Patients with PD who eventually develop dementia differ from DLB in pattern of cognitive performance. Compared to PD with dementia, DLB showed significantly greater deficits in visual processing and mental arithmetic. Object naming was normal but less accurate for the DLB group and may reflect perceptual processing difficulties. Results suggest differences in neuropathology and/or in the distribution of neuropathology across the spectrum of Lewy body disease.

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P.K. OGROCKI, T. FRITSCH, D.S. GELDMACHER, & M.B. PATTERSON. A Diagnostic Profile for Dementia With Lewy Bodies versus Pure Alzheimer's Disease.

Many cases of dementia with Lewy bodies (DLB) meet all the criteria for probable Alzheimer's disease (AD) at the time of presentation. The clinical and neuropathologic features of each disease can occur concomitantly, as in the Lewy body variant of AD (LBV), making prospective clinical differentiation of pure AD and LBV difficult. Pathologically defined groups of pure AD ($n = 66$) and AD with Lewy bodies, LBV ($n = 14$) were compared on clinical history and presentation, cognitive functioning, noncognitive symptoms, and functional abilities. Diagnostic agreement was 98% for pure AD and 28% for LBV, with 72% of LBV cases diagnosed as probable AD. Initial symptoms for both groups included memory and functional impairment. A higher proportion of LBV had a clinical history with early symptoms of delusions/hallucinations ($p \leq .01$) and delirium ($p \leq .08$), as well as masked facies and stooped posture ($p \leq .05$) on clinical exam. After controlling for demographic variables and dementia severity (CDR), LBV was associated with more apathy ($p < .01$), psychotic ($p < .01$), and vegetative ($p \leq .06$) symptoms on the CERAD BRSD. Groups were equally impaired on CERAD tests of language and word list learning. LBV exhibited better delayed recall ($p < .001$) and recognition memory ($p < .01$), and more impaired visuospatial abilities ($p < .05$) (Trailmaking A and Visual Design Copy Test). Despite different cognitive profiles, functional status (ADLs) was equivalent. The assessment of both cognitive and noncognitive symptoms enhances the clinical differentiation of LBV from pure AD.

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M. SINDEN, J. CARR, C. HONEY, & J. MARTZKE. Relationship Between Preoperative Dementia and Outcome Following Pallidal Surgery.

Literature containing patient selection criteria for pallidal surgery to treat Parkinsonian symptoms maintains pre-operative dementia conveys unacceptable risk of post-operative cognitive decline. Thirty-four patients undergoing pallidotomy or pallidal deep brain stimulation underwent targeted neuropsychological (COWA, AVLT, BVRT, Trails A&B, HVOT, Conditional Associate Learning), mood (POMS), quality of life (QOL; SF-36) and motor (Grooved Pegboard) assessment before and after surgery. The Dementia Rating Scale (DRS) was also administered pre-operatively. Range of baseline DRS scores in our sample was 97–144, with 8 patients falling below the cut-off for dementia (mild range relative to Alzheimer Type Dementia norms). Standardized scores were averaged to yield global cognitive, mood and QOL scores at each assessment. Preoperative DRS was unrelated to post-surgical cognitive, mood, motor, or QOL change ($.064 \leq |r| \leq .156$). DRS total and factor scores were also not predictive of change on any individual cognitive measures. Patients in the

lower *versus* the uppermost quartile of the DRS preoperatively also did not differ on any cognitive, mood, motor or QOL change scores. When we contrasted patients with the most favorable ($n = 8$) *versus* the least favorable ($n = 8$) global cognitive change scores, we found no difference on any preoperative demographic, motor, DRS or mood scores. Study of outcome for more severely demented patients is necessary. However, these results suggest mild dementia should not be a contraindication to pallidal surgical procedures as mildly demented patients do not experience greater postsurgical decline in cognitive, motor, mood, or self-reported QOL.

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S. JERKINS, M. JACOBSON, D.P. SALMON, D.C. DELIS, G. PEAVY, K. GOLDEN, & J. COREY-BLOOM. Source Memory Deficits in Huntington's Disease and Alzheimer's Disease.

While a general episodic memory deficit is a consequence of medial temporal lobe damage, an inability to identify the source of remembered information has been attributed to frontal lobe dysfunction. Because HD patients have prominent fronto-striatal but little medial temporal dysfunction, they may show particularly poor source memory in the face of relatively good recognition memory. Patients with AD, in contrast, have severe medial temporal dysfunction with less severe frontal dysfunction and may show the opposite relationship. To test this notion, an analysis of false positive errors (FPE) on the delayed recognition trial of the California Verbal Learning Test was carried out for 16 HD and 16 education- and DRS-matched AD patients. Source memory was measured as semantically related FPE from List B (an interference list presented after the Target list) as a proportion of overall FPE rate [i.e., List B FPE/(List B FPE + all other FPE)]. Although HD patients performed significantly better than AD patients on the recognition trial ($p = .001$), they produced a significantly higher ($p < .01$) proportion of List B FPE (.48) than AD patients (.17), even when hit rate was covaried. Indeed, HD patients made more List B (1.00) than distractor (.44) FPE, whereas AD patients made more distractor (2.06) than List B (1.81) FPE. These results demonstrate a double dissociation in which HD patients exhibit better recognition memory, but poorer source memory, than AD patients, and support the respective roles of medial temporal and frontal lobe structures in these two forms of memory.

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J.D. BAYLESS, E.L. WAGNER, J.E. MEYERS, H.L. PAULSON, R. RODNITZKY, K.N. HALL, & J.S. PAULSEN. Dichotic Word Listening Test Performance in Huntington's Disease.

The Dichotic Word Listening Test, or DWLT was administered to 38 persons considered at risk for Huntington's disease (HD) by virtue of having a parent with a clinical diagnosis of HD. A standardized neurological examination, the Unified Huntington's Disease Rating Scale (UHDRS), was used to determine whether manifest motor signs of HD were present. Twenty-five participants were considered to have definite HD whereas the remaining 13 participants were determined to be "presymptomatic." Using recent age-corrected norms, dichotic listening performance was evaluated in terms of three Index scores: the number of words repeated correctly in the left ear, right ear, and in both ears simultaneously. Patients with definite HD scored significantly lower in all three DWLT indices, as compared with the presymptomatic participants. An abnormal DWLT Index score was noted in only 1 (7.7%) of the presymptomatic subjects, but in 64% of patients with definite HD. DWLT impairments were seen in HD patients with and without generalized dementia, as measured by the Mattis Dementia Rating Scale, suggesting that the DWLT may reflect central auditory pathway involvement in HD, assessing differing brain systems than those captured by traditional mental status evaluation. Upon comparison with other cognitive indices of the UHDRS, the DWLT was failed more frequently than measures of verbal fluency. These findings suggest that DWLT may be a sensitive indicator of early disease in persons at risk for HD.

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C. MORRISON, J. BOROD, K. PERRINE, A. BERIC, M. BRIN, A. REZAI, P. KELLY, G. STEREO, D. ZGALJARDIC, I. GERMANO, D. WEISZ, J.-M. GRACIES, & C.W. OLANOW. Cognition and Subthalamic Nucleus (STN) Stimulation in Parkinson's Disease (PD).

The cognitive effects of STN deep brain stimulation are under investigation, however, there are no reported studies that evaluate, by incorporating a control group, whether neuropsychological test scores in surgical patients change beyond the inherent variability of the measures used. To address this, 17 PD patients (DBSPD) were tested before and 3.3 months after (both off and on stimulation) bilateral STN stimulator implantation. Eleven demographically and clinically matched PD controls (CPD) were administered the same repeatable neuropsychological test battery twice, separated by 2.4 months, with no surgical intervention during the interval. The standardized scores were grouped according to cognitive domain (i.e., Attention, Language, Visuospatial, Memory, Executive). Two-way mixed MANOVAs (2×2) for each domain were used to evaluate the individual effects of electrode implantation [Condition (baseline *vs.* stimulation-off) \times Subject (DBSPD *vs.* CPD)], high-frequency STN stimulation [Condition (stimulation-off *vs.* stimulation-on) \times Subject (DBSPD *vs.* CPD)], and the overall effects of the DBS procedure [Condition (baseline *vs.* stimulation-on) \times Subject (DBSPD *vs.* CPD)]. None of the interactions were significant. Exploratory *post-hoc* analyses revealed trends for surgery to reduce phonemic fluency and verbal memory; stimulation to improve digit span forwards and backwards; and the DBS procedure to reduce semantic fluency and verbal learning. On average, STN DBS had relatively little impact on cognitive functions. However, 1 DBS patient, who underwent staged implantation, demonstrated significant cognitive decline following the second surgery such that he was not testable with stimulation off but was able to complete most of the test battery with stimulation on.

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L. TRÉPANIÉ, J. SAINT-CYR, A. LANG, & A. LOZANO. Neuropsychological Consequences of Neurosurgery for Parkinson's Disease.

These studies examined the impact of unilateral posteroventral pallidotomy (U-PVP) ($N = 42$; 18L and 24R) and bilateral deep brain stimulation of the subthalamic nucleus (STN-DBS) ($N = 11$; 6 > 69; 5 < 69 years old) on neuropsychological functioning in advanced PD patients. *Study 1*: Patients with U-PVP can experience clinical motor benefits and improvements in allocation of attentional resources but can also suffer declines in working memory and in certain aspects of frontal executive functioning. Lateralized declines in verbal learning and fluency followed left-sided lesions and visuoconstructional abilities decreased following right-sided lesions. Declines in verbal learning and fluency were chronic. Behavioral changes of a "frontal nature," increasing dependence and negatively affecting relationships, were reported in 25–30% of patients. *Study 2*: Patients with bilateral STN DBS can experience clinical motor benefits at 3–6 months but many aspects of cognition decline. These were: working memory, speed of mental processing, bimanual motor speed and coordination, set switching, phonemic fluency, long-term consolidation of verbal material and the encoding of visuospatial material. "Frontal" behavioral dyscontrol, without insight, was also reported in the elderly subgroup. Except for learning tasks based on multiple trials, tasks reliant on the integrity of frontal-striatal circuitry either did not recover or gradually worsened over time, especially in patients > 69 years old. *Conclusions*: Lesions or chronic stimulation within frontal-striatal circuits can cause further deterioration of processes normally thought to be dependent on their functional integrity. Elderly patients are especially vulnerable and bilateral STN DBS can impair cognition more severely than U-PVP.

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J. HAMILTON, K. HAALAND, D. HARRINGTON, J. BRANDT, & J. ADAIR. Ideomotor Limb Apraxia in Huntington's Disease is Independent of Chorea.

Introduction: Ideomotor limb apraxia is associated with damage to the left frontal and parietal lobes. The role of the basal ganglia has been studied

less despite abundant interconnections between the caudate nucleus and the dorsolateral prefrontal cortex. Moreover, basal ganglia dysfunction disrupts the programming of sequential movements in patients with apraxia. Hence, if this system is crucial for mediating cortical control of highly skilled gestures, Huntington's disease (HD) patients should demonstrate ideomotor apraxia, independent of chorea. *Methods:* Twenty patients with diagnosed HD and 20 age- and education-matched normal control (NC) subjects were examined. All were assessed using a standardized 15-item apraxia battery in which participants imitated the examiner performing meaningless (e.g., finger to forehead), intransitive (e.g., blow a kiss), and transitive (e.g., flip a coin) movements. Patients who committed greater than three apraxic errors (i.e., -2 SD relative to controls) in both hands were considered apraxic. Motor disability in the HD group was evaluated using the Quantified Neurological Examination (QNE: Eye, Chorea, and Motor Impairment Scales). *Results:* Thirty-five percent (7/20) of the HD patients were apraxic particularly on the transitive movements ($p < .001$). These deficits could not be attributed to chorea ($r = .06, p > .80$), but they were associated with abnormal eye movements ($r = .74, p < .001$) and motor impairment ($r = .48, p < .05$). *Discussion:* The results show that limb apraxia is present in a third of HD patients independent of chorea, suggesting that corticostriate circuits play a role in ideomotor limb apraxia.

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K.K. ZAKZANIS, S.E. BLACK, L.C. ANG, & F. GAO. A Case of Neuropathologically Confirmed Alzheimer's Disease Presenting With a Convincing Constellation of Signs and Symptoms Suggestive of Corticobasal Degeneration.

Cerebral diseases have unique and characteristic distributions of pathology within the brain and do not affect the brain uniformly. Since psychological processes are regionally organized rather than equipotentially distributed, it necessarily follows that retention of specific neurocognitive functions contrasting with the deterioration of others leads to identifiable and differentiable patterns of disorder and characteristic neuropsychological syndromes. At the same time, clinical overlap and heterogeneity among the neurodegenerative diseases is increasingly recognized and makes difficult proper recognition and differentiation of both cortical and subcortical type dementias. Description of patients who do not conform to certain boundaries of a clinical picture are important to document in some detail if we are to understand and elucidate further heterogeneity in dementia syndromes and develop an integrated nosological system for the classification of dementia that includes pathologic, histopathological, clinical, and etiologic criteria. Hence, an accurate diagnosis of dementia is dependent upon characterization at different levels of description that include the neurologic, anatomical, neuropsychological and histological examination. Each level of analysis, beginning at the time of initial patient referral and ending at autopsy, will indeed contribute to the clinical and theoretical understanding of dementia and the resolution of issues of nosology. With these considerations in mind, we present a striking example of a patient (P.G.) who met neuropathologic criteria for dementia of the Alzheimer's type, but presented clinically with a convincing constellation of signs and symptoms suggestive of a diagnosis of corticobasal degeneration. Each level of analysis, beginning at the time of initial patient referral and ending at autopsy, is described.

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K.K. ZAKZANIS & S.E. BLACK. An Unusual Clinical Manifestation of Progressive Supranuclear Palsy.

Progressive supranuclear palsy (PSP), or the Steele-Richardson-Olszewski syndrome, is a progressive neurological disorder characterized by supranuclear ophthalmoplegia, axial rigidity and dystonia, pseudobulbar palsy, and cognitive impairment. Neuropathological changes are most marked in the globus pallidus, subthalamic nucleus, red nucleus, substantia nigra, superior colliculi, nuclei cuneiformis and subcuneiformis, periaqueductal

gray matter, pontine tegmentum, and dentate nucleus. In keeping with the prominent subcortical lesions, PSP has provided the prototype for the syndrome of subcortical dementia. The pattern of deficits include memory loss, impaired abstracting and/or calculating ability (manipulation of acquired knowledge), changes in personality that include apathy, inertia and occasional irritability, and general slowness of thought processes. This pattern of deficits has been suggested to reflect dysfunction of fronto-subcortical neuronal systems. More recently, however, a few cases of PSP with signs of cortical impairment, such as aphasia and apraxia, acalculia, alexia and body agnosia, or environment-driven responses also including echolalia, have been reported. Moreover, the classic PSP clinical-pathological correlates have been challenged by the observation of heterogeneous cognitive profiles and more widespread cerebral lesions which encroach upon several cortical areas. Given the sometime uncertain boundaries of the clinical picture of PSP, we document a clinically unusual case of PSP, neuropathologically verified at autopsy, whose clinical profile was characterized by progressive aphasia usually observed with cortical degeneration.

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P. MATTIS, C. EDWARDS, A. FEIGIN, M. MENTIS, & D. EIDELBERG. Effects of Levodopa Infusion on Cognitive Functioning in PD: Relationship to PET.

In addition to improving motor symptoms in patients with Parkinson's Disease (PD), intravenous levodopa infusion modulates the expression of a characteristic PD-related metabolic covariance pattern (PDRP) quantified using FDG/PET. Nonetheless, the effect of levodopa treatment on cognitive function in PD remains unclear. The current study was designed to identify potential changes in cognitive functioning during levodopa infusion and their association with disease-related metabolic brain networks. Five patients with non-dyskinetic PD (H&Y Stage $M = 2.2, SD = 0.6$) participated (Age $M = 60.8, SD = 4.3$; NART $M = 116, SD = 14.2$; BDI $M = 4.8, SD = 1.6$). They were administered Digit Span, Visual Span, Brief Test of Attention, Symbol Digit Modalities Test, Controlled Oral Word Association and the Hopkins Verbal Learning Test, before and after receiving an individually titrated constant rate levodopa infusion ($M = 72, SD = 29.5$ mg/hr). They were also scanned with FDG/PET off levodopa and during intravenous therapy. There were no significant changes in neuropsychological tests following levodopa infusion. Additionally, changes in PDRP network scores on FDG/PET were not significantly predicted by changes in neuropsychological measures. However, the levodopa-related changes in PDRP subject scores were significantly correlated with estimated premorbid intellectual level (NART; $r = .948, p = .01$). The current findings suggest that despite significant motor improvement and reduction in PDRP network expression with levodopa administration, this treatment does not acutely affect attention or verbal memory. However, they were potentially associated with overall cognitive reserves.

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M. BARRY, M.B. PATTERSON, & D. GELDMACHER. Decline to Dementia in a Case of Hippocampal Sclerosis Verified at Autopsy.

W.H. was an 82-year-old woman at entry into the Alzheimer's Disease Research Registry as a normal control. Medical, functional and behavioral evaluations and a battery of tests measuring executive functioning, language, visuospatial ability, and primary and secondary memory were administered at entry and at annual visits. W.H. was residing at an assisted living establishment where she was active in many recreational and administrative activities. At initial evaluation mildly impaired scores were noted on Porteus Maze and verbal fluency tests and 1 of 4 delayed recall measures, while other scores were normal in those and other realms. Test scores fluctuated over the next three visits but most remained within normal limits and no clear pattern of decline was evident. By the 5th visit, a further slight decline in executive and language scores was noted. By the 7th visit, her executive functioning and primary and secondary memory

scores were clearly impaired, and a dementia diagnosis was made. Verbal fluency scores were also impaired; verbal auditory comprehension, naming and visuospatial scores remained within a normal range. W.H.'s ability to actively function in her roles as volunteer cashier and exercise leader had also diminished, as had her initiation and enjoyment of leisure activities. Autopsy was performed 2 months after the 8th visit. At post mortem examination hippocampal sclerosis was diagnosed. In this case of hippocampal sclerosis, the full dementia syndrome was preceded by executive dysfunction.

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J. LEE, Y. KANG, K.H. RYU, D.W. SEO, & S.B. HONG. Effects of Hippocampal Sclerosis, Lesion Side, and Intelligence on Memory.

Temporal lobes, especially hippocampus, have been found to take an important role in memory. Previous studies reported that lesions of the left temporal lobe result in impairments of nonverbal memory, whereas lesions of the right temporal lobe result in impairments of verbal memory. However, this material-specific memory model still remains controversial. The present study was conducted to find the effects of the hippocampal sclerosis on verbal and visual memory in left TLE (LTLE) and right TLE (RTLE), while controlling the intelligence found to be closely related to memory (Ryu et al., 2000). Forty-seven LTLE (M age = 28.2 ± 8.1) and 36 RTLE patients (M age = 27.4 ± 6.3) participated in the study. The Korean Wechsler Adult Intelligence Scale (KWIS), the Logical Memory Test (LMT), and the Rey–Osterrieth Complex Figure Test (RCFT) were administered. Each group was divided into four subgroups based on the presence of hippocampal sclerosis and the level of intelligence (*high vs. low*). The effects of hippocampal sclerosis on verbal and visual memory were found only in the High-IQ LTLE. In the high-IQ group, LTLE with hippocampal sclerosis performed worse not only on immediate and delayed recalls of LMT but also on immediate recall of the RCFT than those without hippocampal sclerosis, whereas there was no difference in memory measures between RTLE with and without hippocampal sclerosis. In the low-IQ group, there was no difference in memory measures between the patients with and without hippocampal sclerosis regardless of the lesion site. This result confirms the significant effects of intelligence on memory and questions the validity of material-specific memory model. It also suggests the importance of left hippocampus regardless of the material specificity, as Hitch et al. argued.

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L. FREDMAN, G.M.J. SAWA, & C. BERGERON. Neurocognitive, MRI, and Prion Genotype Findings in Sporadic Creutzfeldt-Jakob Disease.

Creutzfeldt-Jakob disease (CJD) is a rapidly progressive and fatal prion disorder that occurs both sporadically and in an autosomal-dominant pattern (10–15% of all cases). We describe the case of a 49-year-old, right-handed woman of Italian descent who presented with a rapidly progressive cerebellar ataxia accompanied by neurocognitive compromise. Routine CT was normal, although FLAIR MRI elicited bilaterally increased signal in the putamen, globus pallidus, and caudate nucleus. Serial EEG revealed only diffuse slowing without periodic complexes, and CSF studies failed to detect the 14-3-3 protein. Terminally, the patient displayed myoclonus, severe dementia, and mutism, and died 11 months after onset. Neuropathologic findings identified diffuse vacuolation and prion protein deposition throughout the brain, predominantly involving the basal ganglia, frontal lobes, cingulate gyrus, and cerebellar cortex. There were also numerous prion plaques deposited throughout the cerebral and cerebellar cortices. Genotype analysis revealed a methionine/valine polymorphism in the gene encoding the prion protein. The presence of distinct clinical and pathologic phenotypic variants of sporadic CJD related to met/val polymorphism in the prion protein gene will be briefly reviewed.

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ASSESSMENT I

W. BEATTY. The Acquisition and Retention of Geographical Knowledge by Men and Women.

This presentation summarizes 15 years of research on sex differences in geographical knowledge and presents new data. When required to locate places on outline maps, males consistently perform more accurately than females. This sex difference in geographical knowledge has been observed in samples throughout the United States, in all age ranges examined from the second to the ninth decade of life and in samples differing in average education level from high school to postgraduate degrees. Both males and females appear to acquire geographical knowledge during surface travel through the environment. The information acquired during everyday travel is apparently integrated into topographic representations that comprise a cognitive map. This process is less efficient in females because they attend to and remember more about landmarks and less about distance and directional cues than do males. The evidence for this claim is that although travel history (places visited) is the best predictor of geographical knowledge for both men and women, it is a better predictor for men than for women ($r = .91$ vs. $.69$) for recent data. The difference arises because some women with extensive travel histories do poorly on tests of geographical knowledge, apparently because they do not form cognitive maps. Once the cognitive map is formed, males and females exhibit no important differences in the long-term storage or retrieval of the geographical knowledge contained in the map. Faithful storage and recall of this topographical information persists for at least 25 years and may be unlimited. Correspondence: *William Beatty, 2364 NW 121st Street, Oklahoma City, OK 73120.*

W. BEATTY & K. OLSON. Where the Heck Is It? Memory for the Location of Objects in the Home.

Several recent studies demonstrate that human females excel on tests of memory for object location. All of the studies employed laboratory tests on which the environmental field was small in scale. To determine whether the sex difference would generalize to a larger, more life-like scale, we administered questionnaires to both partners of 18 heterosexual couples who resided together. For each of 28 objects, the participants indicated whether they or their partner would have been the last to touch the object and the one to find the object if it was misplaced. Self and partner ratings indicated that both men and women were most likely to touch and to find stereotypically masculine and feminine objects respectively, but there were no sex differences for gender neutral objects. However, females showed a relative advantage for finding misplaced objects in the home, especially objects with a masculine or neutral gender valence. Relative advantage was defined as the difference between objects found and objects last touched. The findings suggest that previously reported sex differences in object location memory may generalize to the home, a larger and more ecologically valid environmental field. An experiment in which men and women actually locate misplaced objects in the home will be required to confirm the present observations.

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G. LECKEY & W. BEATTY. Predicting Functional Performance in AD With the PEDL.

Findings from a recent population-based survey indicate that about 33% of patients with dementia reside alone. Because many of these patients may not have a caregiver who visits them regularly, the need for a neuropsychological (NP) test to predict patients' functional competence to live alone safely is evident. In this study, we compared the accuracy of predicting instrumental and basic activities (IADLs and ADLs) of 22 patients with Alzheimer's disease using several standard NP tests and the newly developed Problems in Everyday Living (PEDL) test. The PEDL is comprised of 14 items concerned with practical intelligence including 3 items from the WAIS Comprehension test (lost letter, fire in the movies, lost in

the forest). Performance of IADLs and ADLs as rated by caregivers was significantly correlated with performance on the PEDL, the Mini-Mental State Exam (MMSE), and with a test of verbal abstraction, but not with vocabulary or naming. The PEDL was the first predictor of IADL scores, accounting for more than 50% of the variance, compared to 27% for the MMSE. If only patients with MMSE scores of 15 or greater were included the PEDL accounted for 39% of the variance in IADL scores, but the MMSE accounted for only 8%. The MMSE was the best predictor of ADL scores, accounting for 48% of the variance.

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J. SOMERVILLE & R.A. STERN. Effects of Length of Delay on Rey-Osterrieth Complex Figure Recall.

The Rey-Osterrieth Complex Figure (ROCF) is a commonly used neuropsychological test of visuospatial skills and visual memory. Several different administration procedures are utilized, including varied time intervals between the copy and delay conditions. Currently, there is no standard length of delay for the ROCF, making comparisons across protocols and the use of normative data problematic. According to the literature, ROCF scoring manuals, and a survey of clinicians and researchers the most frequently used delay time intervals are within the range of 20 to 45 min. The purpose of the current investigation was to determine whether length of delay would impact ROCF performance in a sample of 365 older normal participants. Participants were divided into three groups based on length of delay: 20–30 min, 31–50 min, and 51–60 min. Groups were not significantly different in age (Total $M = 68.6$, $SD = 10.8$) or education (Total $M = 13.8$, $SD = 3.1$). Productions were scored using the *Boston Qualitative Scoring System*. The delayed presence and accuracy score (DPA) and the delayed retention score (DR) were used as dependent variables for the purpose of this study. Results yielded no significant between-group differences in DPA ($F = 0.64$) or DR ($F = 0.77$). This finding is similar to that found in a previous study with a smaller N and a less commonly used scoring approach. These results, along with previous research, indicate that at least in normal, older populations, there is little difference in ROCF performance after delays ranging from 20–60 min.

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R. YUSPEH, D. DRANE, P. FASTENAU, L. KLINGLER, J. HUTH-WAITE, & L. FOSTER. Preliminary Norms for the Motor-Independent Extended Complex Figure Test (MI-ECFT).

The present study presents preliminary normative data for the MI-ECFT, a new measure composed of recognition and matching tasks for use following a 3-min visual presentation of the Rey-Osterrieth Complex Figure. Recent research has suggested that the MI-ECFT is sensitive to visual memory deficits and the effects of normal aging. Participants included 55 healthy adults (14 males, 41 females) with a mean age of 50.38 years ($SD = 20.39$), mean level of education of 14.44 years ($SD = 2.00$), and mean MMSE score of 29.12 ($SD = 1.00$). Total MI-ECFT recognition and matching scores were calculated for each participant by adding the total number of points scored on all recognition and matching items, respectively. For the entire sample, mean total recognition score was 18.07 ($SD = 4.51$) out of a possible 30 points, and mean total matching score was 9.35 ($SD = 1.00$) out of a total possible of 10 points. Correlational analyses demonstrated a significant inverse relationship between total recognition score and age ($r = -.51$, $p < .0001$). In contrast, no significant correlation was observed between total recognition score with education or gender. Subsequently, participants were assigned to two age groups (≤ 50 years and > 50 years). T tests indicated the older group scored significantly lower on both total recognition [$t(46) = 3.35$, $p < .002$] and total matching score [$t(37) = 2.36$, $p < .02$] than the younger group. Based on these results, normative scores for the 2 age groups are presented, and recommendations for future research are offered.

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J. BEAUVAIS, S.P. WOODS, R. DELANEY, & D. FEIN. Classification Accuracy of the Tactile Wisconsin Card Sorting Test (TWCST).

The present study evaluated the classification accuracy of The Tactile Wisconsin Card Sorting Test (TWCST), a neuropsychological measure of abstract reasoning and complex decision-making designed for use with visually impaired persons. Fourteen visually and neurologically impaired patients, along with 29 matched, healthy control participants (15 sighted and 14 visually impaired) were administered the TWCST as part of an abbreviated neuropsychological battery. Receiver-operating characteristic (ROC) curves derived from four separate dependent measures within the TWCST (i.e., total categories completed, total errors, total perseverative errors, and an impairment index) each demonstrated a highly significant ability to correctly classify the clinical and control groups. Moreover, the dependent measures provided adequate overall predictive validity, with particularly efficient negative predictive values and low false negative rates. The dependent measure, total number of categories completed, demonstrated the most balanced level of diagnostic efficiency. In sum, the results from this investigation provide empirical support for the classification accuracy of the TWCST with brain-injured patients as compared to controls. The clinical and theoretical implications of these findings are discussed within the context of the current literature.

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T.F. WYNKOOP, S.A. FREDERICKS, & A.C. BARSTOW. Cognistat: Administration and Interpretation in Subacute Stroke Patients.

The Cognistat (formerly the Neurobehavioral Cognitive Status Examination) is a 10-scale, 55-item screen and metric instrument that measures orientation (3 spheres), attention (digit span), language (comprehension, repetition, naming), construction, recall of newly learned information, calculation, and reasoning (similarities, judgement), in addition to level of consciousness. Screen and metric scores of 92 verbal, subacute occlusive stroke patients were analyzed to determine the effectiveness of the screening items, and to develop performance expectations on the metric items for elderly stroke patients [sample characteristics: M age = 70.0 (12.3), 75% were from 65 to 90; 89 were right-handed; 41 were women; M education = 11.7 (2.9); M Barona est. FSIQ = 103.9 (9.2)]. Internal consistencies for the individual Cognistat scales ranged from $\alpha = .65$ (Comprehension) to $\alpha = .85$ (Memory). Because deficit testing results in negatively skewed subscale distributions, upper quartiles were used to establish performance expectations. The results suggest that anything less than perfect performance on all scales except Attention (7), Construction (3), Memory (9), and Similarities (6), may herald specific cognitive difficulties, and these criteria are higher than those set by the test authors (except for Construction). The screening items did not predict acceptable performance as defined in the test manual on the metric items of any of the scales, with false negative rates ranging from 1.2% to 9.7% (2.7–20.8% using upper quartiles as criteria for acceptable performances). Our results suggest, that all Cognistat items (not just screens) should be administered to subacute stroke patients, and that the more stringent upper quartile criteria should be employed to judge problematic performances in this patient population.

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D. FELDMAN, D. ERLANGER, & H. KROGER. Construct Validity of a Web-Based Neuropsychological Screening Tool.

Web-based neuropsychological screening measures offer advantages to clinicians and researchers, particularly with regard to breadth of utility to underserved populations and cost efficiency. However, in order to be an effective tool, the ecological validity of any such web-based measure must be proved. This study examines the results of 105 control participants, 20 patients with degenerative neurological disorders, 20 patients with traumatic brain injury, 10 patients with other neurological disorders, and 20 patients with psychiatric disorders. All completed a 30-min web-based screening measure (the Cognitive Stability Index) in addition to a questionnaire assessing cognitive complaints pertaining to difficulties with independent activities of daily living. The web-based measure has been shown

to be reliable and to have adequate criterion-related validity, and to measure factors best described as attention, memory, processing speed, and reaction time. Examining cognitive complaints and symptoms, four factors also tended to emerge: organization (handling money, remembering medication), verbal memory (naming problems, remembering spoken details), psychiatric disinhibition (controlling temper, misplacing objects), and nonverbal memory (recognizing faces, getting lost). Clinical groups had significantly more cognitive complaints and worse scores on the cognitive screening measures, with associated correlations of mild to moderate effect sizes. Neurological groups also endorsed more difficulties with activities of daily living (eating, getting dressed, doing chores) and were associated with the worst scores and the most invalid scores on the cognitive measures. The integration of both questionnaires related to cognitive function and scores on cognitive tests will help select patients who require a more comprehensive neuropsychological evaluation.

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D. FELDMAN, D. ERLANGER, & H. KROGER. The Effect of Computer Familiarity on Computerized Tests.

An advantage of utilizing computer-based mediums for neuropsychological testing is cost efficiency, both for money and time. However, a patient's *a priori* exposure to computers, either at home or work, may bias their results from a computerized test protocol. This study examined the effects of computer familiarity upon test performance, both computerized and non-computerized. Two hundred and fifty neuropsychologically healthy controls, 50 patients with neurological disorders, and 20 patients with psychiatric disorders completed either 1 or 2 30-min computerized measures of cognitive functioning (the Cognitive Stability Index and the Concussion Resolution Index). Each participant also completed a survey assessing familiarity with various computer- and non-computer-related keyboards. Computer use, including keyboard and mouse use, internet surfing, and e-mail management, was strongly associated with performance on a simple reaction time measure ($r = -.38$) and various tests of memory (r s range up to .46). Various tests of focused attention and psychomotor speed were not correlated with computer familiarity. Familiarity with other keyboards, such as typewriters, calculators, remote controls, cash registers, was not associated with better performance on any measure. The effects of other suppressor variables (such as intelligence, age, and occupational status) were explored albeit none were found to account for the unusual relationship between memory measures and computer familiarity. Older adults endorsed a much more infrequent exposure to computers. Decay of information stored in short-term memory may explain the findings. Implications for test development are discussed.

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D. HIGGINS & D. HARRISON. QEEG as Assessment Tool for Multi-sensory Paresthesia Diagnosis (Schizophrenia).

Research has indicated that a substantial number of patients with the diagnosis of schizophrenia are found to have neurological dysfunction. Moreover, the dangers of misdiagnosing a neurological problem can be significant, as this delays and alters appropriate treatment strategies. Quantitative electroencephalography research data is analyzed demonstrating the utility of QEEG as a confirmatory test of localization for cerebral dysfunction following a neuropsychological evaluation. An adult female, previously diagnosed with schizophrenia, was assessed via an ideographic, syndrome analysis (process-oriented) approach. During the initial assessment, visual, auditory, and tactile formesthesias were reported as dysfunction was noted at left frontal and temporal areas and at right frontal, temporal, and parietal areas. During a second assessment, QEEG procedures provided an objective method for further substantiating conclusions generated from the primary neuropsychological evaluation. Specifically, the QEEG recorded decreased relative activity (across bandwidths) at left frontal (F7) and bilateral temporal (T3 and T4) sites, in comparison to increased relative activity (across bandwidths) at bilateral parietal (P3 and P4) sites. Analyses included a within-subject statistical approach to ana-

lyze interhemispheric comparisons, and also specific site comparisons. DSM-IV criteria for schizophrenia focus on a checklist of symptoms, without implication of underlying cerebral dysfunction (i.e., a patient must show several deficits related to disorganized speech, unusual behavior, flattened affect, delusions, and/or "hallucinations" for diagnosis). Nevertheless, this study illustrates the utility of a neuropsychological assessment/approach with QEEG in localizing cerebral dysfunction in individuals diagnosed with schizophrenia, and it offers a neuropsychological explanation for sensory disturbances common to those diagnosed with schizophrenia.

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J. DONDERS. Factor Structure of the WAIS-III in Patients With Traumatic Brain Injury.

The construct validity of the 4-factor structure of the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III) was evaluated in a sample of 100 patients with traumatic brain injury who had been screened carefully to exclude individuals with complicating premorbid (e.g., psychiatric) or comorbid (e.g., litigation) factors. Maximum-likelihood analysis with oblique rotation was used to evaluate the relative fit of 1-factor (General Intelligence), 2-factor (Verbal vs. Performance), and 4-factor (Verbal Comprehension, Perceptual Organization, Working Memory, Processing Speed) models. Kaiser's measure of sampling adequacy was .88 and there were no Heywood cases or other threats to the interpretability of any of the models. The results indicated that the 4-factor model provided the relatively best fit for the data in this clinical sample, explaining about 82% of the variance, with a reliability of .86, and providing statistically significant improvement over the closest competing model ($p < .05$). This supports the validity of the theoretical basis that was initially suggested for interpretation of data from the WAIS-III standardization sample, and suggests that the factor index scores may provide more meaningful information than IQ scores when evaluating patients with traumatic brain injury.

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D.J. CROCKETT, J. KOZAK, & R. WILKINSON. The Impact of Demographic Factors on Verbal Fluency.

We hypothesized that tasks involving complex verbal functions would be sensitive to the effects of brain dysfunction while more rote naming tasks would not. Based on a review of the medical records for 1,242 right-handed participants (male = 54.1%), we formed broad clinical groups reflecting the presence or absence of brain dysfunction (BD). Our test battery included: WFT-FAS; standardized scores from the Vocabulary subtest (VOC-SS); the Hooper Visual Organization Test (HVOT) and Ideo-Motor Naming Test (INT). The presence of BD was associated with the discrepancy between the predicted and the obtained WFT-FAS score [$F(1,475) = 14.202, p < .001$]. WFT-FAS had a significant relationship with evidence of lateralization [$F(1,475) = 10.120, p < .002$] but not with the location of BD. Patients with evidence of BD more often had lower obtained scores than were expected based on their gender, age, and education [$\chi^2(N = 477) = 15.877, df = 4, p < .003$]. Although there was a significant relationship between performance on the HVOT and the presence of BD [$F(1,235) = 5.400, p < .020$], the discrepancy between the obtained and predicted HVOT score and evidence of BD was not significant. Scores on the INT were unrelated to the presence of BD as were scores from VOC-SS. These results suggest that estimating scores based on demographic variables can shed some light on the relationship between levels of complexity of verbal fluency tasks and the presence of brain dysfunction.

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H. WESTERVELT, G. TREMONT, J. SOMERVILLE, A. PADOLAN-CZUK, & R.A. STERN. Why Are Some Amnesic Patients Oriented?

The neuropsychological substrates of temporal disorientation are unknown. Intuitively, some argue that memory likely plays an important role

in maintaining orientation, though others suggest that orientation is a basic cognitive function which cannot be further reduced. Based on surprising clinical observations that some patients with severely impaired memory functioning are fully oriented, the relationship between memory functioning and temporal orientation was explored in the current study. Participants were 77 mixed neurologic patients selected on the basis of severe memory impaired as defined as (1) percent retention score of less than 30% on a Wechsler Memory Scale (WMS) Logical Memory subtest, or (2) percent retention score of less than 15% on a WMS Visual Reproduction subtest. In this group, 32 exhibited temporal disorientation, and 45 were well oriented. Oriented and nonoriented groups did not differ on most neuropsychological instruments administered, with the exception of poorer performance by the disoriented group on Visual Reproduction retention, Part B of the Trail Making Test, and Animal fluency. When the group was separated on the basis of memory functioning (impaired performance on only 1 memory measure vs. impaired performance on both measures), the group with impairment on only one memory measure showed better temporal orientation and faster time and fewer errors on Trails B, but no differences on other neuropsychological measures. In sum, this study suggests that relatively spared memory functioning in at least 1 domain (verbal or visual) may be important in maintaining orientation, though other areas of cognition appear to play a relatively modest role.

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T. SHILLINGLAW, A. FROL, W. RINGE, & C.M. CULLUM. Cognitive Abilities, Mood, and QOL in Aneurysm Patients With Good Outcomes.

The Glasgow Outcome Scale (GOS) is commonly used for assessing gross neurological and physical functioning after aneurysm surgery. Given the potential limitations of the GOS as an indicator of overall outcome in aneurysm patients, greater attention is being paid to long-term functioning and factors that may contribute to outcome. This study examined cognitive and emotional functioning as well as quality of life (QOL) one to three years post surgery in 17 aneurysm patients with good outcomes on the GOS (GOS = 1). Overall, no evidence of gross long-term cognitive deficits was found in this group of aneurysm patients with cognitive screening measures (Cognistat), and few depressive symptoms were endorsed on the Beck Depression Inventory. In addition, self-ratings of QOL of these individuals were generally good, with only a few low scores suggesting dissatisfaction. Finally, better cognitive functioning and fewer depressive symptoms were predictive of higher QOL scores. It is clear that multiple aspects of an individual's functioning contribute to outcome following aneurysm surgery.

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G.J. CHELUNE & R.I. NAUGLE. Specificity of the Victoria Symptom Validity Test in Patients With Objective Memory Deficits.

Knowledge of the specificity as well as the sensitivity of symptom validity measures is important for their accurate interpretation. Specificity is generally examined among groups with known neurologic dysfunction and presumed high base rates of objective impairment, although information regarding the frequency and severity of such impairment is rarely known. We examined the specificity of the Victoria Symptom Validity Test (VSVT), a forced-choice measure of simulated memory impairment consisting of 24 "easy" and 24 "hard" trials, among 28 right (RTL) and 24 left temporal lobectomy (LTL) patients who underwent surgery for intractable epilepsy and for whom pre- and postoperative Wechsler Memory Scale-III (WMS-III) data were available. Postoperative WMS-III Immediate Memory Index (IMI) and delayed General Memory Index (GMI) change scores were transformed into z scores using standardized regression based norms derived from the WMS-III standardization data. Patients with z scores ≤ -1.64 were classified as having acquired memory deficits. Laterality (RTL vs. LTL) \times Deficit (impaired vs. nonimpaired) \times VSVT (easy vs. hard trials) repeated measure ANOVAs were computed, with separate analyses conducted for dichotomies based on IMI and GMI group classifications.

Significant VSVT trial differences ($p < .000$) were noted in both analyses, but no other group or interaction effects approached significance. Even in the face of objective evidence of acquired memory deficit, patients performed well above chance levels on the VSVT. Only 2 patients (3.8%) obtained VSVT "hard" scores in the questionable range. These data lend strong support to the specificity of the VSVT as a potential measure of symptom validity.

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M. JÓNSDÓTTIR. Diary Studies of Action Slips in Healthy Individuals.

Background: Normative data on the frequency of action and memory slips could be useful in clinical work. Reason's diary study of action slips is well known within cognitive psychology but has not been cited in the neuropsychological literature. I describe attempts at replicating and extending Reason's findings and propose using memory diaries in a therapeutic fashion with people who have sustained mild head injuries. *Study 1.* Fifty-three males and 102 females aged 18 to 74 (M age = 33) completed action slip diaries for two weeks. The mean number of slips over a 2-week period was 4.6 (range = 0–16). Slips were most common on Mondays through Fridays and during the day until 7 p.m. *Study 2:* In this study, which is in progress, similar diaries as in Study 1 will be used. In addition, the subjects will be asked to estimate their everyday memory and memory failures with self-report measures and will also complete a stress inventory. The correlation between the self-report data and the number of slips documented in the diaries will be computed. *Discussion:* Diary studies are limited in a number of ways. However, it is proposed that memory diaries may be useful when working with patients who worry about cognitive sequelae of mild head injuries. The diaries facilitate understanding of the nature of the patients' problems and sometimes demonstrate that the memory or action slips are much less frequent than estimated by the patients. This clinical impression needs further studying.

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C.R. SAVAGE, A. BOHNE, T. DECKERSBACH, S. BITRAN, H. CHUGANI, & S.L. RAUCH. Validation of 3 Alternate Figures for the Rey-Osterrieth Complex Figure Test.

The Rey-Osterrieth Complex Figure Test (RCFT) is a widely-used measure of nonverbal memory and strategic planning. Alternate forms for the RCFT are needed in both research and clinical settings; however, currently available figures (e.g., Taylor) are constructed so that they no longer stress organizational strategies. For instance, the RCFT is composed of several core configural elements (e.g., diagonals) that form the foundation for good organization during construction. Figures such as the Taylor break these configural elements and, therefore, decrease the importance of strategic organization. We sought to create 3 new complex figures that had little overlap with the RCFT, yet maintained strong reliance on core configural elements. Accuracy scoring is similar to the RCFT: 18 elements, zero to 36 score. In addition, organizational approach is quantified based on a system we developed for the RCFT, measuring organization on a zero to 5 scale. We are now investigating the validity of these figures. In the first study, we administered our 3 figures and the RCFT (order counterbalanced) to 24 normal participants and compared copy accuracy and organization and immediate recall accuracy between the figures. Results confirmed that normal subjects obtained similar copy accuracy and organization scores for all four tests (all $p > .10$). On measures of recall accuracy, one figure was similar to the RCFT ($p > .10$) and 2 were slightly more difficult to recall ($p = .05$). We are now conducting another study in 80 normal participants, evaluating performance on the figures when only 1 is used per participant and adding delayed recall. These data will also be presented.

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R. PETERSEN, W. MITTENBERG, C. GASS, S. THEROUX, & E. SIMCO. Estimation of WAIS-3 Premorbid IQ in Neurologic and Psychiatric Patients.

Premorbid intellectual level is typically estimated in clinical settings, but the accuracy of these IQ estimates has not been evaluated using the WAIS-3. This study examined the accuracy of the Barona et al. (1984) demographic equation, the WRAT-3 reading subtest, and the WAIS-3 Vocabulary subtest as estimates of WAIS-3 FSIQ in 68 neurologically normal psychiatric patients and 101 patients with central nervous system disorders. Psychiatric patients with DSM-4 diagnoses of mood disorders ($N = 40$), anxiety disorders ($N = 22$), and somatization disorder ($N = 6$) obtained a mean FSIQ of 99 ($SD = 13.4$). IQ estimates based on the Barona formula ($M = 103$, $SD = 8.3$), WRAT-3 ($M = 99$, $SD = 11.7$), and Vocabulary subtest ($M = 101$, $SD = 14.5$) correlated significantly with obtained WAIS-3 FSIQ ($r_s = .59, .71$, and $.78$, respectively). Neurologic patients with diagnosis of dementia ($N = 33$), head trauma ($N = 28$), CVA ($N = 19$) and other documented disorders obtained a mean FSIQ of 89 ($SD = 14.5$), significantly lower than estimates based on the Barona formula ($M = 101$, $SD = 9.5$), WRAT-3 ($M = 95$, $SD = 15.1$), and Vocabulary subtest ($M = 94$, $SD = 16.4$). Specificity (percentage of psychiatric patients accurately classified) and sensitivity (percentage of neurologic patients accurately identified) were calculated using 10, 12, and 15 point declines from estimated premorbid IQ as evidence of CNS dysfunction. Estimates using the Barona formula significantly discriminated groups, with specificities of 72%, 75%, and 88% for each cut-off score. Respective sensitivities were 57%, 49%, and 43%. The WRAT-3 also discriminated groups significantly, with respective specificities of 79%, 87%, and 97% for each cut-off score. Corresponding sensitivity values were 43%, 33%, and 23%. Estimates using the Vocabulary subtest did not significantly discriminate groups.

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J. KULAS & B. AXELROD. A Regression-Based, Item-Reduction Short Form of the WAIS-III.

Efforts have been undertaken to shorten the administration time of the Wechsler Adult Intelligence Scale-III (WAIS-3). The current study employed item reduction to reduce the number of items within each subtest. The WAIS-3 was administered to 150 outpatients referred for neuropsychological assessment. For each of the subtests, items were regressed against total raw score. This method resulted in the least number of items required to predict total subtest raw score, while maintaining high internal consistency for each subtest. In fact, the item reduced form was found to have reliability estimates that were consistent with those for the full administration and for those reported for in the technical manual for the WAIS-III. The resulting predicted subtests were highly correlated with the full administration of each of the subtests, with correlations ranging from .95 to .98. In addition, the summary IQ scores derived from the item-reduction subtests were highly correlated with the full WAIS-3 ($VIQ = .98$; $PIQ = .96$; $FSIQ = .98$). More than 80% of all item reduced subtest scores fell within 1 age-scaled score point of the full WAIS-3. For FSIQ, 98% of the item reduced scores fell within 6 points of the full WAIS-3. The results of this study, while promising, must be cross-validated on an independent sample prior to its use in clinical populations.

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M. BASSO, F. CARONA, B. AXELROD, M. MATSON, K. HARRINGTON, N. LOWERY, C. GHORMLEY, L. DAVIS, & J. PACE. WAIS-III Practice Effects Across 3 and 6 Months.

Although neuropsychologists frequently re-evaluate intelligence across time, relatively little is known regarding practice effects on commonly administered IQ tests. The publishers of the WAIS-III addressed this issue, and administered the test twice over 12 weeks to 394 individuals. VIQ and FSIQ increased slightly (3 points), but PIQ increased more (6 points). It remains uncertain whether similar increments occur over longer time periods; most investigations of WAIS-R practice effects have occurred over

brief intervals (e.g., 2–12 weeks). Because memory for testing tasks likely mediates practice effects and recall tends to diminish over time, performance increments may be less prominent over longer time spans. Since most clinical re-evaluations take place over 6- or 12-month spans, this is especially relevant. In the present study, 60 adults (ages 17–53) participated. Half were re-administered the WAIS-III over 3 months, and half were re-evaluated after 6 months. Groups were equivalent in age, education, gender, and baseline IQ scores, and data were analyzed using the ANOVA model. The main effect of time and the interaction of time and scale (e.g., VIQ vs. PIQ, etc.) were significant, but effects involving re-test interval failed to reach significance. The results showed that all scores improved significantly upon retesting, but PIQ, POI, and PSI increased more. Notably, length of retest interval had no effect upon gains. Reliable change indices suggest that much change occurs over these intervals, and implications for clinical and research applications are discussed.

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M. WEBER, S. O'BRYANT, & R. J. McCAFFREY. The Memory Measures of the HRNB-A and the MAS: Measuring Similar Constructs?

The Halstead-Reitan Neuropsychological Test Battery for Adults (HRNB) was developed as a fixed battery of tests to be used to assess for the presence and severity of brain impairment. Many neuropsychological practitioners, however, supplement the HRNB with additional tests, particularly memory measures. The aim of the present study was to test empirically if additional memory measures tap functions not assessed by the HRNB. Ninety-one patients referred to a general outpatient neuropsychological practice were administered the HRNB for adults and the Memory Assessment Scales (MAS) as part of their neuropsychological work up. Diagnoses within the sample included traumatic brain injury, stroke, and probable senile dementia of the Alzheimer's type. Intercorrelation matrices within the HRNB and within the MAS in this neurologically impaired sample were derived, as well as the intercorrelations between the MAS subtests and the memory indices of the HRNB (TPT Memory, TPT Localization, and Category Test Subtest VII). In correlation matrices between the MAS subtests and both the raw and the NDS scores of the HRNB memory items revealed significant orthogonal relationships. These results suggest that supplementing the HRNB with additional memory measures provides important information beyond that obtained with the memory items from the HRNB alone. Correspondence: *Miriam Weber, Psychology Department, SS112, University at Albany, State University of New York, 1400 Washington Avenue, Albany, NY 12222.*

T.T. LINEWEAVER, J.A. ZONE, G.J. CHELUNE, B.P. HERMANN, & C. DOW. Repeating the Repeatable Battery for the Assessment of Neuropsychological Status.

The Repeatable Battery for the Assessment of Neuropsychological Status (R-BANS) is a relatively new multi-dimensional cognitive screening instrument. We administered Form A of the R-BANS to 99 community-dwelling, nondemented older adults (ages 53–88; $MMSE \geq 24$; $DRS \geq 124$) twice at a test-retest interval of approximately 6 months (range 4–10). We found adequate stability coefficients similar to those reported in the manual for the Total Scale ($r = .81$) and Attention Index ($r = .80$) scores, with more modest test-retest correlations apparent for the Immediate Memory ($r = .67$), Visuospatial ($r = .65$), Language ($r = .54$), and Delayed Memory ($r = .62$) Indices. Significant practice effects were found for the Immediate (M improvement = 6 points) and Delayed (M improvement = 4 points) Memory Indices, as well as for the Total Scale Scores (M improvement = 2 points). In contrast, no significant mean practice effects were apparent on the Language, Visuospatial, or Attention Indices. Although the mean test-retest differences were fairly modest in magnitude, an examination of the distribution of change scores revealed dramatic fluctuations over the test-retest interval on an individual basis (e.g., decrements up to 32 points and improvements up to 50 points). Neither age nor years of education predicted test-retest differences on the Immediate Memory, Visuospatial, Language, or Attention Indices. However, years of

education significantly predicted test–retest Delayed Memory Index changes, whereas age significantly predicted changes in Total Scale scores. The low stability coefficients and remarkable individual variability in test–retest differences call into question the clinical validity of interpreting test–retest changes on the R–BANS at the index level.

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T.T. LINEWEAVER, J.A. ZONE, G.J. CHELUNE, B.P. HERMANN, & C. DOW. Using the R–BANS With Older Adults: Are Age Corrections Enough?

The Repeatable Battery for the Assessment of Neuropsychological Status (R–BANS) is a relatively new neuropsychological instrument designed to screen cognitive functioning across multiple domains (Immediate Memory, Visuospatial, Language, Attention, and Delayed Memory). We administered the R–BANS to 125 community-dwelling, nondemented older adults (ages 53–88; MMSE \geq 24; DRS \geq 124). Although each index score and total scale score is separately normed for age, examination of the distributions of scores indicated that the Visuospatial and Delayed Memory Indices over-classified impairment in this normal sample. While regression analyses demonstrated that the age-adjusted norms successfully corrected for age-related differences in this sample, education accounted for 4% to 15% of the variance in the index and total score performances. Therefore, education adjustments were calculated using regression-based techniques and were applied to the data. The resulting distributions of age- and education-corrected scores for each index and overall scale better fit the expected patterns of performance in a group of normal adults. These results suggest that age-corrections may be necessary, but not sufficient, for interpreting performances of older individuals on the R–BANS. Adjusting R–BANS index and total scores for both age and education may, therefore, provide a more valid and accurate assessment of cognitive functioning across multiple domains in an elderly population.

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F. HILLARY, S. GONTKOVSKY, E. ROSS, & J. SCOTT. Cross-Validation of the Repeatable Battery for the Assessment of Neuropsychological Status.

The Repeatable Battery for the Assessment of Neuropsychological Status (R–BANS) is a recently developed tool designed to evaluate impairment across a variety of cognitive domains. This study correlated individual measures of the R–BANS with well-established neuropsychological tests in a heterogeneous neurologically impaired patient population. The R–BANS was also correlated with the Global Deterioration Scale (GDS), a score derived by the clinician following a comprehensive review of patient history in conjunction with the neuropsychological assessment profile. Findings revealed strong correlations between R–BANS subtests and other established neuropsychological measures. For example, the R–BANS Figure Copy score correlated at .900 ($p < .001$) with the Rey Complex Figure copy score, and the R–BANS Figure Recall score correlated at .687, ($p < .001$) with the delayed recall score of the Rey Complex Figure. The R–BANS List Recall total score correlated at .818 ($p < .001$) with the Rey Auditory Verbal Learning Test total score. The R–BANS subtest assessing semantic fluency maintained strong correlations with the semantic fluency test of animal naming ($r = .654, p < .001$). Additionally, the R–BANS Picture Naming score correlated at .735 ($p < .001$) with the Boston Naming Test. Finally, the sum of raw scores from separate R–BANS subtests was highly correlated with the GDS ($r = -.744, p < .001$). The R–BANS is a sensitive and efficient measure that can be administered in a period of approximately 30 min, making it particularly useful when patient fatigue is imminent or when the clinician's time is limited.

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F. HILLARY, S. GONTKOVSKY, G. LEDAKIS, J. TESTA, E. ROSS, & J. SCOTT. The R–BANS and the DRS: A Comparison of Test Sensitivity.

This study investigated the sensitivity of the Repeatable Battery for the Assessment of Neuropsychological Status (R–BANS) and the Dementia Rating Scale (DRS) in diagnosing cognitive impairment. The R–BANS is a recently developed assessment tool designed to evaluate impairment across varying cognitive domains. A heterogeneous group of neurologically impaired patients referred for comprehensive neuropsychological evaluation was analyzed. The investigators hypothesized that the R–BANS would be more sensitive than the DRS in detecting neuropsychological dysfunction. Patients were classified as cognitively impaired based on Mini Mental State Examination (MMSE) scores and ratings on the Global Deterioration Scale (GDS). The R–BANS and DRS were compared by using the DRS cutoff total score provided by Mattis and an R–BANS total raw score cut-off derived from 13 elderly controls. The R–BANS successfully diagnosed 84.4% of all patients with MMSE scores below 27 ($n = 32$); whereas, the DRS successfully diagnosed only 70% ($n = 20$). Furthermore, the R–BANS successfully detected cognitive impairment in 80% of all patients with GDS scores of 2 or greater ($n = 20$) and the DRS recognized impairment in only 55% of the patients in this same group. In conclusion, the R–BANS can be quickly administered, has well developed norms and sound psychometric properties, and when compared to the DRS may have greater sensitivity for patients with early signs of dementia or mild neurological impairment. Correspondence: *Samuel Gontkovsky, The University of Oklahoma Health Sciences Center, Department of Psychiatry and Behavioral Sciences, 920 Stanton L. Young Blvd., Post Office Box 26901, Oklahoma City, OK 73190.*

J.S. SMIGIELSKI, T.F. BERGQUIST, & J.F. MALEC. Brief Cognitive Assessment in TBI: Use of R–BANS and Relationship to Standard Tests.

The R–BANS was designed as a brief and repeatable measure to provide a profile of a broad range of neurocognitive functions, including immediate and delayed memory, language, attention, and visuospatial/constructional abilities. This study investigated the application of R–BANS in the early assessment of cognitive functioning for TBI patients during acute inpatient rehabilitation. Mean time of testing postinjury was 38 days. Mean age of participants was 45.19, with 64% having 12 or fewer years of education. The pattern of performance showed lowest mean index scores in Attention (67.60), Immediate Memory (68.13), and Delayed Memory (69.75) scales, consistent with the expected pattern of performance for this diagnostic group. Correlations of R–BANS Index Scores with standard test procedures, including WMS–R Logical Memory, COWAT, Rey AVLT, Benton Visual Discrimination Test, Symbol-Digit Modalities Test Trail Making Test, and WAIS-R Block Design, were computed. Correlations in the range of .60 to .70 were obtained between specific R–BANS subtests and comparable standard psychometric measures. Results provide evidence to indicate satisfactory concurrent validity for R–BANS with standard psychometric tests administered to individuals in the early stages of recovery from TBI. The clinical utility of this brief and repeatable assessment tool with this population is discussed.

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C. GASS & C. LUIS. The New MMPI-2 Short-Form (180 Items): Psychometric Considerations Involving Its Neuropsychological Application.

Although the MMPI-2 is widely used in neuropsychological practice and research, many neuropsychologists do not use this instrument because of the amount of time and effort required of the examinee. Recently, Dahlstrom and Archer proposed the alternative use (under certain circumstances) of a short form of the MMPI-2 consisting of the first 180 items (MMPI2–180). Their data, based on separate investigations of normal individuals and psychiatric patients, suggested that prorated MMPI2–180 scores closely approximate full-scale scores on the basic scales. They concluded that the MMPI2–180 is “psychometrically sound,” but that further research is warranted using other special populations. We investigated psychometric characteristics of the MMPI2–180 as applied to a sample of 205

brain-injured individuals who were referred for neuropsychological evaluation within the Miami VA Medical Center. Standard MMPI-2 profiles were contrasted with those resulting from prorating raw scores based on the first 180 items. We examined scale correlations, mean raw and *T*-score differences, frequency of elevated scales, and code type congruence. Our results confirmed high correlations between prorated and full-scale raw scores on the basic scales. However, the MMPI-2 short form overestimated *T* scores on Sc by an average of 13 points, and underestimated Hs by 8 points. Additional problems with low code-type congruence and frequent discrepancies in the incidence of high ($T > 65$) scores suggest that this short form may not be appropriate for use in neuropsychological settings.

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B. ROURKE, B. HAYMAN-ABELLO, & S. HAYMAN-ABELLO.
Human Neuropsychological Research in Canada: The 1990s.

An overview of research activity that has taken place in Canada during the decade of the 1990s in the field of human neuropsychology is presented. A list of over 200 Canadian neuropsychologists was compiled from membership rosters of national and international neuropsychological societies and organizations. Each was sent a letter describing the project and requesting reprints of their research with humans conducted between 1990 and 1999, inclusive. This presentation includes brief descriptions of investigations that have been conducted by prominent researchers at major academic and clinical institutions across Canada during this time period. Following up on previous reviews of the 1970s and 1980s, the work reviewed here serves to illustrate the enduring and extensive contribution of Canadian investigators to neuropsychological research in humans. It also clearly demonstrates that Canada can be expected to be a continuing leader in this important area of scientific endeavor.

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Symposium 1/4:45–6:15 p.m.

NOVEL APPROACHES TO MEASURING FRONTAL SYSTEMS FUNCTIONING ACROSS THE LIFE SPAN

Organizer and Chair: Melissa Lamar

M. LAMAR. Novel Approaches to Investigating Frontal Systems Functioning Across the Life Span.

Studies of frontal lobe functioning include a wide range of cognitive abilities and clinical populations. Much has been revealed about deficits of attention/concentration, working memory, and prospective memory. This symposium addresses novel approaches to understanding frontal systems functioning either within specific populations or for specific cognitive skills. It is important to continue to expand our investigation of frontal systems, as they are some of the last to develop in children and some of the first to decline in the elderly. The goal of this symposium is to discuss new issues and theoretical perspectives related to frontal systems functioning across the life span. The first two papers from Fein's laboratory discuss pediatric frontal functioning. Garcia discusses developmental trends in source memory using a new assessment tool while Liss evaluates impaired executive functioning in autism. The second two papers discuss a novel approach to investigating frontal systems alterations using production or commission errors as opposed to traditional production deficits or omission errors. Thus, Podell presents a new executive control battery that capitalizes on overproduction not underproduction of the frontal lobes in various adult populations. In addition, Lamar discusses production errors as they relate to specific behavioral measures and regional cerebral blood flow in normal aging. In the final presentation, Libon outlines a novel application of an established theory of frontal functioning in dementia. Serving as discussant, Malloy will add his expertise on novel approaches to assessing fron-

tal systems alterations as he proposes implications for continued lifespan study of the frontal lobes.

Correspondence: *Melissa Lamar, National Institute on Aging–NIH, 5600 Nathan Shock Boulevard, GRC–LPC, Baltimore, MD 21224.*

A. GARCIA, D. FEIN, & A. CILLESSEN. The Development of Source Memory in Children.

Source memory involves a variety of characteristics specifying the condition under which a memory is acquired. Studies have shown that source memory deficits may be related to aging and that source memory and fact memory may be dissociated in brain-injured patients. There is a suggested dependence of source memory on the frontal lobes, an area of the brain thought to mature fully in adolescence, indicating that this type of memory should develop with age. The present study looked at age-related performance on a new task of source memory in 111 normally developing children aged 5 to 12 years. The participants' memory for information presented in a videotape was assessed by measures of fact recognition and source recognition. The performance of the four age groups (Group 1 *M* age = 6.1 years; Group 2 *M* age = 7.9 years; Group 3 *M* age = 9.8 years; Group 4 *M* age = 12.1 years) differed significantly, [$F(3, 107) = 11.32, p < .001$]. *Post-hoc* analyses revealed that Group 4 recalled a significantly greater number of source variables than both Group 1 ($p < .001$) and Group 2 ($p < .01$). The youngest age group recalled a significantly fewer number of source variables than the two oldest age groups. Source memory recognition correlated significantly with fact memory recognition ($r = .271, p < .001$). These findings support a developmental trend of source memory abilities. They do not, however, support a dissociation between fact memory and source memory in normal development.

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M. LISS, D. FEIN, D. ALLEN, M. DUNN, C. FEINSTEIN, R. MORRIS, L. WATERHOUSE, & I. RAPIN. Executive Functioning in High-Functioning Individuals With Autism.

Executive functioning was investigated in 34 children (24 boys and 10 girls) with developmental language disorder (DLD) and 21 children (18 boys and 3 girls) with high functioning autistic disorder (HAD) matched on full scale IQ, nonverbal IQ, age (*M* age 9 years, 1 month), and SES. The DLD group had a verbal IQ that was 10 points higher than the HAD group. These children were given The Wisconsin Card Sorting Test (WCST), the Mazes subtest from the WISC–R, the Underlining test, and the Rapid Automatized Naming test. In addition, these children were given the Vineland Scales of Adaptive Functioning and the Wing Diagnostic Symptom Checklist in order to assess severity of autistic symptomatology. Results indicated that the only significant difference between the 2 groups on the cognitive tasks was perseverative errors on the WCST. There was also significant overlap in the scores between the two groups and the difference in perseverative errors was no longer significant when VIQ was partialled out. Although there was a relationship in the HAD group between executive functioning and adaptive functioning, as well as between executive functioning and autistic symptomatology, these relationships were generally no longer significant in the HAD group after the variance due to Verbal IQ was accounted for. The results are interpreted to indicate that while impaired executive functioning is a commonly associated feature of autism, it is not universal in autism and is unlikely to cause autistic behaviors or deficits in adaptive function.

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K. PODELL. Quantitative Assessment of Productive Deficits in Executive Dyscontrol Using the Executive Control Battery.

Numerous (good) tests exist for assessing the various components of executive dyscontrol (ExDys). However, the overwhelming majority of these tests assess the patient's inability (or negative deficit) and are limited to assessing only one, or at most a few, of the deficits associated with ExDys. Also, several of these tasks are rather conceptually difficult making it hard to understand the instructions. With very few exceptions, what does not

exist are test batteries using quantifiable measures of the productive deficits associated with ExDys. The Executive Control Battery (ECB) is designed to measure quantitatively the various productive deficits associated with ExDys. ECB measures incorporate clinical techniques developed by A.R. Luria and E. Goldberg. ECB consists of 4 subtests used to assess perseveration, echopraxia, inertia, disinhibition, and motor programming deficits. The subtests are easy to understand, quickly administered (even at bedside), and only requires paper and pencil. Normative data and psychometric properties will be presented for healthy controls (HC), frontal lesions (FF), schizophrenia (SZ), traumatic brain injury (TBI), and dementia (DEM). Individual subtest data demonstrates: excellent discrimination between HC and FF, SZ, or TBI—equivalent to, or better than, WCST; dissociability (factor analysis) between perseveration and field-dependency on ECB measures; prevalence of echopraxia in TBI; and differences in graphomotor perseveration type between dementia etiologies. The evidence demonstrates that ECB is a unique, quantifiable battery measuring productive deficits associated with ExDys that has adequate psychometric properties, adequate sensitivity and specificity, is quick and easy to administer, and is the only test that quantifies echopraxia.

Correspondence: *Kenneth Podell, Division of Neuropsychology, Henry Ford Health System, 1 Ford Place—1E, Detroit, MI 48202.*

M. LAMAR, P. MAKI, & S.M. RESNICK. Assessing Frontal Lobe Contributions to False Positive Error Production During PET Recognition Memory Testing.

An increase in false positive errors (FPs), incorrectly identifying a distractor as a target, is seen in disorder of frontal function including Parkinson's and Huntington's disease. Evidence that FPs increase with normal aging has led to the hypothesis that inefficient frontal functioning may contribute to recognition memory error production. The goal of the current investigation was to use neuroimaging techniques (i.e., positron emission tomography; PET) to test this hypothesis directly. Specifically, we examined correlations between the number of FPs and regional cerebral blood flow (rCBF) during performance of a verbal recognition memory test in healthy elderly subjects participating in the neuroimaging study of Baltimore Longitudinal Study on Aging ($N = 119$; 68 men, age = 70.5 ± 7.7 , 51 women, age = 69.0 ± 8.0). We examined the pattern of rCBF correlations in men and women separately. Although men and women made a similar number of FPs, the brain regions that correlated with FPs differed between the sexes. In women the number of FPs correlated significantly with activation in the frontal lobes bilaterally, whereas in men the corre-

lations were greater in the right frontal cortex compared to the left. Behavioral results indicated that FP errors correlated negatively and selectively with total learning across CVLT Trials 1–5 ($r = -.23$), and the following frontal tasks: WAIS–R Digits Forward ($r = -.20$), and verbal fluency (FAS $r = -.22$; all $ps < .05$). These results support the hypothesis that frontal lobes mediate FP error production in aging. In addition, the pattern of frontal lobe activation underlying FP error production differs between men and women.

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D. J. LIBON, M. LAMAR, K.L. DAVIS, & C. PRICE. Aspects of Frontal Systems Dysfunctions in Dementia.

A variety of theories have been put forth attempting to explain the neuropsychological dysfunction associated with the frontal lobes. Most of these theories have emphasized specific neuroanatomic structures or cognitive functions (e.g., dorsal–lateral cortex, working memory) with little emphasis on how frontal systems dysfunction may be expressed in dementia. Our investigations with cortical (AD) and subcortical dementia patients (VaD with white matter alterations) suggests that the underlying mechanism for frontal systems deficits in dementia is best understood within the context of a hierarchical continuum involving rudimentary to very specific cognitive operations. First, we found that the perseverations produced by patients with AD were very content specific and highly related to tests of semantic knowledge deficits, a hallmark of this disorder. The perseverations produced by patients with VaD were driven by rudimentary motor dysfunction and were correlated with motor test performance. Second, on tests of concept formation, the errors produced by AD patients were concrete and associated with tests of semantic/lexical knowledge and verbal response interference. The errors produced by VaD patients were often bizarre and associated with poor performance on tests of working memory and perseveration. Third, on tests of working memory the output produced by AD patients tends to remain stable over time, by contrast, the output produced by VaD patient showed a steep and precipitous decline over time. We speculate that the mechanism that may underlie frontal systems deficits in dementia may revolve around cortico–cortico disruption for patients with cortical dementia; and impaired gating associated with elements of prefrontal–basal ganglia–thalamic pathways for subcortical dementia. Correspondence: *Daniel J. Libon, Ph.D., Box 24, University of the Sciences, Philadelphia, PA 19104.*

THURSDAY MORNING, FEBRUARY 15, 2001

Plenary Session I

**MEMORY, AMNESIA AND THE
HIERARCHICAL ORGANIZATION OF
THE HIPPOCAMPAL SYSTEM/
9:00–10:00 a.m.**

Mortimer Mishkin

**NEURAL NETWORKS AND HUMAN
PREFRONTAL CORTEX/
10:00–11:00 a.m.**

Robert Knight

Poster Session 2/9:00–10:45 a.m.

**CHILD TUMOR, NEUROLOGIC,
AND MEDICAL ILLNESS**

**S. PATEL, M. MARES, B. BAUMEISTER-PETERS, & E. KATZ.
Bilingualism as a Cognitive Predictor Among Pediatric Brain Tumor
Patients.**

Background: There now exists extensive research examining neurocognitive functioning and related factors among pediatric brain tumor patients. Most studies, however, have focused on predominantly White samples. Very little is known about ethnicity/cultural influences on the cognitive presentation of cancer patients. Yet such knowledge is essential as the proportion of Hispanic pediatric patients rapidly grows in some US cities. *Method:* We examined WISC–III data from 27 Hispanic and 11 White children seen for routine neuropsychological evaluation following diagnosis and treatment for malignant brain tumor. All patients were post tumor resection, with treatment including chemotherapy and/or cranial radiation. Mean age at diagnosis and at evaluation time was 70 and 131 months, respectively. All children with predominantly Spanish-speaking parents were assessed by a bilingual Spanish–English examiner. VSIQ was not obtained

for the few children who preferred testing in Spanish. Statistical multiple regression model predicting IQ scores involved the following independent variables: age at diagnosis, time since diagnosis, radiation dose, tumor location, chemotherapy treatment and predominant language spoken at home. **Results:** The model identified predominant language at home, along with time since diagnosis, as a significant predictor of VSIQ but not PSIQ and FSIQ. Time since diagnosis of brain tumor consistently predicted variance in VSIQ, PSIQ, and FSIQ. Additional analysis found that language at home, and not ethnicity, was an important predictor of lower WISC-III verbal scores in our sample. **Discussion:** Our findings emphasize the need for continued research. It will be important to investigate cultural influences on cognitive outcomes specific to pediatric brain tumor patients beyond those associated with nonmedical groups.

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S. PATEL, B. BAUMEISTER-PETERS, M. MARES, & E. KATZ. Neuropsychological Functioning in Long-Term Survivors of Posterior Fossa Brain Tumor.

Posterior fossa (PF) refers to the back area of the brain containing the cerebellum, fourth ventricle, and brain stem, and is the most common site for pediatric brain tumors. Possibly because of the cerebellum's well-established role in regulation of motor activity, injury in this area of the brain traditionally is thought to have minimal impact on higher order cognitive abilities. Recently, researchers have proposed that the cerebellum may contribute to motor-independent learning via projections to the cortex. Researchers in the area of pediatric brain tumors have contributed toward this new body of literature through reports on the late effects of treatment on the intelligence of children with PF tumors. More recent reports have focused on sustained attention skills in children with PF tumors due to potential influence of the brainstem ascending activation system. We examined measures of intelligence, academic achievement, visual memory, verbal memory, working memory, visual motor integration, brief auditory attention, cognitive flexibility, and fine motor coordination skills obtained on 14 survivors of pediatric brain tumor in the posterior fossa. Patients were seen for neuropsychological assessment at least 5 years post-diagnosis. Performances were compared to normative means, as well as compared to psychometric data obtained from children with tumors in the midline or subcortical brain areas. Results revealed significant dysfunction relative to normative means for most cognitive variables assessed. Parent report of cognitive or behavioral problems in this group was not significantly different from normative samples. Comparisons between the group treated for PF brain tumors and those treated for subcortical brain tumors generally were not significant suggesting that any impact of PF tumor location beyond radiation treatment may not yield location-specific cognitive compromise.

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K. NIELSEN & K. O'TOOLE. Pediatric Arteriovenous Malformation: Cognitive Outcomes.

Little information is available on the neuropsychological manifestations and follow-up of children with arteriovenous malformations (AVM). The cause is unknown, although it has been proposed that AVM may be caused by the clotting of a blood vessel that occurs during prenatal development. This study follows 3 children who were evaluated at discharge from a day rehabilitation program after treatment for AVM. Participant 1 was a 10-year-old boy who had emergency resection of a bleeding cerebellar AVM with brainstem compression. Participant 2 was a 15-year-old girl who had emergency resection of a left temporal AVM with large intracerebral hemorrhage. Participant 3 was an 11-year-old boy with elective resection of a right frontal AVM discovered on evaluation for febrile seizures. All 3 participants were previously receiving A and B grades in regular classes. Comprehensive neuropsychological evaluation was performed on each child with results suggesting average intellectual functioning in all participants.

Academic functioning was best preserved in participant 3. In participants 1 and 2, reading remained average but math declined to borderline-low average. All participants had neuropsychological deficits in regions in which the AVM was located. For example, participant 1 had deficient manual dexterity and graphomotor functioning. Participant 2 had deficient confrontation naming. Participant 3 had deficient nonverbal planning and organization. All children will be re-evaluated in 6 months and that data will be incorporated into the study findings. Further studies need to assess the relative roles of AVM location and hemorrhage in developmental outcome. Correspondence: *Kathleen Nielsen, Department of Neuropsychology, Children's Healthcare of Atlanta, 1001 Johnson Ferry Road NE, Atlanta, GA 30342.*

E.V. FLORENDO, L.K. PAUL, C.M. DUNN, M.M. FOX, A.A. TURK, S.R. GARRELS, & W.S. BROWN. Interhemispheric Transfer in Children With Callosal Agenesis.

Adults with agenesis of the corpus callosum (ACC) have deficits in interhemispheric integration of spatial and tactile information. Prior to complete myelination of the corpus callosum, normal children also show interhemispheric transfer deficits. The Finger Localization Task (FLT) and Tactual Performance Test (TPT) were administered to 8 children with ACC and normal intelligence (ages 7–12) and 9 age and IQ matched controls to examine interhand (interhemispheric) performance over levels of complexity, established by number of TPT blocks (6, 8, 10) and number of finger touches (2, 3). It was hypothesized that ACCs would have reduced information transfer and that the interhand performance of the ACC group would become increasingly impaired as task complexity increased. TPT: A 3-way ANOVA yielded a significant main effect for group ($p < .001$) and difficulty ($p < .001$) and an interaction between Hand (dominant vs. nondominant) \times Group ($p < .05$). Performance of all participants declined with increasing difficulty, and ACC participants were slower overall. Most importantly ACC participants exhibited diminished interhemispheric transfer on more difficult tasks (8 and 10 block). FLT: There was a significant effect for hand ($p < .001$) and difficulty ($p < .001$), indicating that all children had difficulty transferring information on between hand trials and that performance declined with increased task complexity. There was only a trend toward a group effect ($p = .072$) and no significant interaction. Overall, these findings suggest that ACC children exhibit relatively diminished interhand (interhemispheric) performance particularly as the complexity of the task increased.

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R. BUTLER, G. JONES, & P. MYERS. Neurocognitive Impairment in Survivors of Childhood Osteosarcoma.

Osteogenic sarcoma (OS) is a primary tumor of bone which is the third most common malignancy in adolescents. Currently, nonmetastatic OS is treated with approximately 70% long term disease-free survival. Treatment includes high doses of systemic methotrexate, an antimetabolite chemotherapy which inhibits dihydrofolate reductase and causes, among other things, an acute folate deficiency. This folate deficiency elevates homocysteine levels which, in turn, increases the likelihood of seizures, stroke and vascular damage. Thus, there is reason to believe that high dose systemic methotrexate may cause neurocognitive impairment. We compared a group of childhood patients treated for OS ($N = 13$) to a group of pediatric cancer patients who did not receive methotrexate as part of their treatment ($N = 8$) on neuropsychological measures of intelligence, attention, memory and academic achievement. The OS group performed at a significantly more impaired level in performance IQ, vigilance attention, nonverbal memory, and reading achievement. While not always statistically significant, the OS group was inferior to the comparison group on all measures administered. We conclude that there is preliminary evidence that high dose systemic methotrexate may cause neurocognitive deficits. The mechanism underlying this impairment remains unclear, but may involve elevated plasma homocysteine.

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A. BUIZER, L. DE SONNEVILLE, & A. VEERMAN. Effects of Chemotherapy on Attention and Information Processing in Survivors of Childhood Cancer.

In this study we investigated the effects of chemotherapy on attention and information processing in children with cancer, as these basic neuropsychological functions are known to be particularly vulnerable to neurotoxic damage. Children with leukemia form a special focus of investigation because central nervous system (CNS) prophylaxis is an essential component of their treatment. Cranial radiation therapy (CRT) has been demonstrated to be effective, but it is also known to cause neurocognitive and academic deficits in children. Therefore, the trend is to avoid the use of cranial irradiation in favor of chemotherapy as much as possible. From studies performed to date, no definite conclusions can be drawn with respect to the effect of chemotherapy alone on long-term neuropsychological status. In a retrospective study we examined 13 survivors of acute lymphoblastic leukemia (ALL, the most common form of leukemia in children, treated with systemic and CNS chemotherapy) and 11 survivors of Wilms tumor (treated with systemic chemotherapy, not directed at the CNS) using computerized neuropsychological tests and compared their results to 106 healthy controls. We investigated focused, divided and sustained attention. Although performance in the patient groups on most tasks did not differ from controls, the results did show reduced accuracy in a sustained attention task and reduced reaction speed in a memory search task in ALL patients only, suggesting a lack of inhibitory control and a decreased working memory capacity. These results indicate that subtle defects in attention and information processing are present in children treated with CNS chemotherapy.

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R. LILLIE, T. HERSHEY, M. SADLER, & N. WHITE. Retrospective Report of Severe Hypoglycemia Related to Reduced Delayed Response.

Previously, we reported that Type 1 diabetic children at a higher risk of experiencing severe hypoglycemia performed worse on long delays of a spatial delayed response (SDR) task. Long-delay performance has been associated with medial temporal dysfunction, a region potentially affected by severe hypoglycemia. However, due to small sample sizes, we could not determine if the number of severe episodes was related to performance. The present study tested this hypothesis in a larger group of Type 1 diabetic children ($N = 49$; M age = 11.9; M age of onset = 7.1). Children performed the SDR task with short and long delays. Interviews were conducted with one or both parents about their child's experiences with severe hypoglycemia. Cross-checks with medical records were performed when possible. Data were analyzed with a hierarchical linear regression procedure with long delay performance as the dependent variable, and age, age of onset, and number of severe hypoglycemic episodes as independent variables. Number of episodes accounted for a unique and significant portion of the variance after controlling for age and age of onset ($p < .01$). In a similar analysis, number of episodes was not significantly related to short delay performance. Further, in patients who had experienced severe episodes, whether or not they experienced seizures during an episode was significantly related to performance ($p < .01$). We conclude that an increase in number and/or severity of hypoglycemic episodes in children with Type 1 diabetes increases the risk for reduced performance on a task sensitive to medial temporal dysfunction.

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R. ACKERMAN, D. ZARABOZO, & E. MATUTE. Neuropsychological Functioning in Children Who Survived Acute Lymphoblastic Leukemia.

We evaluated the impact of intrathecal chemotherapy (ITCT) as a prophylactic measure to the central nervous system (CNS) in a group of children who survived acute lymphoblastic leukemia (ALL). We were specifically concerned in knowing the effect of age at beginning of the treatment on the development of neuropsychological functioning, therefore, a group of 9 children who received ITCT before turning 4 and an-

other of 7 who were treated after they turned 5 were administered WISC-RM and the Test of Memory and Learning (TOMAL). The execution of each group was compared with its respective control group (CG), neurologically intact and sound children, who were matched by chronological age and gender. In comparison with their CG, all survivors who were diagnosed before turning 4 presented a meaningful decrease in the VIQ, PIQ, TIQ and comprehension, digit span, block design, object assembly and coding from WISC-RM, and Verbal, Nonverbal and Composite Memory Indexes, and subtests on Digits Forward, Paired Recall and Memory for Location from TOMAL; while children who received ITCT after turning 5 showed a significantly lower yield in information and arithmetic tests from WISC-RM and in Letters Forward and Facial Memory from TOMAL. The results suggest that ITCT affects the performance of cognitive tasks at any stage of infancy, however, when applied before turning 4, alterations are more global and when administered after turning 5, difficulties are related to school learning.

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J. SCOTT, D. ELKIN, M. THOMPSON, J. SCHOENFELD, J. PARKHURST, & M. GUMERLOCK. Treatment Factors Predicting Cognitive Outcomes in Pediatric Cancer Survivors.

Treatment of childhood cancer has often been associated with long term cognitive morbidity in children. Our previous research has examined the effect of radiation and chemotherapy on the neuropsychological functioning in children of this population. The current study examined the role of several treatment factors in long term neuropsychological outcome. Subjects consisted of a heterogeneous sample of children with cancer, tested over a 7-year period. Cancer types included 23 medulloblastomas, 14 ALL, 7 astrocytomas and 9 other tumor types. Results indicate that those patients receiving both radiation and chemotherapy have the poorest outcome compared to those receiving monotherapy. Within those groups receiving only one therapy, those receiving only chemotherapy performed better than those receiving radiation alone. Radiation response was noted to be highly dose dependent in both the mono therapy and poly therapy groups. Consistent with previous findings, both age at diagnosis (i.e., treatment onset) was significantly related to long term outcome. There were also significant differences over time, with psychometric performance decreasing over time. In addition, analysis suggests that sample factors, such as length of time off all treatment, time since diagnosis, number of neurosurgical procedures, complication during neurosurgery, necessity of a shunt revision, presence of a seizure disorder and which POG protocol was employed, were not significantly related to outcome. Differences in factors predicting outcome among the various tumor groups are discussed as is the need for future research.

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K. TINGUS, E. TENG, D. POWARS, & P. CONTI. Cerebral Glucose Hypometabolism and Cognitive Performance in Sickle Cell Anemia.

Cerebral ischemia causing stroke with overt sensory/motor impairments is a major disabling consequence of sickle cell anemia. An additional group of SS children who do not show obvious sensory/motor impairments suffer from subtler neurologic dysfunction including cognitive impairments. The early identification of children with subtle neurologic dysfunction is crucial in providing appropriate preventive therapy. The aims of the current study were to (1) investigate the association between cerebral hemispheric metabolic asymmetry and neuropsychological test performance, and (2) to compare the relative sensitivity of clinical observations, MRI, and PET as indicators of cerebral vasculopathy. 22 patients with sickle cell anemia (ages 4–19), were assessed by clinical examination, MRI, PET, and a neuropsychological test battery. Asymmetric indices (AIs) for cerebral metabolic rates were calculated for the whole hemisphere, frontal, temporal, and parietal lobes. AIs were then correlated with cognitive and psychomotor test findings. Neuropsychologic test scores were significantly higher in subjects whose regional AIs did not deviate more than 2.0

from zero: FSIQ ($p = .001$), VIQ ($p = .005$), PIQ ($p = .001$), WIAT ($p = .017$), WRAML ($p = .001$), Purdue Pegboard ($p = .03$). Among the 22 participants, respectively 11(50%), 13(59%), and 15(68%) showed clinical, MRI, and PET indications of cerebral vasculopathy, indicating that PET abnormality precedes MRI and clinical abnormalities in detecting cerebral vasculopathy in sickle cell anemia.

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K. HERZEL, J. CHANDLEE, L.T. HEATHFIELD, & J. RAD-CLIFFE. Early Childhood Lead Exposure: Preliminary Evidence for Differential Impact on Language Functions.

Although lead exposure is associated with negative IQ effects in preschool children, inconsistent language effects are reported. Lead has affinity for hippocampal, prefrontal cortical, and cerebellar brain structures, which play an important role in automatic language functions. Automatic language functions, such as speeded naming and auditory attention/verbal short-term memory, were hypothesized as impaired relative to verbal formulation, semantic store, and abstract reasoning among preschool age lead-exposed children. The Philadelphia sample of the Treatment of Lead Exposed Children study consisted of 94 children, ages 49–73 months, with low to moderate (20–40 $\mu\text{g}/\text{DL}$) lead exposure. Children were tested with a battery including the WPPSI-R and NEPSY. On principal components analysis, a 2-factor solution emerged. The first (eigenvalue = 2.56) had positive loadings from all 5 subtests selected, reflecting a general language factor, and accounting for 51.16 percent of the variance. The second solution (eigenvalue = 21.09) had small, but positive, loadings for the postulated automatic linguistic functions, and accounted for another 21.1 percent of the variance among subtests. This study supported the hypothesis that automatic and attention related language functions were differentially impacted relative to crystallized language skills in lead-exposed preschool children. Further neuropathologically informed exploration of language functions in this population is warranted.

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D. GOLDMAN & V. SCHAFER. Neuropsychological Profiles of Post-institutionalized Foreign Adoptees.

Children adopted from institutions in foreign countries are at risk for neuro-behavioral difficulties due to their medical-biological and psychosocial histories. They provide a natural experiment for the examination of the effects of stimulus deprivation, particularly "maternal" care. We hypothesize that institutionalization increases the risk for neuropsychological impairment beyond the effects of pre- and perinatal risk factors. Our clinic-referred sample of postinstitutionalized children originated from Eastern Europe, the Far East, Latin America, and India, ranged in age from 2 to 13 years at the time of their evaluations, and had lived in institutional settings for periods ranging from 2 months to 8 years. Results indicated a significant correlation between the amount of time children had spent in institutionalized care and their cognitive abilities ($r = -.57, p < .01$). This relation appeared stronger for verbal abilities relative to nonverbal abilities. The correlation appeared to hold more strongly for the whole sample than it did for the Eastern European sample; this may reflect greater prenatal alcohol exposure. We did not, however, find evidence for a relation between specific neuropsychological deficits and the amount of time children had been institutionalized. This may be partially due to the high rates of specific deficits diagnosed across the entire sample of children (92% attention problems, 60% language disorders, 20% pervasive developmental disorders). These results replicate previous findings in nonclinic samples of Romanian adoptees. This more impaired and later-adopted sample suggests that institutionalization is an important factor in producing behavioral and cognitive abnormalities.

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CHILD GENETIC DISEASES

C. MILLER & G. HYND. Developmental Gerstmann Syndrome: Links to Other Neuropsychological Diagnoses.

Developmental Gerstmann syndrome (DGS) is a neurological disorder that has been infrequently described in the literature since 1993, and received only limited coverage prior to the 1990s. This may be due, in part, to the controversy that surrounds DGS as a "true syndrome." DGS is characterized by a tetrad of symptoms: left-right confusion, finger agnosia, dyscalculia, and dysgraphia. Constructional apraxia is often included as a fifth symptom of DGS. In addition to the essential diagnostic characteristics, several other characteristics are commonly seen with DGS, such as average or better reading skills. This presentation will address DGS symptoms that frequently co-occur in populations of children with various types of learning disabilities from a neuropsychological perspective. The etiology of DGS is unknown, but several hypotheses have been proposed. None of the hypotheses has been conclusively confirmed. The literature on DGS has not taken advantage of different imaging procedures for research or diagnostic purposes. Based on the paucity of recent research on DGS, it is theorized that individuals that meet the diagnostic criteria for DGS are being given other diagnoses, such as Fragile X syndrome, Williams syndrome, nonverbal learning disabilities, right hemisphere learning disabilities, and Asperger syndrome. There appears to be a clustering of behavioral symptoms and neuropsychological features across these disorders, which suggests similar neurological bases.

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T.P. SWALES, B.H. COHEN, & M. CORWIN. Neuropsychological Functioning in Kearns-Sayre Syndrome.

Kearns-Sayre syndrome (KSS) is an adolescent-onset mitochondrial encephalomyopathy characterized by progressive external ophthalmoplegia/ptosis, atypical pigmentary degeneration of the retina, disorder of cardiac conduction, and increased CSF protein. The rate of progression towards a dementia in KSS has not been systematically defined. We hypothesized that elevated lactate in the central CNS is responsible for progressive dementia among affected patients. Three cases of KSS (ages 15, 27, 31) who underwent comprehensive neurological and neuropsychological evaluation are presented, along with data on mitochondrial functioning from muscle biopsy, and brain metabolites from magnetic resonance spectroscopy (MRS). Progressive dementia was evident in the two older patients. The relationship between mitochondrial dysfunction, brain lactate metabolites and progressive dementia in KSS clearly warrants further investigation.

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M. GERDES, C. SOLOT, P. WANG, D. McDONALD-McGINN, E. ZACKAI, & E. MOSS. Neuropsychological Profile of Infants and Preschoolers With 22q11.2 Deletion.

Microdeletions on chromosome 22q11.2 are identified in patients with the DiGeorge, Velocardiofacial syndrome and conotruncal anomaly face syndrome. Phenotypic expression of this deletion varies across the population, but all experience learning problems. The purpose of this study is to describe the neuropsychological outcome of infants and preschoolers with 22q11.2 microdeletion. *Method:* population: 112 children, ages 6–72 months with 22q11.2 deletion. Grouped by age: infants (<12 months): $n = 22$, toddlers (12–3.5 months): $n = 55$ and preschoolers (3.5–6 years): $n = 35$. Assessments: BSID-II, WPPSI-R, PLS-R and parent interviews. *Findings:* Means scores reported: In infants: MDI of 76 ± 14 , PDI 65 ± 13 with 27% between 1 SD of mean, 32% between 1 and 2 SD below mean and 41% > 2 SD below mean. In toddlers: MDI of 67 ± 15 , PDI 65 ± 13 with 22% between 1 SD of mean, 20% between 1 and 2 SD below mean and 58% > 2 SD below mean. Preschoolers: FIQ 78 ± 12 , PIQ 78 ± 12 , and VIQ 81 ± 12 with 34% between 1 SD of mean, 32% between 1 and

2 *SD* below mean and 34% > 2 *SD* below mean. All demonstrated delayed onset of speech. Of 52 children who received PLS-R, total communication—77 ± 12, auditory comprehension—82 ± 11, expressive communication—76 ± 12. Hypotonia and behavior problems were reported. *Summary:* Infants and preschoolers with 22q11.2 deletion are likely to experience developmental delays (significant to mild), speech/language problems, hypotonia, and behavior problems.

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M. KRONENBERG, S. RAZ, B. NAGEL, M. LAUTERBACH, A. YU, T. HOPKINS, F. GUNNING-DIXON, & C. SANDER. Cognitive and Motor Outcome of Children Born to Women With Preeclampsia.

We studied the influence of antepartum complications, specifically preeclampsia (maternal high blood pressure and proteinuria or edema), on developmental outcome in preschool children. Placental insufficiency and the attendant reduction in maternal-fetal oxygen and nutrient transport adversely affect intrauterine growth in infants of preeclamptic women and may constitute an antenatal mechanism underlying compromised development. We recruited graduates of BMH NICU, Memphis, Tennessee. Group 1 (*N* = 24) included children of preeclamptic mothers. Group 2 (*N* = 14) included children with birthweight below the sixteenth percentile born to preeclamptic women. The comparison group, Group 3 (*N* = 18), included appropriate for gestational age children. Groups were similar in sociodemographic attributes. The WPPSI-R VIQ and PIQ were dependent measures in a mixed linear model multivariate analysis with group affiliation as a predictor. Covariates were chronological age, gestational age, SES, number of perinatal complications, and supplemental oxygen requirement. Analyses revealed a group effect on the linear combination of VIQ and PIQ [Wilks's Lambda (4,94) = 0.81, *F* = 2.65, *p* = .04]; follow-up univariate analyses disclosed a group effect on PIQ only [*F*(2,48) = 3.85, *p* = .03] with differences between Groups 1 and 2, and Group 3. Degree of growth retardation, but not hypertension, significantly contributed to variance in PIQ [*F*(1,48) = 4.85, *p* = 0.03] and gross-motor performance [*F*(1,45) = 10.826, *p* = .002]. Results suggest that preeclampsia is more likely to affect cognitive and motor performance in children who manifested reduced intrauterine growth.

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N.C. WALZ, A. WEBER, & D. FRANZ. The Myth of Tuber Location as a Marker for Autism in Tuberous Sclerosis Complex.

Theories of the pathophysiology of autism have implicated the frontal lobes, temporal lobes, or cerebellum. Although there has been some empirical evidence in support of each of these neuroanatomical correlates of autism, none have been replicated consistently. Tuberous sclerosis is an autosomal dominant disorder that affects approximately 1:10,000 individuals. Cortical tubers, subependymal nodules, or subependymal giant cell astrocytomas are present in the brains of most individuals. The high prevalence rate of autism in tuberous sclerosis provides an opportunity to study the pathogenesis of autism in a homogenous population. One study of autism in tuberous sclerosis found an association between autism and temporal lobe tubers (*N* = 18). However, Baker et al. found no association between tuber location and autism (*N* = 12). This study investigated the relationship between a DSM-IV diagnosis of autism and tuber location in a sample of 50 individuals with tuberous sclerosis. Chi-square analyses revealed no differences between individuals with autism (*N* = 15) and those without autism (*N* = 35) on the occurrence of tubers in the right or left frontal, occipital, parietal, or temporal regions. There were no differences between the 2 groups in the occurrence of tubers in subcortical or cortical regions. In the largest sample to date, these results disconfirm the hypothesis that supratentorial tuber location is a marker for autism.

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E. MATUTE, O. INOZEMTSEVA, T. MONTIEL, D. ZARABOZO, & L. RAMIREZ. Do Turner's Syndrome (TS) Girls Show a Male Cognitive Profile?

We observed that, in 15 TS (45,X) girls who were matched by total IQ and other factors with a female control group, in verbal tests so administered, the TS girls showed a lower significant performance, regarding verbal tasks linked to understanding of complex grammar relations, as well as to understanding and expressing right-left orientation. The difference, which is usually reported for the performance IQ, was demonstrated by using the Wechsler Scales (WISC-RM or WAIS), with significant lower scores in all the subtests except in block design. For this study, we included a group of 15 children who were matched by the same factors. They were administered the same set of verbal tasks and the Wechsler Scales. The results show that even when the TSs obtain the lowest scores in the Wechsler Scales, the number of significant differences changes compared with the previous study, with the following characteristics: they stay within the performance IQ as well as within picture completion and object assembly subtests; they become evident within the block design subtest; they disappear within digit span, picture arrangement and digit symbol. In verbal tasks, differences are maintained only in the comprehension and expression subtests of right-left relations. As the number of differences in verbal tasks decreases and is maintained in tasks which imply space management, the results so obtained indicate that upon including a group of males, only differences of spatial tasks are confirmed with or without verbal content.

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J. OGLINE, J. MOON, J. WILBARGER, J. STEDRON, & B. PENNINGTON. Do Impairments in Down Syndrome Follow a Pattern of Hemispheric Dissociation?

Wang et al. and Bihle et al. claimed evidence for an uneven profile of abilities in right and left hemisphere processes in Down syndrome (DS) in 2 domains: short-term memory processing and spatial organization. Wang et al. found that individuals with DS had intact visual short-term memory, but that verbal short-term memory was impaired. In addition, Bihle et al. found that individuals with DS tended to focus more on a global level of analysis as opposed to the local level while completing a hierarchical drawing task. These results suggested that processes that may require mediation from the left hemisphere could be impaired in DS. The current study examined verbal and visual short-term memory as well as global and local spatial organization in 21 individuals with DS ages 9–18 as compared to 21 mental-age-matched controls. The dissociation between visual and verbal short-term memory in this disorder was replicated, but the dissociation between global and local spatial organization was not found. On Navon's test of hierarchical drawing, the children with DS showed equal levels of accuracy on the local and global forms while control children tended to be more accurate on the global level. This result suggests that the cognitive profile in DS may not follow a clear pattern of hemispheric dissociation. In addition, the present study questions the validity of the hierarchical drawing task as a measure of global and local spatial organization due to the variety of processes (executive functioning, etc.) required for the task.

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J. MOON, J. OGLINE, J. STEDRON, L. NADEL, & B. PENNINGTON. Long-Term Memory Functions in Children With Down Syndrome.

Although there is well-replicated evidence to suggest that individuals with Down syndrome (DS) show specific deficits in verbal short-term memory (STM), the nature of long-term memory functioning in DS remains largely unexplored. The current study examined verbal and visual long-term memory function in children with DS (*N* = 26, ages 9–18). The performance of the children with DS was compared to a group of MA matched children with no history of developmental delays (*M* age 4.5 years). Participants

completed the CANTAB Paired Associates Learning and Pattern Recognition tests, in addition to the NEPSY List Learning test. On the nonverbal measures, the children with DS made fewer correct responses on the Paired Associates test and recognized fewer targets on the Pattern Recognition Test. On the NEPSY List Learning test, the children with DS showed relatively greater forgetting across the delay interval than control children. These findings implicate hippocampal dysfunction in children with trisomy 21. Given the link between DS and Alzheimer's disease, this finding raises a number of important issues for cognitive and developmental research.

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T. AHLUVALIA, L. KENWORTHY, K. TOWBIN, A. WAGNER, & G. WALLACE. Language Organization in High-Functioning Autism and Aspergers Syndrome.

Introduction: There has been increasing evidence of executive dysfunction in Autism and Aspergers syndrome. Also, individuals with Aspergers syndrome (AS) are currently differentiated from High-Functioning Autism (HFA) on the basis of intact language development. In this study, it is hypothesized that AS and HFA groups differ on measures of verbal intelligence, but not on language organization, an aspect of executive functioning. *Method:* Participants consisted of HFA ($N = 15$) and AS ($N = 15$) patients consecutively evaluated through a neuropsychology service. Groups matched on age (range = 7–16 years; $t = 6.1, p = .5.5$) and PIQ (range = 75–131, $M = 95.6, SD = 14.5; t = .06, p = .96$). As part of their neuropsychological evaluations, patients completed the WISC-III, verbal fluency measures, and CVLT-C. *Results:* The AS group performed significantly better than the HFA group on the Verbal Comprehension Index (VCI) of the WISC-III ($M = 120$ vs. 103; $t = -2.8, p = .009$). Also, using ANCOVA to control for differences in the VCI, the AS group performed significantly better on semantic verbal fluency [$M = 111$ vs. 95; $F(1,24) = 27.5, p = .000$]. However, controlling for general verbal intelligence (VCI), the two groups were equivalent on phonemic verbal fluency [$M = 89$ vs. 84; $F(1,24) = 3.4, p = .08$], reflecting weaknesses in both groups on this measure sensitive to language organization. Also, the AS group performed worse than the HFA group on semantic clustering on the CVLT-C [M standard scores = 86 vs. 95, $F(1,24) = 55.6, p = .000$]. Impairments in language organization were thus found in both the HFA and AS groups.

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D. ROBINS, D. FEIN, & M. BARTON. Autism in Young Children: Use of the Modified CHAT in Predicting Clinical Impairment.

Early intervention is critical for children with autism. Therefore it is important to study the effectiveness of a screening instrument in predicting characteristics of very young children with possible autism. The Modified-Checklist for Autism in Toddlers (M-CHAT), a 23-item parent-report scale, was used to screen 1072 children between the ages of 18 and 30 months. Of the children screened, 44 children (34 male, 10 female) met criteria for being at risk for autism, and were seen for a diagnostic/developmental evaluation. Thirty of the 44 were diagnosed with autism or PDD, and 14 were diagnosed with language delay or global cognitive impairment. Clinical data collected included the Bayley Scales of Infant Development, the Vineland Adaptive Behavior Scales, and the Childhood Autism Rating Scale (CARS). Analysis of variance demonstrated that children who received diagnoses on the autism spectrum were significantly impaired relative to children who received diagnoses other than autism/PDD on all measures except for the Motor Skills domain of the Vineland. The M-CHAT score was significantly correlated with Bayley Mental Development Index ($r = -.37$), Vineland Communication ($r = -.49$) and Vineland Daily Living domains ($r = -.34$), and CARS score ($r = .58$). Simultaneous regression analyses showed that the M-CHAT contributed unique variance (beyond Bayley and Vineland scores) to predict the severity of autistic symptoms as measured by the CARS (Beta = .38, $p < .006$). Results indicate that the

M-CHAT, a brief, simple screen, is a useful tool for predicting the presence of autistic features.

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L. CHAPIESKI & A. FRIEDMAN. Cognitive and Behavioral Functioning in Children and Adolescents With Sturge-Weber Syndrome.

Sturge-Weber Syndrome (SWS), a rare neurocutaneous disorder, is generally characterized by a combination of a facial port-wine stain and a leptomeningeal angioma. Previous studies of individuals with SWS have focused on the medical aspects of this syndrome but little is known about the cognitive, affective and behavioral correlates. The goals of this study were to (1) identify the aspects of psychological functioning most likely to be compromised, (2) identify the neurological and social factors that place children with SWS at risk for behavioral, academic and intellectual problems and (3) to assess the stability of behavioral and cognitive functioning with increasing age. With the assistance of the national Sturge-Weber Foundation, psychological and medical data were collected through surveys from the parents and teachers of 79 children with SWS and a group of 59 siblings. The results of intellectual assessment were also obtained for a subset of the children with SWS. The young people with SWS were found to exhibit more problems across a number of domains: intellectual/academic, social skills, mood and compliance. Those children most at risk were those with lower levels of intellectual functioning, those with seizure disorders and those with more frequent seizures. Larger port-wine stains were also associated with an increase in mood and social problems but only for older children. The data also indicated that, as children with SWS age, they are increasingly at risk for mood and social problems. The data, surprisingly, did not indicate that they are at risk for cognitive deterioration.

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MALINGERING AND FORENSIC NEUROPSYCHOLOGY

J. REXER, M. HISCOCK, & J. CAROSELLI. Evaluating a New Method for Detecting Malingering.

Richert et al. described a novel method for detecting dishonest test performance. A stimulus appears on a computer screen too rapidly to be recognized and the participant indicates whether that stimulus or a confusable stimulus was seen (e.g., 'O' vs. 'Q'). The computer is programmed to reinforce 1 choice (e.g., 'Q') arbitrarily on a proportion of trials that varies across blocks of trials. Honest performers adjust their responses so as to maximize positive feedback, but simulators disregard the feedback. The total number of reinforced responses discriminated groups with sensitivity of .87 and specificity of .96. In the first of 2 additional experiments, we applied the same procedure to 32 university students who were assigned randomly to honestly performing and feigning conditions. The stimulus was presented for 30 ms with backward masking to ensure that it could not be recognized reliably. The cutoff score used by Richert et al. differentiated the two groups with sensitivity of 1.00 and specificity of .81. The purpose of Experiment 2 was to determine how participants would respond to incongruity between their perception of the stimuli and the responses for which they were reinforced. Three stimulus durations (30, 60, and 90 ms) were used with 48 honestly performing and 48 feigning students. The results indicate that the conflict generated by longer exposure durations (60 and 90 ms) did not diminish the feigning of deficits but did seem to confound honest performers and thus decrease the specificity of classification. Consequently, the procedure is most effective when the stimulus is difficult or impossible to identify.

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W.D.S. KILLGORE & L. DELLAPIETRA. Detecting Malingering with the WMS-III: A Revision of the Rarely Missed Index (RMI).

In a previous report (1999), we presented preliminary data on a new technique for detecting malingering, which we called the Rarely Missed Index

(RMI). The RMI was derived by evaluating the pattern of responses to infrequently missed items of the Logical Memory Delayed Recognition (LMDR) subtest of the WMS-III. We presently report a modified version of the procedure applied to a larger sample of subjects that has yielded improved sensitivity and specificity to simulated poor performance. First, we evaluated item response biases to the LMDR items in a sample of 50 healthy volunteers who were completely naïve to the content of the Logical Memory stories. According to the binomial distribution, six LMDR items were endorsed correctly above chance probabilities. These six rarely missed items were then entered as predictors in a discriminant function analysis to distinguish 51 neurological patients from 36 volunteers who attempted to feign head injury and poor cognitive performance. A weighted combination of the six items was summed to form a single Rarely Missed Index (RMI). The RMI accurately classified over 98% of participants and demonstrated high sensitivity (97%) and specificity (100%) in discriminating between analog malingerers and true neurological patients, and these rates were maintained when cross-validated using the Jackknife procedure. Because the RMI is calculated directly from the LMDR items, it has the advantage of requiring no additional administration time or materials, and thus may serve as a quick screen for dissimulation that can be obtained without additional testing.

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E.B. DRAKE, C.A. SMITH, & W.G. VAN GORP. Use of Selected WAIS-III Performance Scores in the Detection of Insufficient Effort.

Detection of insufficient effort in medical-legal evaluations continues to be a problematic issue for neuropsychologists. Prior research has suggested that visual spatial measures may be more difficult for individuals to successfully mangle owing to their lack of familiarity with the task demands. Given this, we investigated the utility of selected WAIS-III Performance subtests and the Perceptual Organization Index to detect insufficient effort in individuals referred for neuropsychological evaluations in a medical-legal context. Thirty-five individuals with mild to severe traumatic brain injury and/or neuropsychiatric complaints were classified as honest or probable malingerers based upon previously published objective criteria for classifying probable malingering. Independent sample *t* tests revealed significant differences between groups on Perceptual Organization Index, Picture Completion, Block Design, Matrix Reasoning, and Picture Arrangement. A discriminant function analysis using these variables correctly classified 84.2% of honest responders and 68.8% of suspect responders, with an overall classification rate of 77.1%. Cross validation of the results, in which each case was independently classified based on the functions derived from the other cases, yielded a correct classification rate of 73.7% for honest responders and 62.5% for suspect responders. These results, though preliminary, suggest that these WAIS-III subtests and the Perceptual Organization Index may be useful for assessing motivation in individuals evaluated in a medical-legal context.

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S. OREY & D.T.R. BERRY. The Effect of Monetary Incentive on Successful Feigning in Analog Malingering Studies.

The detection of malingered neuropsychological deficits has been of increasing interest over the past decade. Unfortunately, because real-world malingerers rarely confess, most of the available work has relied on simulation studies in which volunteers are asked to feign deficits. This dependence on analog designs suggests that methodological issues may be of great importance in determining the internal and external validity of results. One factor that has been suggested to be important in analog malingering studies is the provision of a significant incentive for successful feigning in order to parallel the circumstances facing real world malingerers. In the present study, 32 mildly head-injured college students were divided into two groups of analog malingerers who were asked to feign deficits secondary to a head injury on a battery of standard neuropsychological and malingering tests. Participants in 1 group were told that each malin-

gerer who was able to feign successfully by presenting deficits but escaping detection, would win a \$25 prize. The other group was not provided this incentive. Results showed that the group provided the incentive scored significantly lower on certain standard neuropsychological tests, but there were no significant differences on malingering tests. This suggests that the presence of an incentive may result in the presentation of more realistic deficits (e.g., impaired standard neuropsychological test scores but unremarkable malingering test scores).

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A. LANE, S. TOMASZEWSKI, D. COREY, & F.W. BLACK. Memory Test Performance Patterns Support the TOMM as a Measure of Dissimulation.

While initial studies indicate that the Test of Memory Malingering (TOMM) is highly sensitive and specific in detecting dissimulation, a recent study suggested an association between memory functioning and performance on the TOMM, suggesting the need for additional research. The purpose of this study was to determine if malingerers and nonmalingerers differed in their pattern of performance across memory measures as compared to TOMM performance. Participants ($N = 123$) grouped by etiology, CHI or toxic exposure (TE), were divided into groups according to TOMM performance: "nonmalingering" (CHI: $n = 69$; TE: $n = 23$) or "malingering" (CHI: $n = 21$; TE: $n = 10$). TOMM scores, converted to *z* scores using the normative mean of 49.9 (.4), were compared to composite scores of selected memory measures: Wechsler Memory Scale-III (WMS-III) and Rey Auditory Verbal Learning Test (RAVLT). Mixed ANOVAs, used to compare performance on the TOMM to the WMS-III and RAVLT separately, clearly documented the differences between malingerers and nonmalingerers, regardless of neurologic etiology. The nonmalingering groups' mean scores ranged from $z = -.34$ to -3.97 on the WMS-III and RAVLT as compared to the malingering groups' mean scores of $z = -1.98$ to -3.46 . However, the nonmalingering groups' average scores on the TOMM were $z = -1.5$ (or 49/50) as compared to the malingering groups' average scores of $z = -.39$ (or 34/50). The malingerers demonstrated an opposite pattern of performance as compared to nonmalingerers, showing significantly poor performance on more difficult memory measures as compared to the TOMM. This distinction provides clear evidence that memory impairments cannot solely account for poor performance on the TOMM.

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J. ANDRIKOPOULOS. Malingered Cognitive Dysfunction, MMPI-2 Elevations and Postconcussive Symptoms.

This study examined the interrelationship between feigned cognitive deficits, the MMPI-2, and the reporting of post-concussive symptoms (PCS) in mild head injured litigants. Four consecutively examined patient groups were formed. The Mild Head Injury Group (MHIG, $N = 117$) consisted of mild head injured litigants separated into a low motivation group (LMG, $n = 65$) and high motivation group (HMG, $n = 52$). The LMG had impairment equal to or worse than a moderate to severe head injury group (CHIG, $n = 47$) not in litigation. The average number PCS reported by the MHIG was 17.42. Patients with greater than 17 symptoms were placed in the high symptom group (HSG, $n = 58$) and those with 17 PCS or less in the low symptom group (LSG, $n = 56$). The psychiatric control group (PCG, $n = 46$) was referred for self-reported memory complaints, were examined by a neurologist, and had a CT or MRI of the brain. A chi-square analysis revealed a greater number of patients in the HSG fell into the LMG ($p = .005$) and had significantly greater elevations on the MMPI-2 suggesting the exaggeration of symptoms. Alternatively, a greater number of patients in the HMG fell into the LSG. A conservative estimate of malingered cognitive dysfunction was 30%. The LMG had clinically and statistically significant greater elevations on the Hs, D, Hy, Pt and Sc clinical scales compared to the CHIG; exceeded the HMG on the Hs, D and Sc scales and

exceeded the PCG on Hs and Hy. There were no differences between the HMG and PCG on the MMPI-2.

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C. DEARTH, C. VICKERY, D.T.R. BERRY, T. VAGNINI, D. CRAGAR, & S. OREY. Detection of Malingered Head Injury With the MMPI-2.

The MMPI-2 is commonly included in neuropsychological assessments to provide information on the emotional and behavioral sequelae of head injury. In addition, information from the MMPI-2 validity indices is often considered when deciding whether persons are performing their best on the assessment. However, it is unclear at this point whether the MMPI-2 validity indices are sensitive to malingered head injury symptoms. The present analogue study examined this issue by administering the MMPI-2 to participants with moderate head injury (LOC \geq 1 hr) and neurologically intact community volunteers within the context of a larger neuropsychological assessment battery. Twenty head-injured participants (HIM) and 20 community volunteers (CVM) received symptom coaching and instructions to feign or exaggerate head injury symptoms throughout the assessment, while 20 head-injured participants (HIS) and 20 community volunteers (CVS) received standard instructions. Performance on the MMPI-2 was compared for the four groups. No significant interaction effects of instruction set and head injury status were found for the validity or clinical indices. Significant main effects were found for instruction set, with participants receiving instructions to feign or exaggerate head injury generating higher elevations on F, DS-2, and FBS than the participants receiving standard instructions. Significant main effects of instruction set were also demonstrated for several clinical indices. Information from the MMPI-2 may assist in identifying neurologically intact persons feigning head injury and persons exaggerating current head injury symptoms within the context of a neuropsychological assessment.

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C. VICKERY, C. DEARTH, D.T.R. BERRY, T. VAGNINI, D. CRAGAR, & S. OREY. Does the Experience of Head Injury Improve the Ability to Malinge Successfully on Neuropsychological Tests?

We investigated whether analogue malingerers who have experienced a significant head injury (greater than one hour loss of consciousness) are better able to feign deficits on neuropsychological testing than non-head injured individuals, hypothesizing that the experience of head injury might aid successful malingering by producing more realistic patterns of feigned deficits. We used a 2×2 factorial design with Head Injury Status (HI vs. No HI) and Instructional Set (malingering vs. standard instructions) as the factors. Forty head injured and forty non-head-injured participants were administered a battery composed of standard neuropsychological tasks and tests of motivation and effort (PDRT, DMT, TOMM, LMT). No interaction of factors was found on the standard neuropsychological tests, although both main factors were significant with poorer performance in the head injured conditions and the analogue malingering conditions. On the malingering tests, no significant interaction was found, and a main effect was found only for Instructional Set, with analogue malingerers performing more poorly than control participants. Specificities for the malingering tests were uniformly high (94–100%), while sensitivities ranged from poor (12.5%, PDRT) to very good (87.5%, LMT). The detection rates for head injured and non-head injured analogue malingerers were very similar on all of the malingering tests. Overall these results suggest that the experience of head injury does not aid the head injured analogue malingerer in producing a more realistic pattern of feigned deficits on either neuropsychological tests or tests of motivation and effort.

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A. PALAV, K. DUFF, S. O'BRYANT, M. WEBER, & R.J. McCAF-FREY. Identifying Symptom Exaggeration/Dissimulation With the WAIS-R.

Recent interest in the identification of symptom exaggeration has resulted in the development of a number of measures which purport to assess pos-

sible malingering. The present study compared the WAIS-R IQ and subtest scores of individuals suspected of symptom exaggeration and those of individuals not suspected of symptom exaggeration. Twenty-nine clinical neuropsychological examinees were divided into two groups based on performance on two measures designed to assess dissimulation (Test of Memory Malingering (TOMM) and Rey 15-Item Test): suspected of symptom exaggeration (TOMM Trial 2 score $<$ 45 or REY \leq 9) and not suspected of symptoms exaggeration (TOMM Trial 2 score \geq 45 and REY $>$ 9). These groups were compared on 14 WAIS-R variables using chi-square analyses. Results indicate that examinees suspected of malingering performed significantly worse than those not suspected of malingering on 8 of the 14 variables, with the majority of the suspected malingerers falling more than 2 standard deviations from the mean. Sensitivity and specificity for these 8 variables ranged from .36–.77 and .71–1.0, respectively. Although replication of these results with the WAIS-III is necessary, these results indicate that performance patterns on intelligence tests may be helpful in detecting possible symptom exaggeration when used in conjunction with tests of possible malingering.

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S. O'BRYANT, A. PALAV, K. DUFF, M. WEBER, & R.J. McCAF-FREY. Performance of Dissimulators on the Memory Assessment Scales.

As the role of the neuropsychologist in the courtroom has grown, there has been an increased effort in the detection of possible symptom exaggeration/malingering in neuropsychological testing. The Memory Assessment Scales (MAS) are commonly used in neuropsychological evaluations while Test of Memory Malingering (TOMM) and REY 15-Item test are often utilized as tests of symptom validity. The purpose of this study was to compare MAS scores of subjects suspected of symptom exaggeration (Group 1 = TOMM Trial 2 score $<$ 45 or REY score \leq 9) to those not suspected of symptom exaggeration (Group 2 = TOMM Trial 2 score \geq 45 and REY $>$ 9). Archival data on 38 litigants from an outpatient practice setting were utilized. The mean MAS scores of the four summary scores and 12 subtest scale scores of the two groups were analyzed relative to the statistical norms (Summary Scores: $M = 100$, $SD = 15$ and Subtest Scale Scores: $M = 10$, $SD = 3$). Multiple, Bonferroni-corrected t tests were computed. All sixteen of the MAS variables of Group 1 were statistically significantly lower than the statistical norms. In contrast, the pattern of performance of Group 2 revealed that only one of the four summary scores and 3 of the 12 subtest scores were significantly below the statistical norms. The results of this study indicate that the performance patterns on the MAS, when used in conjunction with other tests, may prove useful in detecting possible symptom exaggeration.

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P.D. NEWMAN, N. FICHTENBERG, B. KAUDER, & R. HANKS. Generalizability of the Wechsler Malingering Detection Principle.

The detection of malingering or incomplete effort on the Wechsler adult scales (WAIS-R and WMS-R) has been successfully replicated using a malingering index, both with simulated malingerers and clinical patients with financial incentive. Analysis of these studies suggests that their success derives from the misconception that tasks of immediate attention span are more affected by traumatic brain injury (TBI) than empirical data reveal. If so, generalization of these findings to other memory scales should be possible so long as they include a measure of immediate attention span. This paper reports on an example of this generalization, using the Memory Assessment Scale (MAS) and creating a General Memory-Short Term Memory difference score (from age corrected scaled scores). One group consists of 43 patients with equivocal TBI (all had GCS of 15 and negative CT/MRI results) and financial incentive (either personal injury or workman's compensation), and the other group, of 43 patients with moderate to severe TBI (M GCS = 6.7, $SD = 2.9$) and no financial incentive (no liti-

gation). The results reveal a negative mean score ($M = 12.02$) for the TBI group without financial incentive (short term memory > general memory) and a positive mean score ($M = 6.35$) for the equivocal TBI group with financial incentive (short term memory < general memory). The effect size for this statistically significant ($p < .001$) difference was a large 1.23. A discriminant analysis using the difference score alone correctly classified over 70% of the sample. It appears that the basis for certain malingering indices involves examinee misconceptions regarding the effect of TBI on basic attention.

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K. DUFF, A. PALAV, S. O'BRYANT, M. WEBER, & R.J. McCAF-FREY. Utilizing Neuropsychological Deficit Scores to Identify Possible Malingering.

Numerous measures have recently been developed to identify individuals who may be exaggerating neuropsychological deficits. Adding these measures to an already lengthy fixed battery, however, may be unnecessary if measures within the fixed battery already identify possible malingerers. The present study assessed the ability of measures within the Halstead Reitan Neuropsychological Battery (HRNB) to identify individuals suspected of malingering. Thirty clinical neuropsychological cases were divided into two groups (suspected of malingering, not suspected of malingering) based on two "malingering tests" (Test of Memory Malingering, Rey 15-Item Test). Comparisons were made between the two groups on 19 HRNB Neuropsychological Deficit Scale scores (NDS). Chi-square comparisons indicate that individuals suspected of malingering performed significantly below those not suspected of malingering on 8 of the 19 HRNB NDS, with the majority of the suspected malingerers falling in the severely impaired range (NDS = 3). Optimal hit rates for these 8 NDS (77–93%) lead to sensitivity and specificity values which ranged from 64–91 and 68–100, respectively.

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K. DUFF, A. PALAV, S. O'BRYANT, & R.J. McCAFFREY. Memory Assessment Scales: Assessing Malingering Too?

In this age of limited time and resources, neuropsychological measures that can perform "double duty" (i.e., tap more than 1 domain) are increasingly valuable. The present study investigated the ability of a memory test, Memory Assessment Scales (MAS), to also assess for the exaggeration of deficits. Twenty-seven clinical neuropsychological cases were divided into 2 groups (suspected of malingering, not suspected of malingering) based on a "malingering test" (Test of Memory Malingering) and comparisons were made between the two groups on the 15 indices of the MAS. Chi-square comparisons indicate that individuals suspected of malingering performed significantly below those not suspected of malingering on 14 of the 15 MAS indices, with the majority of the suspected malingerers falling three or more standard deviations below the population means. Based on the optimal hit rates for these 14 MAS indices (85%–92%), sensitivity and specificity values ranged from 40–100 and 71–100, respectively. Although the findings are preliminary, the MAS appears to assist clinicians in identifying individuals who are exaggerating deficits.

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C. GROTE, E. KOOKER, D. GARRON, D. NYENHUIS, C. SMITH, & M. MATTINGLY. Cross-Validation of and Alternative Cut Scores for the Victoria Symptom Validity Test.

Previous research suggests that the Victoria Symptom Validity Test (VSVT) is effective in confirming or disconfirming the validity of a patient's reported cognitive impairments. We sought to cross-validate the findings of the VSVT standardization study, and to determine cut-off scores that are most efficient in discriminating our samples of compensation-seeking patients, primarily with mild traumatic brain injury (CS; $n = 53$), and non-compensation-seeking patients with intractable seizures (NCS; $n = 30$). The VSVT is a test of forced choice recognition wherein the difficulty of items appears to vary. The outcome measures are memory and response

latency scores for both "easy" and "difficult" items. The test manual suggests that a preliminary interpretation of "valid" be considered when difficult memory scores are significantly above chance, using binomial probability theory. We found this criterion to be overly lenient, and instead propose that the "90% correct" rule, as proposed in other research, be used as a way of detecting insufficient effort. In our study, 93.3% of the NCS patients correctly answered at least 90% of the difficult memory items, compared to only 35.8% of the CS patients. The response latencies of the CS group were significantly longer than those of the NCS group, but this variable was not independent of the memory scores. In conclusion, this study confirms previous research that non-compensation-seeking patients with documented brain injury or disease do well on the VSVT, but that many compensation seeking patients perform poorly on this measure.

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M. JOHNSON, H. BUCHTEL, N. GORDON, & K. ADAMS. Experience with Brain Injury and Feigning Impairment on the Rey 15-Item Test.

Numerous studies have assessed normal individuals' ability to mimic neuropsychological impairments. Several demographic factors influence this ability, and presumably these factors similarly affect malingerers. This study examines how one factor, experience with Traumatic Brain Injury (TBI), influences the performance of students simulating TBI status. *Participants:* Ninety-seven college undergraduates volunteered participation. *Measure:* The Rey 15-Item Visual Memory Test (RVMT) served as the malingering measure. It consists of 15 common numbers, letters, and shapes which can easily be grouped to promote retention. However, participants are told they have only 10 s to memorize all 15 items so as to deceptively make the test seem difficult. *Procedure:* Participants were first instructed to perform like someone with moderate TBI. The RVMT was then administered using overhead projection. Lastly, they were asked for demographic information and their simulation strategies. *Results:* Participants were divided into high experience and low experience with TBI. The high experience group provided more correct RVMT items ($M = 13.48$, $SD = 2.46$ vs. $M = 11.52$, $SD = 3.37$; $t = 2.87$; $p = .006$) and more correct sets ($M = 4.10$, $SD = 1.45$ vs. $M = 3.29$, $SD = 1.65$; $t = 2.14$; $p = .039$), while omitting fewer items. Qualitatively, both groups altered the order of otherwise correct items. *Discussion:* Less experienced individuals exaggerated the deficits of patients with moderate TBI, suggesting that lay individuals may overestimate cognitive disturbances associated with TBI. This finding has great ramifications, considering the importance of social reintegration in the rehabilitation process. In terms of malingering detection, results indicate a need to account for the sophistication of examinees with respect to the referral issue when interpreting objective performance.

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J. SUHR, J. GUNSTAD, & J. BARRASH. Exaggeration Index for an Extended Version of the AVLTL: Robustness to Coaching.

Recently, an Exaggeration Index (EI) was developed for an extended version of the AVLTL. EI is based on the premise that malingerers have misconceptions about memory that manifest in performance, and malingerers who omit recall/recognition of words will not be able to keep track of "remembered" versus "not remembered" words over multiple delays. EI was developed and cross-validated in clinical samples (patients identified *a priori* as probable malingerers, brain damaged patients, and psychiatric patients). However, the version of AVLTL was not standard (no List B, no immediate recall of List A). Further, although it is assumed that EI is robust to sophisticated malingering, this has not been empirically tested. We evaluated the effectiveness of EI using standard AVLTL (with addition of 60-min delayed recall/recognition), and the effect of coaching on EI. Participants were 34 undergraduates asked to give their best effort, 36 undergraduates asked to simulate head injury (naïve), and 30 undergraduates asked to simulate head injury but warned that malingering detection may occur during the 2-hr neuropsychological evaluation (warned). Scores of greater than zero on EI correctly identified 39% of naïve and 57% of warned

malingers, with a false positive rate of 15%. Using a cut-off of 3 or greater, sensitivity to malingering was 19% in naive and 27% in warned malingers, with 100% specificity. Results show EI is valid for use with standard AVLT administration, adding only 60-min delayed recall/recognition, and EI is robust to general warnings about malingering detection.

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J. GUNSTAD & J. SUHR. The Suppression of Poor Performance in Coached Malingers: Threats to Detection.

In recent years, increased attention has been given to the role coaching may play in the detection of individuals who mangle on neuropsychological tests. A growing number of studies suggest that individuals may better escape detection when warned about detection attempts than those without such a warning. This possibility was examined in three patient groups referred for full neuropsychological evaluation (head injury, seizure patients prior to operation, and neurological conditions) and two groups asked to simulate head injury on a brief neuropsychological battery (AVLT, PDRT, TMT). Participants in the simulation groups randomly received either basic information about head injury sequelae or head injury information plus a non-specific warning about malingering detection. The warning did not provide information about the nature of malingering detection devices and did not instruct participants how to avoid detection. Results on the Portland Digit Recognition Test (PDRT) show simulators without a warning about malingering detection performed worse than all patient groups on the 5-s ($F = 8.61, p < .001$), 15-s ($F = 6.77, p < .001$), 30-s items ($F = 6.23, p < .001$), and on total PDRT performance ($F = 9.42, p < .001$). Warned simulators were not significantly different from patient groups on any PDRT performance index. These findings suggest that individuals aware of the possibility of malingering detection attempts during evaluation may suppress the tendency to do devastatingly poorly and may better escape detection on the PDRT.

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K. MCCOY, D. DEDE, J. ESQUERRE, J. MUSICK, R. DAVIS, & M. BEIN. Neuropsychological Deficits in Incompetent and "Competency-Restored" Defendants.

Legal criteria defining competency to stand trial do not clearly delineate the necessary cognitive abilities. Researchers have hypothesized that competent defendants must possess adequate attentional, verbal/language, memory, and executive functioning skills to contribute meaningfully to their defense, however, there is limited research on this population. We evaluated 53 males (average age = 35) adjudicated incompetent to proceed and hospitalized in a forensic psychiatric facility. Average education = 10th grade; 57% African American and 43% White. All had psychiatric diagnoses; 72% psychotic disorders (Brief Psychiatric Rating Scale = 19.5). Mean length of stay at time of evaluation was 226 days. Evaluations conducted by forensic psychiatrists and psychologists revealed that 27 had competency restored at the time of cognitive assessment. Incompetent and "competency-restored" defendants differed on length of stay (342 days and 108 days respectively). The neurocognitive battery included measures of intellectual functioning (Wechsler Adult Intelligence Scale-Revised), attention (Trail Making Test A; Auditory Consonant Trigrams), verbal skills (Wide Range Achievement Test-III reading; Verbal Fluency), memory (Wechsler Memory Scale-Revised), and executive functioning (Trail Making Test B). Defendants who remained incompetent demonstrated significantly poorer performance in all domains when compared with "competency-restored" individuals. Relative to normative data, the entire sample performed significantly worse on all measures. Results suggest that defendants who remain incompetent after several months of treatment have greater deficits in cognitive functioning than defendants who attain competency within the same time period. Neuropsychological assessment may clarify diagnosis and be helpful in predicting restorability.

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C.A. SMITH, W.G. VAN GORP, & E.B. DRAKE. Evaluating Effort in Psychological Assessment: CART Modeling as an Alternative to Cut-Scores.

Specific indices (Total Recall, Long Delayed Cued Recall, Recognition, and Discriminability) on the California Verbal Learning Test (CVLT) have been shown to detect poor motivation among persons with mild head injury. No study has yet determined if these indices are appropriate for use in detecting poor effort in non-head-injury evaluations. With this, we sought to extend the research on the CVLT indices to a broad array of medical/legal neuropsychiatric referrals by evaluating the classification rates established with the published cut-offs. In addition, we sought to compare these rates to the classification rate established by a decision tree generated by simultaneously establishing the optimal classification cut-offs (CART modeling). Forty-three individuals who were referred in a medical/legal context with neuropsychiatric dysfunction as their primary complaint were identified. Individuals were classified as honest/suspect responders based upon previously published objective criteria for classifying probable malingering. Results indicated that established cut-offs resulted in an 80% classification rate for the honest responders and a 50% rate for the suspect responders. In contrast, a 4-step decision tree using the same four CVLT indices resulted in an 88% classification rate for honest responders and an 84% classification rate for suspect responders. These results suggest that a multilevel decision tree contributes to a significant improvement in classification rates as compared to the use of single cut-off scores. These results are preliminary, and additional cross-validation is needed to confirm the use of multilevel decision trees in the assessment of motivation in psychiatric evaluations.

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H. STOTT, S. GONTKOVSKY, J. SCOTT, & W. BEATTY. Effect of TBI Severity and Litigation on Family Ratings of Patient Deficits.

Research has demonstrated the implications of litigation status and head injury severity on MMPI-2 scores, such that litigation produces significant elevations on Scales 1 and 3 unlike TBI severity which produces an inverse suppression on Scales 2 and 3. However, research has also suggested that impaired awareness of deficits following TBI may serve to minimize subjective patient reports of both cognitive and physical functioning. The present study examined the relationship between TBI severity and litigation status on family member ratings of patient deficits on the Cognitive Behavior Rating Scales. Participants were 98 patients with confirmed traumatic brain injury referred for neuropsychological evaluation. Participants were initially grouped according to head injury severity (i.e., mild or moderate/severe) as determined by established criteria, including Glasgow Coma Scale scores, duration of loss of consciousness, and extent of posttraumatic amnesia. Groups were subsequently divided according to litigation status. Findings revealed a significant main effect for litigation status ($p < 0.05$) on CBRS scales measuring agitation, depression, dementia, apraxia, higher cognitive disorder, and disorientation, but no significant differences were found for need for routine or language disorder. There were no differences among the mild or moderate/severe groups family ratings of functioning on the CBRS. These findings indicate a significant influence of litigation on family members ratings of patient's functioning, but suggest that family ratings are insensitive to TBI severity.

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A. LANSING. Receptive and Expressive Vocabulary Performance in a High-Risk Youth Population.

Juvenile delinquents are at substantial risk for cognitive deficits and studies often find specific verbal impairments. However, these findings are typically based on Verbal IQ subtests rather than the assessment of underlying language skills (e.g., receptive and expressive language) essential for intact verbal performance. This omission is critical: Better information about language skills is needed to develop interventions tailored to the communication level of delinquents. One thousand, six hundred and one detained delinquents were administered the Peabody Picture Vocabulary

Test-Revised (PPVT-R) and the Wide Range Achievement Test, 3rd Edition (WRAT-III) Reading subtest. The PPVT-R assesses single word *comprehension* without requiring verbal production of a definition. The WRAT-III assesses single word *pronunciation* rather than ability to define words. The contribution of key demographic (e.g., race, gender) and sociodemographic variables (e.g., criminality) to PPVT-R/WRAT-III performance were examined using least squares regression analysis. (1) Detainees were significantly impaired on receptive vocabulary (Standard Score $M = 69$, $SE = .68$), falling 2 standard deviations below the PPVT-R standardization mean; (2) African American and Latino youth demonstrated the greatest need for services targeting receptive language deficits; (3) Latino females had significantly higher PPVT-R scores than Latino males; (4) detainees reporting truancy, drug use and nonviolent criminal activity performed *better* on the PPVT-R than did youth not reporting these activities; and the (5) WRAT-III Reading scores fell in the borderline to low average ranges, without significant group differences. Results suggest that comprehensive language assessments of delinquent youth are essential and public policy implications are addressed.

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M.F. GREIFFENSTEIN, W.J. BAKER, & T. GOLLA. Epidemiology of Invalid Performances in a Large Postconcussion Syndrome Sample.

The prevalence of poor motivation or malingering in persistent postconcussive claimants is a controversial, unsettled topic. The objective of this study was frequency estimation of three types of exaggerated impairment (memory, motor and psychiatric) in a sample of 252 compensation seeking, neurologically normal chronic PCS patients. We examined prevalence under two different rules: Definite invalid scores (performance more than 1 *SD* below a severe CHI prototype group, $N = 66$) and probable (scores below the CHI mean). Resulting percentages are expressed in the following order: Definite rule then probable rule. Invalid memory scores (using the Rey Word Recognition list) were found in 36% and 63.2% of PCS claimants. Suspiciously poor motor scores (grip strength) were seen in 36.2% and 63%. Psychiatric symptom magnification (MMPI F scale) was definitely present only 14.8%, probably 48%. Analysis of joint occurrence patterns showed that 63% and 92% showed invalid performance on *at least one* measure. Global invalid performance (poor on all measures) was seen in 15.1% and 22.2%. The modal pattern was poor "motor with any other sign", with rates of 14.6 and 24.2%. We tested Miller's contention that invalid presentations correlate inversely with injury severity. Results showed a significant trend of increasing invalid performance from moderate closed head injury to whiplash, consistent with Miller's hypothesis. The authors conclude that the frequency of at least one form of exaggerated deficit is present in a strong majority of persistent PCS claimants, even under the most stringent of decision rules.

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HIV

K. WALTON, E. RYAN, W.G. VAN GORP, S. FERRANDO, J. RABKIN, E. HAINEN, & S. FINKLEBERG WHITE. Clinical Markers of HIV Disease Progression and Their Relationship to Psychomotor Functioning.

Increased viral load, a powerful marker of HIV-1 disease progression, may be a better clinical predictor of neuropsychological functioning than other indices. However, most studies have not found a relationship between neuropsychological impairment and higher peripheral viral load. The present study investigated the relationship between psychomotor functioning, a hallmark of HIV-related NP impairment, and clinical markers of disease severity: CDC stage, antiretroviral regimen potency (HAART vs. non-HAART), physical symptoms, CD4, and peripheral viral load. Neuropsychological tests, assessing the specific domain of psychomotor speed, were administered to 29 HIV-seropositive individuals (21 males and 8 females). Mean age was 38.6 ($SD = 5.4$). Sixty-two percent of participants had a

detectable viral load, 79% were on HAART, 72% were CDC stage C (AIDS indicator conditions) and none of the participants were asymptomatic. Peripheral viral load was significantly associated with tasks of psychomotor functioning (R 's ranged from .38–.48, $p < .05$), whereas other clinical markers were not. In comparison to other clinical disease markers, peripheral viral load was a fairly robust predictor of psychomotor functioning. Correspondence: Kimberly Walton, 525 East 86th Street, Box 147, New York, NY 10021.

V. HONN & R.A. BORNSTEIN. Performance of HIV-Infected Individuals on the Wechsler Memory Scale-III.

A significant proportion of HIV-positive individuals demonstrate cognitive impairment which, typically, is subcortical in nature. The present study used the Wechsler Memory Scale-III (WMS-III) to examine memory in two HIV-positive groups, medically asymptomatic participants ($N = 21$) and those with AIDS ($N = 48$). The two groups did not differ on age, education, gender or racial composition, viral load, or use of AIDS medications including highly active antiretroviral therapies. AIDS patients had lower average CD4 counts than asymptomatics (372 and 675, respectively). A 2×6 repeated measures ANOVA compared performance of the two groups across WMS-III index scores. There was a significant main effect for index, but no group main effect or interaction. Pairwise comparisons indicated that participants' lowest scores were on visual immediate and visual delayed indices and highest scores were on auditory immediate, auditory delayed and auditory recognition delayed indices. Working memory scores were between the visual and auditory index scores. According to WMS-III normative data, all mean index and subtest scores were in the average range. On learning slope, retention, and retrieval scores, the groups were equal and performed in the average range. In summary, patients with HIV infection, as a group, do not demonstrate significant memory impairment on the WMS-III. They appear to have relative deficits in memory for visually presented information as compared to information presented aurally, but do not show a subcortical pattern of impairment on this test. Patients in more advanced stages of illness perform equivalently on the WMS-III to those without overt symptoms.

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T. HARRIS, E.M. MARTIN, R. REED, V. CARSON, & M. PRIME-AU. Prospective Memory in HIV-Seropositive Women.

Prospective memory (PM), generally defined as *memory for the intention to perform a future action*, is considered to be heavily dependent on the integrity of prefrontal-subcortical and possibly hippocampal systems. Models of PM distinguish "time-based" from "event-based" PM systems on the basis of component mental operations and hypothesized underlying neural substrates. "Time-based" PM requires generating an internal strategy for future remembering and is considered particularly dependent on the integrity of prefrontal-subcortical systems. HIV has an affinity for prefrontal-subcortical systems and hypothesized components of PM (e.g., working memory) are defective in HIV+ persons. We studied PM function in 20 HIV+ women without dementia or other neurologic disease and 20 HIV- high-risk controls. Groups were well matched on demographic and substance abuse variables. Subjects performed measures of time-based and event-based PM that were embedded as ongoing activities in a larger battery of neuropsychological (NP) tasks. We found that HIV+ women performed significantly more poorly on both PM measures compared to controls ($p \leq .02$ for time-based PM; $p \leq .0001$ for event-based PM), although subject groups did not differ globally across NP tasks. Within the HIV+ group, performance on the time-based (but not event-based) PM task correlated significantly with verbal working memory performance ($p \leq .01$) supporting the hypothesis that time-based PM is more strongly dependent on the integrity of prefrontal-subcortical systems. These initial data demonstrate clear defects in PM in HIV+ individuals that have implications for complex behaviors including adherence with regimens for antiretroviral therapy and possibly reduction of high-risk behavior.

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D. MOORE, R. GONZALEZ, R. HEATON, J. RIPPETH, M. CHERNER, I. GRANT, & THE HNRC GROUP. Cognitive Complaints, Neuropsychological Ability, and Depressive Symptoms in HIV. Recently published studies suggest that cognitive complaints in HIV-1 infection are related to both depressive symptoms and to a lesser degree neuropsychological (NP) ability. The objective of the current study was to test this cross-sectional finding in our sample and to examine the factors that lead to changes in cognitive complaints over time. *Method:* We examined 258 HIV+ individuals who completed a comprehensive NP battery, the Beck Depression Inventory (BDI), and the Patient's Assessment of Own Functioning Inventory (PAOFI). Ninety-one (35%) were classified as NP impaired based on blind clinical ratings of demographically corrected *T* scores. Eighty-two (32%) had an AIDS diagnosis. *Results:* Individuals with AIDS were similar with regard to NP status, average BDI score, and average number of cognitive complaints when compared to HIV+ individuals who did not have an AIDS diagnosis. As previous research has suggested, BDI scores were significant predictors of cognitive complaints. AIDS diagnosis and NP status were not significant predictors of cognitive complaints when depressive symptoms were included in the model. Furthermore, no specific NP abilities aided in the prediction of cognitive complaints after controlling for depression. To determine whether this pattern of results continued over time, we examined the change in depressive symptoms, NP status, and cognitive complaints from one testing to the next. Longitudinally, BDI continued to be the only significant predictor of cognitive complaints. *Discussion:* It appears that depressive symptoms are the best predictor of cognitive complaints cross-sectionally and longitudinally. Correspondence: David J. Moore, HIV Neurobehavioral Research Center, 150 W. Washington Street, 2nd Floor, San Diego, CA 92103.

J.M. RACENSTEIN, E.M. MARTIN, R. REED, V. CARSON, K. STALEY, & M. COHEN. Cognitive Reserve and Neuropsychological Performance of HIV-Seropositive Women.

Recent literature within the dementia population suggests support for the hypothesized protective effects of cognitive reserve. Few studies have investigated the effects of brain reserve capacity as it applies to the neuropsychological functioning of HIV+ individuals. Even fewer studies have examined its influence on the neurobehavioral performance of HIV+ women. Recent findings within the dementia literature suggests that women with lower brain reserve capacity may be more susceptible to cognitive decline than cohort-matched males. In the current study we examined the influence of cognitive reserve, using an estimated premorbid verbal IQ, on the neuropsychological performance of 76 HIV+ women who use drugs and 24 HIV- women who were well matched for age, education, and substance abuse history. The incidence of abnormal protocols was significantly greater among the HIV+ women with lower cognitive reserve in comparison to the HIV+ women with high cognitive reserve ($p < .05$). Among the HIV- women the incidence of abnormal scores did not differ as a function of brain reserve capacity. Thus, the data demonstrates that greater neuropsychological impairment is associated with lower brain reserve capacity in HIV+ individuals. In addition, the present data support the construct of cognitive reserve, and its possible role in protecting against the neurobehavioral impairment associated with HIV- infection.

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H.E. McNEELY, B.K. CHRISTENSEN, K.R. CAVE, M.L. KLASWICK, & R.R. HENRY. Cognitive Processes Underlying Trails B Performance Among Persons With HIV-1.

Individuals infected with the type 1 human immunodeficiency virus (HIV-1) are often impaired on Trails B, a test of executive function. However, this test involves several cognitive operations, including working memory, motor skills, and visual search; thus, poor performance indicates little about the specific cognitive operations impaired in HIV-1. The present study assessed the cognitive processes underlying Trails B performance at different stages of HIV-1 infection. Non-infected controls ($n = 19$), asymptomatic HIV+ ($n = 24$) and symptomatic HIV+ ($n = 29$) individuals completed

Trails B and three tests designed to separately assess working memory, motor skills and visual search. For the sample as a whole, these three tests accounted for 51% of the variance in Trails B performance. Moreover, each test accounted for a unique and significant proportion of variance. When patterns among predictors were examined as a function of disease stage, asymptomatic HIV+ individuals differed little from controls. For these two groups, working memory accounted for the majority of variance in Trails B; motor skills and visual search added similar, though relatively less, predictive power. However, among symptomatic HIV+ individuals, working memory, while still the best predictor of Trails B, accounted for markedly less variance as compared to other groups. Moreover, working memory and motor skills were highly correlated in the symptomatic group, but uncorrelated in the asymptomatic or control groups. Our findings support the role of multiple cognitive processes in Trails B performance, and indicate that these processes are differentially involved depending on HIV-1 status.

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H. DAVIS, O. SELNES, A. ANDRADE, A. WU, C. HILL, A. LETZT, R. SEIFERT, D. KASEMAN, W. MYERS, J. LEFKOWITZ, & J.C. MCARTHUR. Reaction Time Assessment With the Disease Management Assistance System (DMAS).

Background: Psychomotor slowing is an early marker of neurocognitive impairment in HIV disease. Neuropsychological tests, such as the California Computerized Assessment Package (CalCap), are used to assess motor/psychomotor speed in HIV+ populations. Most measures require additional apparatus (i.e., computer, pegboard) to assess psychomotor speed. The DMAS is a portable, electronic device that serves several purposes: measures reaction time (RT), provides verbal prompts to take antiretrovirals (ARVs), and records the time/day when ARVs were taken. *Objective:* To test the accuracy and comparability of the DMAS RT and CalCap in assessing psychomotor slowing, and evaluate the reliability of daily measures of RT among HIV+ individuals. *Methods:* 19 HIV+ individuals were followed over 8 weeks. The DMAS RT task required patients to press a key as rapidly as possible when a light appeared. The CalCap was administered at baseline Week 4, and Week 8. *Results:* The DMAS results from Week 4 [$MDN = 568.00 MS \pm 242.24$, range = 277–1023] and the CalCap (Wk. 4) [$MDN = 450.00 MS \pm 110.68$, range = 358–768] were significantly correlated ($r = .46$, $p < .05$). The DMAS (Wk. 8) [$MDN = 527.67 MS \pm 366.58$, range = 260–1440] was significantly correlated with the CalCap (Wk. 8) [$MDN = 421.00 MS \pm 71.75$, range = 350–618] ($r = .47$, $p < .05$). The DMAS results from Weeks 4 and 8 were strongly correlated ($r = .87$, $p < .001$). *Conclusion:* The DMAS and the CalCap RT measures are comparable in assessing psychomotor slowing among HIV+ individuals. It is also capable of providing daily measures of performance, something infeasible with interval visits.

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J. RIPPETH, D. MOORE, R. GONZALEZ, L. DAWSON, T. MARCOTTE, R. HEATON, I. GRANT, & THE HNRC GROUP. Neuropsychological Effects of HIV Infection and Methamphetamine Dependence.

The present study investigated possible interactive effects of HIV infection and methamphetamine use on neuropsychological (NP) status. Four groups of subjects were examined: (1) HIV+/methamphetamine dependent (METH+); $N = 26$; (2) HIV-/METH+; $N = 20$; HIV+/METH-; $N = 14$; HIV-/METH-; $N = 15$. The METH+ groups met DSM-IV criteria for methamphetamine dependence within 18 months of the NP assessment, but were not currently using. Subjects were excluded for lifetime dependence on other substances (e.g., alcohol, marijuana, cocaine) or for other medical/neurological problems which affect NP status. Groups were similar for ethnicity (about 70% White), although they differed on age (HIV-/METH- significantly younger than HIV+/METH-), education (METH+ groups less educated than METH- groups), and sex (HIV+ groups higher proportion of males). The HIV+ groups were com-

parable for proportion of participants with AIDS. NP status was assessed by blind clinical ratings of global neurobehavioral status utilizing demographically corrected *T* scores from a comprehensive NP battery. Ability areas assessed by the NP battery included learning, memory, attention/working memory, abstraction, verbal fluency, processing speed, and motor skills. Groups differed in rates of global cognitive impairment (chi-square analysis; $p < .05$; HIV+/METH+ > HIV-/METH-). The HIV+/METH+ group demonstrated the highest rate of impairment (65%), followed by the HIV-/METH+ group (45%), the HIV+/METH- group (43%), and the HIV-/METH- (20%). Results suggest HIV infection and methamphetamine dependence may be associated with increased rates of cognitive impairment over either factor alone.

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M. CHERNER, E. MASLIAH, R. HEATON, R. ELLIS, I. GRANT, & THE HNRC GROUP. Value of Neurocognitive Status in Predicting HIV-Related Brain Disease.

Previous work by our group has shown relationships between cognitive impairment and neuropathologic evidence of HIV-related brain disease. The present study used a larger sample to investigate the predictive value of antemortem cognitive functioning in detecting postmortem evidence of HIV encephalitis (HIVE). Thirty-nine HIV+ study participants were assessed during life with a comprehensive neuropsychological battery. Cognitive impairment was determined by blind clinical ratings based on demographically corrected scores for all tests. Presence or absence of HIVE was defined on the basis of post-mortem immunocytochemical detection of the viral protein gp41 in multiple brain areas, and by histopathologic evidence, such as presence of multinucleated giant cells, microgliosis, and myelin pallor in several brain regions. Of 18 Ss with NP impairment, 17 (94%) had evidence of HIVE. By contrast, of 21 NP normal individuals, 10 (48%) showed postmortem HIVE. The sensitivity and specificity of our NP diagnosis in detecting the occurrence of HIV encephalitis with neurodegeneration were 63% and 92% respectively. Presence of NP impairment in life was almost always predictive of HIVE in our sample. These results suggest that if NP impairment is detected, there is a strong likelihood that HIV-related changes will be evident in brain tissue. NP diagnosis can be a powerful tool in selecting HIV+ patients for pharmacologic treatments that target the CNS.

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L. GRANDE, E. LERITZ, K. MASON, D. EVANS, & R. BAUER. Longitudinal Neuropsychological Assessment of Women with HIV.

Neurocognitive impairment is commonly associated with human immunodeficiency virus (HIV) infection. Previous research has reported a pattern of neuropsychological deficits that suggest subcortical involvement including psychomotor slowing, attentional difficulties and memory impairment. Few studies have examined the neurocognitive effects of HIV in women, and even fewer have followed this group longitudinally. The current study followed 39 women [29 HIV seropositive (HIV+), 10 HIV seronegative (HIV-)] of low socioeconomic status for a 2-year period. Sixty-three percent of the study sample was comprised of minority women (African American and Hispanic). Of the HIV+ women, 17 were symptomatic and 12 were asymptomatic at study entry. Participants were administered a broad battery of neuropsychological tests. The selected measures were designed to assess attention, memory, language, psychomotor speed and motor functioning. A repeated measures analysis of variance (ANOVA) conducted on each measure revealed overall significant differences between groups only on measures of controlled and automatic selective attention. Pairwise comparisons of the attentional measures revealed that symptomatic HIV+ women performed more poorly than asymptomatic HIV+ and HIV- women. The asymptomatic HIV+ and HIV- groups did not differ. These results suggest that selective attention measures may be sensitive to subtle cognitive differences between symptomatic and asymptomatic HIV+ individuals. Unlike previous studies, we found

no difference between groups on measures of motor functioning. The pattern of differences and similarities in performance will be discussed in light of the concept that HIV induces a subcortical dementia.

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K.I. MASON, H. DAVIS, A.L. CAMPBELL, S. MADHERE, O. LEWIS-JACK, P. HAWKINS, & L. HICKS. Working Memory Performance in HIV+ Individuals With a History of Substance Abuse.

HIV-infected individuals demonstrate impairment in neurocognitive processes mediated by frontal-subcortical circuits. Individuals with a history of substance abuse may be particularly vulnerable to these HIV-related deficits. We examined the effects of substance abuse and HIV infection on verbal and spatial working memory, in a sample of predominantly African American men and women (97%). Working memory tasks used in this study were those with known sensitivity to HIV-associated neurocognitive impairment (e.g., delayed match to sample task) and others that constitute the Working Memory Indexes from the WMS-III and WAIS-III. Thirty-nine HIV+ asymptomatic and 58 HIV- individuals participated in this preliminary investigation. Of these participants, 57% had a history of substance abuse. Using multivariate analyses, controlling for age and education, we found that in asymptomatic individuals, HIV status did not significantly affect working memory. Individuals with a history of drug and concurrent alcohol abuse were found to be impaired on a spatial working memory ($p < .01$), but not verbal working memory tasks. No interaction between HIV status and substance abuse was found for either the verbal or spatial working memory domains. Longer periods of abstinence were associated with better working memory performance (correlations between .37 and .67). In summary, these findings support previous studies that have found no evidence of cognitive impairment in the early stages of HIV infection. The results further suggest that substance abuse is not a risk factor for working memory deficits in asymptomatic patients and that HIV+ substance abusers, who refrain from alcohol use, may be less susceptible to HIV-related neurocognitive impairment.

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S. CASTELLON, C. HINKIN, D. HARDY, M. LAM, M. STEFANIAK, & B. ZOLNIKOV. Information-Processing Efficiency Among Substance Abusing HIV+ Persons.

There is a high prevalence of substance abuse among HIV-infected individuals. Because the independent effects of substance abuse and HIV have both been associated with cognitive compromise, substance abusing HIV+ persons may be at particularly high risk to experience cognitive decline. To date, early stage information processing has not been examined among HIV+ substance abusers. We administered the Span of Apprehension Task to 16 HIV+ current substance abusers (HIV+/SA+), 16 matched HIV+ individuals without history of substance abuse, and 16 matched HIV-seronegative controls (HIV-). As a group, participants were 43.1 years old and had completed approximately 14 years of education. The Span task requires target detection in briefly presented arrays of varying size (1, 4, and 12 letters), with processing demands increasing as a function of increasing array size. The 3 groups did not differ on decision-making reaction time at any of the three Span array sizes (all $ps > .25$). However, there were significant group differences in response accuracy. The HIV+/SA+ participants were significantly less accurate than either the HIV+ nonabusers or the HIV- controls ($F = 3.3, p < .05$), a finding driven by HIV+/SA+ participants making fewer correct responses at the 12-letter array size than either of the other two groups ($p < .01$). HIV+/SA+ participants were also less likely to respond to a true target at the 12-letter array size than either of the other 2 groups ($p < .01$). These findings suggest that current HIV+ substance abusers may have specific deficits in early stage information processing when task demands are maximal.

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D. HARDY, S. CASTELLON, C. HINKIN, E. LOPEZ, E. SINGER, & A. ARANOW. Response Inhibition Impairment and Stimulant Abuse in HIV+ Adults.

One category of cognition that is increasingly important to models of drug abuse and drug-related behavior is that of *automatic processes*. Such processes are difficult to modulate, such as the inhibition of a reinforced response. It is proposed that drug abusers exhibit particular difficulty in inhibiting a prepotent response at an elementary level of information processing. Current stimulant (cocaine and/or methamphetamine) abusers ($n = 10$) were compared to past stimulant abusers ($n = 12$) and non-abusers of stimulants ($n = 36$) in a sample of 58 HIV+ adults on a novel paper-and-pencil test of response inhibition as well as standard neuropsychological tests. Response inhibition was assessed with compatible and incompatible responses to a series of letters "L" and "R." A check-off box is located to the left and right of each letter. An example of an incompatible response is when the box to the left of an "R" must be checked off. The natural response is to the right. Incompatible (relative to compatible) response time was impaired in current stimulus abusers (20% slower) compared to past abusers (6% slower) and nonabusers (6% slower; $p = .05$). There was no

group difference in global cognitive functioning ($p = .33$). Also, response inhibition was substantially related to global cognitive functioning in current ($R^2 = .35$) and past ($R^2 = .31$) stimulant abusers but not in nonabusers ($R^2 = .00$). These results provide preliminary evidence that current stimulant abuse impairs elementary response inhibitory mechanisms. Furthermore, stimulant abuse (current or past) appears to forge a strong link between basic response inhibition and general cognitive state relative to nonabusers.

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Birch Lecture/11:00 a.m.–12:00 p.m.

**NEURAL MECHANISMS OF ATTENTION
IN THE HUMAN BRAIN**

Leslie G. Ungerleider

THURSDAY AFTERNOON, FEBRUARY 15, 2001

Paper Session 2/1:30–3:15 p.m.

DEMENTIA I: CORTICAL DEMENTIAS

S. McPHERSON, K. TINGUS, G. BUCKWALTER, & C. BACK. Progression of Cognitive Decline in AAMI and MCI: A Preliminary Study. The distinction between age associated memory impairment (AAMI), mild cognitive impairment (MCI) and early Alzheimer's disease (AD) has become a central focus of recent research. Patients with MCI appear to have an increased risk of developing AD at the rate of 10-12% per year, while the majority of patients with AAMI are considered to be nonprogressive. This pilot study was undertaken to identify (1) whether changes in cognitive functions vary in these two groups and (2) the nature of these changes over time. A total of 34 patients meeting criteria for MCI ($N = 22$) or AAMI ($N = 12$) were assessed on two occasions with a mean retest interval of 2 years. Results of repeated measures revealed no significant group interaction effects for change over time. Results of paired t tests revealed significant change for the entire sample for: Digit Span Backwards ($p < .004$), Digit Symbol ($p < .006$), Trails B ($p < .04$), FAS ($p < .03$), Rey Copy ($p < .02$), and AVLT short delay ($p < .02$). Animal fluency and Boston Naming Test approached significance (respectively, $p < .07$ and $p < .06$). Recent research has focused on the utility of memory scores in predicting which patients will progress to dementia. Although preliminary, our findings suggest that subtle declines in frontal functions may represent a critical marker for identifying those patients whose mild cognitive deficits may progress into dementia. The utility of the current diagnostic nomenclature will be explored.

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R.S. WILSON, D.A. BENNETT, L.A. BECKETT, D.W. GILLEY, & D.A. EVANS. Age and Rate of Cognitive Decline in Alzheimer's Disease. Age is the most robust risk factor for Alzheimer's disease (AD), but its relation to dementia progression has been controversial. We studied this issue in longitudinal studies of clinic-based and population-based samples of affected persons. In both studies, persons meeting NINCDS/ADRDA criteria for AD underwent annual evaluations, including cognitive function testing, for approximately 3.5 years with overall rates of follow-up participation among survivors of about 90%. A growth curve approach was

used to assess change in cognitive function and its relation to age. In the clinic-based group ($N = 410$), age was inversely related to cognitive decline. Thus, there was a small, approximately linear increase in rate of decline on global and specific cognitive measures (based on 18 individual tests) as age at baseline decreased. The other study was of a stratified, random sample of older persons from a geographically defined community. In those who had AD at baseline ($N = 97$) and in those who developed AD during the study ($N = 95$), age was unrelated to either initial level or rate of change on a global cognitive measure (based on 8 tests). Together, these results (1) support the idea that in clinical settings, cognition declines slightly more rapidly in younger compared to older persons with AD, but (2) suggest that this effect may be due to age-related differences in the factors that bring affected people to medical attention rather than in some underlying feature of the disease.

Correspondence: Robert S. Wilson, Ph.D., Rush Alzheimer's Disease Center, 1645 West Jackson Boulevard, Suite 675, Chicago, IL 60612.

K. RASCOVSKY, D.P. SALMON, G. HO, D. GALASKO, L.A. HANSEN, & L.J. THAL. Mattis DRS Profiles Differ in Alzheimer's Disease and Frontotemporal Dementia.

The performance of autopsy confirmed FTD and AD patients on the Mattis Dementia Rating Scale (MDRS) was examined in order to determine if these conditions produce distinct cognitive profiles, and whether these profiles can aid in the clinical differentiation of these disorders. MDRS subscale profiles were compared for 14 FTD and 28 AD patients, all of them autopsy-confirmed, and matched for overall level of education and dementia. Repeated measures MANCOVA controlling for age and education revealed a highly significant test by group interaction ($F = 4.431, p = .005$), reflecting distinct cognitive profiles for each diagnosis. While FTD patients performed worse on the Attention (81% vs. 84% of possible maximum scores), Initiation/Perseveration (44% vs. 54%) and Conceptualization (63% vs. 70%) subscales as compared to AD patients, they performed better in the Construction (70% vs. 56%) and Memory (60% vs. 42%) subscales of the MDRS. However, only the difference in performance on the Memory subscale was statistically significant ($F = 4.223, p = .047$). Stepwise Logistic Regression with age, Construction, Initiation and Memory subscales produced a model that significantly aided in the prediction of diagnosis, having an overall correct discrimination of 85.7%. A model excluding the most severely demented patients (DRS score < 70) and taking into account age, Initiation, Conceptualization and Memory subscales accurately discriminated all (100%) patients in both groups. These results

indicate that MDRS profiles may be a useful adjunct in the clinical differentiation between FTD and AD, especially among mildly to moderately demented patients.

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J.T. ELDER & B.R. REED. Cognitive Patterns in Autopsy-Proven Lewy Body Dementia and Alzheimer's Disease.

Dementia with Lewy Bodies (DLB) is the second most common subtype of dementia, following Alzheimer's disease (AD). Diagnosis of DLB remains difficult, and there are only limited data regarding neuropsychological characteristics of DLB. Previous studies have suggested that attention, executive, and visuospatial deficits may be more prominent in DLB, with memory impairment more pronounced in AD. However, prior research has included predominantly cognitive screening instruments, small samples, and few autopsy-confirmed DLB cases. The present study examined comprehensive neuropsychological data on substantial samples of autopsy-confirmed DLB and AD cases. It was hypothesized that DLB patients would perform significantly better than AD patients on measures of memory, but would do worse on measures of attention, visuospatial, and executive functions. CERAD criteria were utilized to identify 30 autopsy-proven DLB cases and 30 definite AD cases closely matched on age, education, and severity of dementia. Diagnoses were made by a single neuropathologist following uniform protocols at a university Alzheimer's disease center. AD cases with subcortical pathology and cerebrovascular disease were excluded. Baseline neuropsychological evaluations were analyzed, and as expected, patients with DLB performed significantly better than AD patients on measures of verbal (list learning, $p < .05$) and visual memory (WMS-R, Visual Reproduction, $p < .01$). However, in contrast to earlier studies, no significant differences were found with attention, visuospatial, and executive functions. Overall, differences between DLB and AD mean scores were modest, with considerable overlap between groups across measures. Results suggest that common neuropsychological tests may have limited utility in discriminating DLB from AD pathology.

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A. HAYS, A. ROSLER, M. MAPSTONE, M-M. MESULAM, & S. WEINTRAUB. Deficits in Visual Exploration in Individuals With Mild Cognitive Impairment.

Mild Cognitive Impairment (MCI) poses a risk factor for Alzheimer's disease (AD) in elderly individuals. It is characterized by isolated deficits on tests of explicit memory in the absence of other cognitive or functional disturbances. It is not known whether more subtle non-memory deficits might exist in individuals with MCI as part of a prodrome of early AD. One early nonmemory deficit in AD is an impairment in visual search. In the present study, we analyzed eye movements, a physiologically-based marker of visual search, to determine if subjects with MCI show alterations similar to those we previously demonstrated in persons with early AD. Participants were 10 individuals with clinically diagnosed MCI and 10 age-matched cognitively normal elderly controls (EC). Eye movements were recorded as participants searched a computer screen for a target in an irregular array of distractors. Target detection accuracy and response time were calculated. Total search time was divided into eye Fixation Time and Motor Time. MCI participants were slower (MCI = 5.3 s; EC = 3.9 s, $p < .0003$) and less accurate (MCI = 69%; EC = 87%, $p < .01$) than EC in detecting targets. The increase in target detection time in MCI participants was caused by an increase in the Fixation Time component (MCI = 2.5 s; EC = 1.5 s, $p < .01$). MCI and EC did not differ with respect to other components of the search task. These findings are qualitatively similar to those we reported in early AD patients and suggest that deficits in attention may also be detected in MCI with more sensitive measures.

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J.C. ADAIR, R.L. SCHWARTZ, S.L. RUIZ, K.Y. HAALAND, & A.M. RAYMER. Action Knowledge in Probable Alzheimer's Disease (pAD).

Objective: To assess knowledge of learned skilled movement in pAD. *Methods:* Patients ($n = 10$) who met NINCDS criteria for pAD were compared with age- and education-matched controls ($n = 8$). Conceptual understanding of different gestures was measured using the Gesture Naming (GN) and Gesture Recognition (GR) subtests of the Florida Apraxia Battery. Action knowledge was also assessed using the Florida Action Recall Test (FAR). *Results:* Patients performed significantly worse than controls on GN (68% vs. 87%), GR (71% vs. 95%), and FAR (53% vs. 86%). All three measures of movement knowledge correlated significantly with one another. Across groups, there was no difference between scores on GN and GR. For both GN and GR, all subjects interpreted intransitive gestures more accurately (pAD 86%, control 99%) than transitive gestures (pAD 62%, control 82%). There was no significant interaction between group and gesture type. Dementia severity, measured by ADAS-cog, correlated highly with performance on GN ($r = -.76$), GR ($r = -.79$), and FAR ($r = -.73$). Adaptive status, measured by Functional Activity Questionnaire, also showed significant correlations with GN ($r = -.75$) and GR ($r = -.82$) but not FA ($r = -.53$). *Conclusions:* Action recognition and retrieval tasks were impaired in pAD, suggesting deficits in semantics processing with regard to learned skilled movement. Degradation of skilled movement representations (*praxicons*) and loss of action knowledge (action semantics) worsen with disease progression.

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Paper Session 3/1:30–3:15 p.m.

BRAIN PLASTICITY AND CHILDHOOD DISEASES

N. DENBURG, N. TRANEL, & D. TRANEL. The Crowding Hypothesis in a Patient With Infantile Meningitis: A Test of Neural Plasticity.

The Crowding Hypothesis (CH) refers to the notion that recovery of speech and language abilities following early left-hemisphere damage is supported anatomically by regions in the right hemisphere (RH) homologous to damaged left-hemisphere language structures, and occurs at the expense of "crowding out" nonlanguage abilities subserved by the now overtaxed RH. Despite a proliferation of research on neural and cognitive plasticity, few clinical and research reports have addressed the CH phenomenon. This issue has renewed clinical and scientific importance in light of recent studies showing that early damage to some neural structures (namely, ventromedial prefrontal cortex) may *not* be followed by reorganization of function, leaving the victims permanently and irrevocably impaired in the associated cognitive and behavioral domains. Here, we report a carefully studied case that supports the CH, and that may help explain why some cognitive functions are more "plastic" than others in the context of early brain damage. We present the case of an 11-year-old, left-handed (with no familial sinistrality) boy who suffered spinal meningitis at seven months of age, followed by a series of left-hemisphere strokes. Early neurological history demonstrated immaturity, inappropriate affect, mild right hemiparesis, and delayed language skills. Current neuropsychological evaluation revealed remarkably intact language abilities, and average intellect. In contrast, many of his RH capacities were impaired, including visual perception, right-left discrimination, and prosody. We present experimental data to illustrate that the CH can have implications for less obvious capacities, such as social and moral reasoning, factual social knowledge, and the recording and retrieval of emotional knowledge.

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R. HETHERINGTON & M. DENNIS. Plasticity for Recovery and Development in Twins Discordant for Childhood Stroke.

Recovery of function after an acquired brain insult is an instance of plasticity, the ability of the brain to support old and new behaviors. Plasticity

for recovery supports the restitution and reorganization of functions lost or disrupted by brain insult; plasticity for development supports the young brain in acquiring new functions, skills, and knowledge. For the immature, damaged brain, plasticity for recovery coexists with plasticity for development, and both contribute to long-term cognitive outcome. We describe cognition and language in a set of likely monozygotic 13-year-old twins raised together and discordant for an extensive left hemisphere stroke that took place 6 years previous to the study. Based on normal developmental expectations and the cognitive status of the unaffected twin, four possible outcome profiles that reflected the relative contributions of recovery and development to long-term cognitive and language function were evaluated. Profiles showing full recovery of lost skills and full or partial development of new skills typically involved either semantic memory, or right hemisphere lateralized functions such as visual perception skills. Profiles showing limited development of new skills and full or partial recovery of lost skills involved either active verbal memory or oral language skills that are left hemisphere lateralized. Language skills concerned with real-time lexical retrieval, or the use and understanding of morphology and grammar, were least likely to recover and continue to develop. After a middle childhood stroke, many skills exhibit plasticity for recovery, but, particularly with respect to grammar, plasticity for development appears limited. Correspondence: *R. Hetherington, Department of Psychology, The Hospital for Sick Children, 555 University Avenue, Toronto, ON M5G 1X8, Canada.*

S. MAJERUS, I. PALMISANO, M. VAN DER LINDEN, K. BARISNIKOVA, & M. PONCELET. An Investigation of Phonological Processing in Williams Syndrome.

This study was designed to further explore phonological processing in Williams syndrome (WS). Four WS children (aged 10–12 years) and 12 chronological age-matched normal children were administered (1) rhyme judgment, minimal pair discrimination and phoneme detection tasks, assessing phonological awareness; (2) immediate serial recall (ISR) tasks for lists of words and nonwords of increasing length, assessing phonological short-term memory (STM); (3) word–word and word–nonword learning tasks, assessing long-term phonological acquisition. In each task, there were lists of CVC words and nonwords matched for phonotactic frequency, assessing the influence of lexical knowledge, and CVC nonwords with low phonotactic probabilities, a comparison between the two types of nonwords assessing the influence of sublexical phonological knowledge. Mean performance of the WS group was 2 standard deviations below the mean of controls for all phonological awareness and learning tasks. However, performance was in the normal range for ISR. These results were confirmed by nonparametric *U* tests. For controls, Wilcoxon tests showed better performance for words and phonotactically-frequent nonwords versus phonotactically-infrequent nonwords in the learning and ISR tasks, but not for phonological awareness tasks where there was a ceiling effect. WS subjects however showed no effect of phonotactic frequency in any task, and they did not perform significantly better for words than for nonwords. WS children do not seem to be phonologically aware nor to use sublexical or lexical phonological knowledge in phonological learning and STM tasks. Their good performance on ISR might rely on acoustical rather than phonological short-term storage.

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S. CHRIST, D. WHITE, & J. BRUNSTROM. Memory and Executive Control in Children With Spastic Diplegic Cerebral Palsy.

Spastic diplegic cerebral palsy (SDCP) is a developmental disorder of movement and posture often associated with MRI findings of periventricular white matter damage (i.e., periventricular leukomalacia). A range of cognitive deficits has been associated with SDCP, but little work has been conducted to define disruptions in specific subcomponent processes of memory (e.g., encoding, retrieval, storage, use of executive strategies). The California Verbal Learning Test–Children’s Version was used to compare the memory performance of 13 non-mentally-retarded children with SDCP and 13 uncompromised controls. Children ranged from 6 to 18 years of age

($M = 11$ years for both groups). Estimated verbal IQs for SDCP and control groups were 92 and 107, respectively. Because of the significant difference in estimated verbal IQs, this was used as a covariate in all analyses. The SDCP group performed significantly more poorly than the control group in terms of learning over repeated trials (Trial 1 through 5 recall), semantic clustering, cued recall, and long-delay free recall. Initial learning (Trial 1) and recognition were intact. The between-group difference in learning over trials was no longer significant after controlling for differences in semantic clustering. Taken, together, these results suggest that children with SDCP have deficits in the use of executive control strategies that facilitate encoding and retrieval. One possible explanation for the observed pattern of memory deficits is that the white matter damage frequently associated with SDCP disrupts interactions between prefrontal and medial-temporal regions of the brain.

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B. CORBETT, K. KHAN, D. CZAPANSKY-BEILMAN, N. BRADY, P. DROPIK, D. ZELINSKY-GOLDMAN, K. DELANEY, H. SHARP, I. MUELLER, & R. ZIEGLER. Double-Blind, Placebo-Controlled Crossover Study of Secretin on Autistic Children.

Autism is a developmental disorder characterized by qualitative impairment before the age of three in verbal and nonverbal communication, reciprocal social interaction, and markedly restricted repertoire of activities and interests. Many children so diagnosed exhibit gastrointestinal (GI) symptoms. A recent case series reported the incidental findings of improved social and language skills and amelioration of GI symptoms in children with autistic spectrum disorders after the administration of secretin, a peptide hormone. Based on the findings, the authors suggested a potential treatment association with secretin. The current study investigated the effect of a single intravenous dose of porcine secretin on 12 autistic children (age 4–12 years) through a randomized, double-blind, placebo-controlled, crossover design. Children were assessed on language, social, neuropsychological, neurophysiological, and gastrointestinal measures to evaluate drug effects. The subject sample consisted of twelve male autistic children with a mean age of 6.5 years, and an average IQ of 47. Multivariate analysis for repeated measures was used to compare baseline values, treatment, period, and carryover effects. While two of the variables of interest, Positive Affect ($F = 8.9, p = .01$), and Activity ($F = 4.75, p = .05$) were statistically significant, the majority of the dependent variables did not result in statistical significance or trends. Due to the sensational interest and conflicting reports between empirical studies and parental testimonials, additional research in this area is warranted, particularly to further investigate effects of secretin on affect and activity level.

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Poster Session 3/1:30–3:15 p.m.

ATTENTION

J. SADEK, B. CROSSON, L. GRIFFIN, R. ASH, R. BRIGGS, D. GÖKÇAY, K. GOPINATH, D. SOLTYSIK, A. CATO, & R. BAUER. fMRI Activation Changes in Medial Posterior Cortex Due to Language Practice.

Patterns of activation can change when a task is rehearsed. Changes measured by functional neuroimaging may reflect increased neural efficiency or the evolution of cognitive processes. Category exemplar generation was performed covertly by 26 participants while undergoing functional MRI (fMRI). Whole-brain fMRI data were collected at 1.5T using a 2-spiral sequence. Six categories were presented to each participant. Generation periods alternated with rest. Participants were instructed to keep their eyes open and focused on a single point throughout generation and rest. The same set of 6 categories was repeated 3 times with instructions to say items

that came fastest and easiest. Pilot behavioral data indicated that production rates increased with practice and that items were produced consistently. Signal differences between generation and rest were calculated for each practice level. Comparison between the three practice levels showed changes in posterior cingulate and medial parietal cortex. A task-related decrease in fMRI signal in these two regions was associated with novel generation. Practice eliminated activation decreases in posterior cingulate and medial parietal regions. It is argued that practice resulted in changes in attentional states, which was reflected by changes in posterior cingulate and medial parietal activation. This finding was unexpected and underscores the importance of nonspecific cognitive processes in functional neuroimaging research.

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A. MARGOLIS, U. KIRK, S. KEMP, & M. KORKMAN. The Role of Executive Functions on Visual Attention.

The performance of the 3–12-year-old children in the NEPSY standardization sample was evaluated for speed, accuracy, and speed-accuracy on simple and complex visual attention (VA) tasks. One task (Cats) was presented to all ages; another task differed for ages 3–4 (Bunnies) and 5–12 (Faces). Success involves executive functions: generating a plan (strategy), remembering the target to distinguish it from distracters (working memory), and working quickly without making mistakes (monitoring). MANOVAS for speed and accuracy revealed robust age, but not gender effects for each task, $p < .001$. Tukey contrasts revealed that 3-year-olds showed little evidence of executive functions on Cats, working slowly, coloring, and making many errors. The 4–6-year-olds were faster and made fewer errors. Ages 8–12 were both fast and accurate. Similar patterns, younger children focusing on one task constraint, older children attending to both constraints, emerged across tasks. On Bunnies, the easier task for ages 3–4, age 3 was slower and made more errors than age 4. On Faces, the complex task for age 5–12, accuracy increased until age 8; speed increased after age 8. Plotting age against speed and accuracy revealed that children began to attend to both task-constraints at age 8. This provides evidence that planning, monitoring, and working memory (executive functions) contributed to improved performance. These results are consistent with the pattern observed on the NEPSY visuomotor precision (VMP) task. The constraint to which young children attended first, however, varied with the task: speed on VMP; accuracy on VA.

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R. J. HINES, L.K. PAUL, & W.S. BROWN. Between-Field Shift of Visual Attention in Callosal Agenesis.

Previous research with split-brain patients suggests that when visual attention is directed by a symbolic cue (i.e., an arrow) attention is dependent upon subcortical mechanisms and redirection of attention between visual fields is not dependent on the corpus callosum (CC). When attention is directed by a peripheral sensory cue (i.e., highlighting a box located in 1 visual field) attention is carried out independently within the sensory processes of each hemisphere and redirection is dependent on the callosum. Thus split-brain patients can rapidly shift attention between visual fields on tasks that use symbolic cues, but cannot on tasks that use peripheral sensory cues. This study examined the effects of a peripheral sensory and central symbolic precue on the reorienting of visual selective attention within *versus* between-visual fields in 7 adults and 2 children with agenesis of the corpus callosum (ACC) and 9 controls. RT was recorded to valid and invalidly cued (peripheral or symbolic) targets in the right and left visual fields. Results yielded a significant difference for reorienting attention within *versus* between-fields ($p < .007$) and significant interaction for reorienting attention-by-group ($p < .03$). ACCs were relatively slower at between-field attention shifting. Most importantly, analyses did not yield a significant interaction for reorienting attention-by-group-by-experiment. The results of this study demonstrate that acallosals are slower in shifting attention between visual fields regardless of whether central symbolic or peripheral

sensory cues are used. Thus, the previous hypothesis based on results from split-brain patients is called into question.

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R. HOLTZER, B. CHOUDHURY, J. FARGIONE, F. KOU, M. MURRAY, J. SALVAGGIO, R. BURRIGT, & P. DONOVICK. Dual-Task Measures and the Prediction of Functional Competence in the Elderly.

The ecological validity of neuropsychological tests is a critical issue faced by both clinicians and researchers. This study examined the relationship between measures of concomitant allocation of attention to visual and verbal tasks and functional competence in daily living. Baddeley and Hitch's model of the "Central Executive" served as a template for the construction of 2, theory-based and clinically suited, dual-tasks designed to measure concomitant allocation of attention. A Questionnaire of Functional Daily Competence (QFDC), administered in an interview format, was used to collect information regarding the individual's level of functioning in daily life. Items covered daily functions such as money management and transportation as well as recreational activities such as reading, dining and participation in social activities. The regularity at which daily functions and recreational activities occur was evaluated as well. The participants were 60 elderly individuals who were obtained from both residential facilities and independent community setting. The results showed that scores on the dual-task measures were highly related to everyday behaviors. Specifically, 36% of the variance in functional competence in daily living was accounted for by scores on two 2-min dual-task measures. Furthermore, a canonical discriminant function analysis using dual-task scores as predictors placed accurately 75% of the participants into a two level criterion of drivers ($n = 23$) and nondrivers ($n = 37$). These findings indicate that dual-task measures are cost effective both in terms of their short administration time and generalizability to everyday behaviors.

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A.N. UEERROTH & D.S. GELDMACHER. Target/Distractor Effects on Cancellation Tasks in Aging and Alzheimer's Disease.

Previous studies have shown that target-to-distractor (T/D) ratio can influence the performance of random array letter-cancellation tests. The purpose of this study was to determine the effect of Alzheimer's Disease and age on random array letter-cancellation tests with varying T/D ratios. Ten Alzheimer's patients, 9 healthy elderly control subjects, and 10 healthy young controls were each given 9 random array letter-cancellation tests with T/D ratios varying from 1:19 to 19:1. Omissions, completion time, and an overall performance score (calculated from both speed and accuracy variables) were compared between the groups. Completion time and omissions were higher for the Alzheimer group than the elderly control group and higher for the elderly control group than the young control group for all T/D ratios. The results for the performance score were just the opposite. In addition, performance score increased with increasing T/D ratio for all three groups. At high T/D ratios, young control participants exhibited a clear benefit on performance scores relative to other groups, consistent with faster motor ability of younger participants. Performance score was a linear function of T/D ratio on log-log plots for all three age groups. For all three groups, the slope of the line for T/D ratio less than 1:1 is approximately twice that of the slope for T/D ratios greater than or equal to 1:1. This indicates that although AD patients and healthy, elderly adults perform slower than healthy younger adults, they are not additionally adversely affected by the presence of distractors.

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S. PONGONIS, J. ALLEN, & T. SULLIVAN. Validation of the NEPSY Auditory Attention/Response Set and Visual Attention Subtests.

The NEPSY is a comprehensive neurodevelopmental battery for children 3 through 12 years of age and is one of only a few neuropsychological test

batteries developed specifically for children. There has been little research with the NEPSY and few external validation studies have been conducted. This study evaluated the validity of the Auditory Attention/Response Set and Visual Attention subtests of the NEPSY as measures of inhibition, vigilance, and selective and sustained attention. As part of an ongoing study children ($N = 45$) 5–12, referred from a children's hospital psychology clinic for evaluation, completed the NEPSY Auditory Attention/Response Set and Visual Attention subtests as part of a comprehensive neuropsychological assessment. The performance of children from 2 diagnostic groups (epilepsy: $N = 15$; psychiatric disorders: $N = 15$) and a control group ($N = 15$) was compared on commonly used objective measures of attention including the WISC-III subtests of Digit Span, Coding, Symbol Search, and Arithmetic; the Conners' Continuous Performance Test, Trails A & B, and a behavioral measure, the Conners' Parent Rating Scale, Revised. Initial data indicate only weak correlations between the NEPSY attention subtests and other commonly used attention measures. Theoretical and clinical implications for the NEPSY attention subtests are discussed as well as issues related to the identification of children with epilepsy and various psychiatric disorders.

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E. HITCHCOCK, J. WARM, P. SHEAR, G. MATTHEWS, & W. DEMBER. Effects of Task Demand on Cerebral Hemovelocity During Sustained Attention.

Neuroimaging studies have identified brain regions (e.g. nucleus locus coeruleus, cingulate gyrus) associated with sustained attention or vigilance performance, but have not examined their functional role. The present study employed transcranial Doppler sonography, allowing continuous hemovelocity measurements in the left and right middle cerebral arteries, while participants ($N = 128$) completed a 40-minute vigil. Two signal salience levels (high/low) were combined factorially with 4 conditions in which monitors received forewarnings about the imminent arrival of critical signals (100%, 80%, and 40% reliable cuing and a no-cue control). For both levels of signal salience, the frequency of signal detection remained stable over time in the 100% cue-reliability condition but declined in the remaining cue conditions, so that by the end of the vigil, performance efficiency was best in the 100% condition followed in order by the 80%, 40%, and no-cue conditions. These performance effects for cuing were mirrored by hemovelocity measurements in the right hemisphere in conjunction with low salience signals. No cuing effects were observable in hemovelocity recordings taken from the left hemisphere in conjunction with either high or low salience signals. Moreover, an additional monitoring group ($N = 16$) that passively gazed at the same display with no performance imperative exhibited no decline in hemovelocity over time. The results indicate that changes in cerebral hemovelocity and signal detection across a vigil are at least partially related to common mechanisms, such as the expenditure of information-processing resources. They are also consistent with past findings indicating that vigilance performance is right hemisphere lateralized.

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S. DICKSON, T. PACE, L. SCOTT, M. SHERER, & R. ADAMS. Effect of Depression Severity on Tests Sensitive to Attention.

Depression is often encountered in populations with which neuropsychologists work, and its effect on cognitive processes can have significant implications for interpretation of neuropsychological results. Empirical studies of the specific effects of depression on neuropsychological test performance are a relatively recent trend, and results have been mixed due to various methodological problems. Furthermore, the significance of depressive symptoms with respect to cognition has been questioned. The present study explored the effect of differing levels of depression severity (*no, low, moderate, and high*) on attention performance while controlling for anxiety in a sample of 1,209 participants referred for neuropsychological evaluation in an academic medical center. Depression severity was de-

termined by scores on MMPI Scale 2, and attention performance consisted of scores on tests sensitive to attention. Results of a MANCOVA with *post-hoc* analyses showed that performance on attention measures was significantly affected by depression severity. Increasing levels of depression resulted in poorer performance on WAIS-R Digit Span and Digit Symbol and the WMS-R Attention/Concentration Index. These results are consistent with previous studies showing significant decreases in attention performance with increasing levels of depressive symptoms.

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K.E. WILDER-WILLIS, K.W. SAX, H.L. ROSENBERG, D. FLECK, P.K. SHEAR, & S.M. STRAKOWSKI. An Aspect of Attentional Dysfunction in Remitted Bipolar Disorder.

Previous research has shown that individuals with bipolar disorder (BPD) commonly exhibit attentional dysfunction during abnormal mood episodes; however, few studies have examined whether attentional deficits are evident in clinically stable patients with BPD. The goal of the current study was to determine whether clinically stable patients with BPD demonstrate persistent attentional disturbances relative to healthy controls. Fourteen clinically stable individuals with BPD (M age 33, $SD = 7$) and twelve healthy controls (M age 33, $SD = 10.5$) participated in the study and were administered tests of perceptual sensitivity and reaction time (Degraded Stimulus Continuous Performance Test, DSCPT), resistance to interference (Digit Span Distractibility Test; DSDT) and fine motor coordination (Grooved Pegboard Test; GPT). Psychiatric symptoms were assessed with the Young Mania Rating Scale and Scale for the Assessment of Positive Symptoms. Medication side effects were measured with the Simpson Rating Scale. In comparison to the control group, the patient group showed significantly slower reaction times on the DSCPT ($z = -2.52, p < .01$) and greater impairment on the GPT ($z = -3.37, p < .001$). There was a nonsignificant trend toward the BPD patients demonstrating impaired perceptual sensitivity on the DSCPT ($z = 1.68, p < .09$). The two groups did not differ on the DSDT ($z = -1.06, p < .3$). Poor performance on the GPT and DSCPT reaction time were not associated with symptom ratings or medications. The findings suggest that impairments in fine motor skills and reaction time may persist in clinically stable patients with BPD, even after accounting for residual psychiatric symptoms and medication effects. Correspondence: *Kelly Wilder-Willis, Department of Psychology, University of Cincinnati, 429 Dyer Hall, Cincinnati, OH 45221-0376.*

J. VASTERLING, J. CONSTANS, L. DUKE, M. STANFORD, & C. MATHIAS. Attentional Bias to Threat in PTSD: Relation to Attention in Neutral Contexts.

Posttraumatic stress disorder (PTSD) has been found to be associated with deficits on attention tasks using emotionally neutral stimuli. Although such deficits appear to be accompanied by neurobiological alterations associated with PTSD, less is known about the potential contributions of information processing biases to impaired attention. The aims of this study were to (1) examine attentional bias in PTSD to trauma-relevant *versus* trauma-irrelevant threat information and (2) determine whether potential attentional biases were associated with performance on emotionally-neutral attention tasks derived from Mirsky et al.'s model. Participants were 10 PTSD-diagnosed and 10 healthy Vietnam veterans. Using an "emotional" Stroop paradigm, methods incorporated a 3 (condition: combat, social-threat, neutral) \times 2 (diagnosis: PTSD, no-PTSD) mixed factorial design. Results indicated a Diagnosis \times Condition interaction [$F(2,36) = 6.73, p = .003$], suggestive of attentional bias to trauma-relevant information. PTSD-diagnosed participants showed significantly slower reaction times (RTs) to combat words, whereas the comparison group showed no RT differences among conditions. In addition, attentional bias to trauma-relevant information was positively correlated with omissions on tasks requiring target detection (letter cancellation, $p = .017$, and continuous performance test, $p = .044$) and on time to complete Trails B, $p = .011$. There was no association between attentional bias and performance on the standard Stroop Test and Wisconsin Card Sorting Test. Results provide at least partial support for a resource allocation explanation of attentional impairment in PTSD

in which attention is directed to emotionally salient information and away from neutral stimuli.

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R. CHAN, R. HOOSAIN, T. LEE, Y. FAN, & D. FONG. Attentional Profiles of Patients With Closed-Head Injury.

Aim: This study aimed to examine the attentional profiles of patients with closed-head injury (CHI). A multicomponential perspective of attention was adopted, including intensity aspect of attention (sustained attention), selective aspect of attention (selective attention and divided attention), and attentional control processing. It was hypothesized that subtypes of patients with CHI may be identified according to different combinations of the deficits in these attentional components in both the laboratory and functional measures. *Method:* The sample consisted of 92 patients with CHI with a mean age and education of 37.63 ($SD = 9.62$) and 9.39 years ($SD = 3.38$) respectively. The sample comprised of 71.7% males. All participants received comprehensive measures of attention tapping sustained attention (Sustained Attention Response to Task, Backward Digit Span), selective attention (Stroop Test, Color Trails Test), divided attention (Paced Auditory Serial Addition Test, Symbol Digit Modalities Test), and attentional control (Tower of Hanoi, Six Elements Test). A 2-stage cluster analysis was conducted. Ecological measures of attention were used to validate the cluster solution. These included the Test of Everyday Attention, Cognitive Failures Questionnaire and Dysexecutive Questionnaire. *Results:* The findings indicated that there were 3 subgroups of patients with different combinations of attentional deficits, namely “mild deficits in intensity of attention,” “deficits in selectivity of attention,” and “general deficits in attention.” MANOVA also indicated that these three clusters were statistically and clinically different from one another in terms of different attentional components proposed. These findings underscore the importance of clinical intervention for patients with different combinations of attentional deficits.

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C. RUFF, T. WOODWARD, A. THORNTON, & P. GRAF. Memory Deficits Reflect Distinct Attention Systems in Schizophrenia.

Memory deficits are common and marked among patients suffering from schizophrenia. In contrast to the memory problems associated with more focal brain disorders affecting the temporal lobes and diencephalic structures, the neuropsychological mechanisms of the deficit connected with schizophrenia are poorly understood. This holds especially true for the rarely examined domain of prospective memory, which is nevertheless vital for everyday functioning. We examined the relationship between performance on tests of different aspects of memory (prospective, retrospective verbal, and retrospective visual memory) and various indices of attentional performance. Participants were 23 patients suffering from schizophrenia according to DSM-IV criteria. The measures of retrospective memory were highly intercorrelated, and showed relationships to the performance on tests of vigilance, monitoring, and divided attention. The index of prospective memory was not associated with any of these measures, but instead with the performance on a paper-and-pencil and a computerized single-trial version of the Stroop task. This pattern of associations and dissociations suggests that a deficit in sustained cognitive control might be a crucial factor for the commonly observed retrospective memory problems of schizophrenic patients, but not for their prospective memory performance. Deficits in this memory function seem instead linked to disturbances of the ability to disengage from salient features of the situation. Correspondence: Allen Thornton, Department of Psychology, Simon Fraser University, Burnaby, BC V5A 1S6, Canada.

J.L. WOODARD, B.N. AXELROD, K.D. SHANNON, & S.E. BO-WEN. Value of Signal Detection Theory Indexes for Wechsler Memory Scale-III Recognition Measures.

Recognition subtest score calculations in the Wechsler Memory Scale-III (WMS-III) focus only on correct responses (hits and correct rejections) to

the neglect of false alarm (FA) errors. In contrast, signal detection theory (SDT) indexes analyze both hits and FA to provide indexes of discrimination between targets and distractors (d') and response bias (c). We investigated the utility of SDT indexes over the conventional WMS-III age-scaled score in a mixed clinical sample. Participants included 23 psychiatric patients and 25 dementia patients referred for neuropsychological evaluation, who were administered the WMS-III as part of a larger battery. SDT indexes of d' and c were computed in addition to age-scaled scores for all participants. For the dementia group, d' was correlated strongly with age-scaled ($r = .53-.86$) scores for all recognition measures, while c was effective in identifying ‘yea-saying’ and ‘nay-saying’ response bias for the dementia patients. Except for Faces I, both raw and age-scaled scores were correlated negatively with FA only ($r = -.54-.97$). In contrast, for the psychiatric group, d' was correlated strongly ($r = .53-.94$) with both raw and age-scaled scores, while both hits ($r = .40-.74$) and FA ($r = .45-.80$) were related to overall performance. Our results suggest that WMS-III recognition performance is most strongly compromised by FA errors in dementia patients, whereas both hits and FA contribute to total score for psychiatric patients. We conclude that SDT indexes provide unique information, characterizing both discriminability and response bias, over the sole reliance on age-scaled scores with the WMS-III.

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S. CHRISTMAN & J. LOCKETT. Attending to One Versus Multiple Objects: Upper-Lower Visual Field Differences.

Judgments that a line is bisected below versus above center are geometrically equivalent to judgments that the upper versus lower line segment is longer. Psychologically, however, these judgments may be based on different mechanisms: bisection involves treating the stimulus as a single object to be analyzed, whereas comparison judgments involve treating the stimulus as two separate objects to be compared. This possibility was explored by employing bisection and comparison tasks on the same set of stimuli. Stimuli were vertically aligned pairs of rectangles or lines, in which either the upper or lower member was larger; additionally, 20% of trials consisted of equal size stimuli. In the bisection task, participants indicated whether stimuli were bisected above or below center. In the comparison task, participants indicated whether the upper or lower stimulus was larger. Bisection of rectangles was faster when the upper stimulus was larger, whereas comparison was faster when the lower stimulus was larger. Furthermore, when stimuli consisted of equal sized rectangles, participants were biased to respond that they were bisected below center (meaning that the upper stimulus appeared bigger), whereas the lower object appeared bigger in the comparison task. Line stimuli did not show differential effects of task, eliciting general biases to perceive the lower stimulus as larger. Thus, for rectangular stimuli, bisection versus comparison tasks biased participants to perceive the upper versus lower stimuli as being larger; this supports the hypothesis that attention to single versus multiple objects is associated with upper versus lower visual field attentional biases, respectively.

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CHILD ADHD

R. BURMEISTER, K. KRULL, L. BUONO, & J. FEIGIN. Factor Analysis of the Continuous Performance Task Commission Error Subtypes.

Continuous performance task (CPT) commission error subtypes have most often been evaluated collectively as a measure of impulsivity. However, the factor structure of the CPT has not been examined to determine if these errors represent a unitary factor or if different subtypes could be representing distinct psychological processes. Gordon Diagnostic System visual vigilance task data was collected for 90 children (ages 6–14) who were referred to an attention problems clinic. Factor analysis was performed on the 6 commission error subtypes, correct responses, and mean reaction times.

The analysis reveals a 3-factor structure. The first factor appears to be consistent with the concept of impulsiveness (decreased reaction time correlated with increased probability of errors in response to the cue stimulus). In contrast, the second factor is distinguished by increased reaction time and slow response errors (responding to the stimulus following the target sequence). The third factor does not appear to have a relationship with reaction time, with random error types loading on this factor. The results suggest that although some subtypes of commission errors represent impulsivity, others may represent other psychological processes that would aid in assessment of attention problems.

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L. HARRIS & R. ZIEGLER. Convergent Validity of the Test of Everyday Attention for Children (TEACH).

Attentional difficulties are commonly associated with childhood neurologic and neurodevelopmental disorders. Currently, the ability to assess the full range of attentional capacity is limited. Assessment of attention primarily relies on computerized continuous performance tasks and behavior rating scales. Recently, a child-friendly measure of attention has been developed (i.e., TEACH). We sought to assess the convergent validity of the TEACH with instruments considered to be "gold standards" of assessment of attentional functioning. A group of 25 children (aged 6–15 years) with a variety of disorders completed the TEACH screener battery and the Test of Variables of Attention (TOVA). Administration of the Wisconsin Card Sort Test (WCST) allowed for comparison of attention indices with higher-order conceptual reasoning skills. Completion of the Behavior Assessment System for Children–Parent Report (BASC) allowed for comparison of behavioral measures of inattention. None of the children were on stimulant medication regimens. Findings from zero-order correlations indicated mild-to-moderate relationship between TOVA and TEACH indices of reaction time, and between TOVA Vigilance and TEACH Dual Task performances. When controlling for FSIQ, these relationships remained, though they were somewhat weaker. A greater relationship was found between WCST and TOVA scores, though this relationship, too, declined after partialing out FSIQ. Attention Problems on the BASC were correlated with loss of set on the WCST and with conceptual ability on the WCST. In sum, this study provides further support for conceptualizing attention as a multidimensional construct.

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K. KIRLIN, C. FIORE LERNER, S. HALL, P. BACH, & R. VELIN. Use of Children's CVLT–C and WCST Scores to Predict Inattention on Conners' CPT.

Presented is a component of a Master's thesis project examining the relationship between children's scores on Conners' CPT and their performance on measures of learning and executive function. Participants were 9–12-year-old children referred for neuropsychological evaluation ($N = 71$). First, ANOVA was used to contrast the CVLT–C and WCST scores of children with high (>11) and low (<8) CPT overall index scores, and cluster analyses were used to determine whether these cut-off scores identify homogeneous groups. The results of these analyses are reviewed elsewhere. Following the cluster analyses, 2 discriminant analyses were conducted: 1 for CPT group membership, and a 2nd for cluster membership. The first stepwise analysis generated a two-variable function with a 67.6% classification hit rate. An acceptable level of predictive accuracy is considered to be one-fourth greater than chance based on the proportional chance criterion (in this case 64%); however the accuracy of an internal classification analysis is often biased upwards and results that barely exceed chance should be viewed with caution until validated with an independent sample. The second discriminant analysis for cluster membership yielded two 3-variable functions that far exceed the chance rate of 58% with classification accuracy of 98.6%. These results demonstrate a potential predictive relationship between children's scores on the CVLT–C and WCST and their performance on the CPT that warrants further investiga-

tion with an independent sample. The discriminant loadings of the variables entered into the 2 functions used to predict cluster membership are used to further delineate the clusters' profiles.

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O. MOSKO, J. MURPHY, M. SHIN, A. SILVERMAN, & D. TUCKER. Speed of Processing in Boys With ADHD.

The present study investigated the importance of speed of information processing in the overall attentional impairment of children with ADHD. Participants consisted of 11 boys aged 9–13 years diagnosed with ADHD, Combined Type. Controls were 11 age- and IQ-matched boys, with no history of ADHD. Participants were evaluated with the Austin modification of the PASAT, which is similar to the standard PASAT. However, to better estimate speed of processing, the interstimulus interval (ISI) decreases by 0.1 s for each successive stimulus item. The ISI at which the participant made 2 consecutive errors or 2 errors within 4 stimulus items (e.g., responding to every other item) was considered their maximum speed of processing. To increase reliability, each participant was administered 3 trials beginning with an ISI of 3.3 s and continuing until discontinue criteria was met. The average of the 3 trials was used as the dependent variable in the subsequent analysis. Also, this task was presented in both the auditory and visual modalities separately. A 2×2 mixed ANOVA, with modality of presentation as the repeated measure, resulted in significant main effects for group [$F(1,20) = 6.358, p = .02$] and modality of presentation [$F(1,20) = 6.918, p = .016$]. The Group \times Modality interaction also reached significance [$F(1,20) = 7.706, p = .012$]. Thus, the ADHD group showed slower information processing speed relative to controls, but only in the visual modality. These data suggest that information processing speed may be an important component of the attentional deficit in ADHD. Also, this attentional deficit appears to have modality-specific features.

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V. LOZANO, K. KRULL, L. BUONO, & J. FEIGIN. Principal Component Analysis of Attention Measures in Clinic-Referred Children.

A principal component analysis of 5 attention measures administered to 56 school-aged children referred to a clinic for attention problems was conducted. All children completed the Differential Ability Scale (DAS), Wechsler Individual Achievement Test (WIAT), Gordon Diagnostic System (GDS), Stroop Color-Word Reading Test, and Random 'A's Cancellation Test as part of a larger clinic battery. Only children who obtained a General Conceptual Ability ≥ 70 on the DAS were included in the sample. The principal component analysis, which included the DAS' Recall of Designs subtest, the WIAT's Listening Comprehension subtest, Random 'A's percent of correct responses, the Stroop's interference score, the GDS's number of correct responses, and reaction times from each of the 3 blocks on the GDS, yielded 4 principal components. Component 1 comprising the GDS reaction times across Blocks 1–3, is felt to be reflective of stability of attention over time. Component 2, comprising Listening Comprehension and Recall of Designs, is felt to represent the encoding of information. Component 3, comprising Random 'A's, is felt to reflect focused attention. Component 4, comprising GDS correct responses and Stroop interference, may be reflective of interference control, as these variables are negatively correlated.

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T. MIRRASHIDI, L. HUMPHREY, S. SMALLEY, & A. LIU. Impact of Working Memory on Reading Skills in a Sample of ADHD Children.

The impact of working memory on reading skills in a sample of 96 children between the ages of 8 and 16 with attention deficit hyperactivity disorder (ADHD) was examined. ADHD was diagnosed using a DSM–IV semistructured psychiatric interview, the K-SADS (Schedule for Affective Disorders and Schizophrenia for School Aged Children). Working memory was measured by using the difference between the longest Digits Forwards and Digits Backwards spans on the WISC–III–R. The ADHD children

in this sample performed significantly worse on this measure of working memory skills ($p < .01$) as compared to the standardization sample of the U.S. population children. However, the ADHD children in this sample scored significantly higher on two measures of reading skills on the PIAT-R: Reading Comprehension and Reading Recognition ($p < .01$) than children in the normative sample. A regression model with the following variables: the difference between Digits Forward and Digits Backward, Word Attack standard score, and Reading Recognition score was used to explore the variation in Reading Comprehension. We used a stepwise selection method to finalize a model that significantly explained 58% of the variance in Reading Comprehension ($R^2 = 0.58$). Specifically, Reading Recognition was the most significant variable in explaining the variance in Reading Comprehension ($p = .0001$), and the difference between Digits Forwards and Digits Backward was the second most significant variable in explaining the variance in Reading Comprehension ($p = .0306$). Limitations of the use of the difference between Digits Forward and Digits Backward in isolation as a measure of working memory are discussed.

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C. YEAGER, T. PETROS, L. LEADBETTER, J. SMITH, L. LIS-TUG, & R. McBRIDE. The Effect of Comorbid ODD on Executive Functioning in ADHD Children.

Attention deficit hyperactivity disorder (ADHD) is hypothesized to be a disorder of executive functioning. One test that is frequently used to measure executive functioning in ADHD is the Wisconsin Card Sorting Test (WCST). Results of studies comparing ADHD with control children using the WCST are inconsistent, with some studies showing group differences while others show no differences. One limitation of these studies has been the failure to control for frequently occurring comorbid psychiatric conditions in the ADHD children, such as oppositional defiant disorder (ODD) and conduct disorder (CD). Previous studies have demonstrated that children with ADHD and comorbid ODD or CD perform significantly better on tests of executive functioning when compared to children with ADHD only. Based on these results, the present study tested the hypothesis that children with a diagnosis of ADHD only would show deficits on the WCST relative to controls, but that children with a comorbid diagnosis of ADHD and ODD or CD would not show such deficits. A series of one-way ANOVAs was used to examine performance on the WCST. Results indicated support for the hypothesis, in that children with ADHD only had fewer total correct, fewer categories completed, more trials administered, more perseverative errors, and more total errors than control children, while children with comorbid ADHD and ODD/CD were not found to be significantly different from controls on these measures. These results suggest that ADHD symptoms co-occurring with ODD/CD are not associated with deficits in executive functioning.

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J.E. HOLIFIELD, W.D. ROSEN, & J. KAVANAUGH. Burton's WRAML Factors in Children With Processing and Attention Deficits.

The Wide Range Assessment of Memory and Learning incorporates 6 memory and 3 learning subtests. As such, it may well assess children with brain lesions underlying memory deficits, but is probably used mostly, with uncertain validity, for children with neurodevelopmental processing deficits. To investigate its validity with the population, 142 six-to-sixteen-year-old children showing attention deficit hyperactivity disorder (ADHD) and visuosperceptual deficits (VPD) or verbal deficits (VD) with and without ADHD were assessed using the Burton et al. empirically derived factors (Visual Memory, Verbal Memory and Attention). Participants were assigned to 1 of 5 groups based upon WISC-III VIQ-PIQ discrepancy and DSM criteria for ADHD. No significant group effects were found on the Verbal Memory and Visual Memory indices, suggesting that either these indices do not tap the purported skills, or alternatively, that children with developmental processing and attention problems may not have recognition and retrieval difficulties once the information has been registered and

stored. Second, a surprising group difference was found on the Attention factor ($p < .001$), indicating that the VPD group without ADHD performed significantly better than the VD ($p < .001$), ADHD ($p < .01$), and VD plus ADHD ($p < .01$) groups. Two of the 3 subtests on this factor, Number/Letter and Sentence Memory (vs. Finger Windows) may load more heavily on linguistic processing than attention, placing into question this factor label and subtest covariation. Attention deficits may be modality specific, suggesting the need to reconsider ADHD nosology.

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R. STEPHENSON, L. HUMPHREY, & S. SMALLEY. Differential Patterns According to ADHD Subtype on ROCF Reproductions.

Executive functioning in children with ADHD has been the subject of much research, and a number of studies has identified organizational deficits in children with ADHD on the Rey-Osterrieth Complex Figure (ROCF). Few studies, however, have examined executive functioning dependent on ADHD subtype. One recent study found that children with ADHD, combined type (ADHD-C), performed worse on select tasks of executive functioning (WCST, Stroop) than children with ADHD, predominantly inattentive type (ADHD-I), and significantly worse than controls. The aim of this study was to further investigate differential patterns in executive abilities of children with ADHD according to subtype. Preliminary data, from a larger ongoing study on the genetic susceptibility of ADHD, were obtained from 40 children diagnosed with ADHD (ADHD-I, $n = 20$; ADHD-C, $n = 20$). Participants, all unmedicated, were administered the ROCF, and reproductions were scored according to the Waber and Holmes developmental system. For the present study, only copy administrations were examined. Results from a series of 1-way ANOVAs indicated that children with ADHD-I differed significantly from children with ADHD-C on organization score and structural accuracy, with the former subtype evidencing greater impairment in organization of the complex drawing and in the accurate reproduction of the base rectangle and primary substructure line segments. Findings suggest that children with ADHD-I have greater impairment than ADHD-C on select executive abilities. Results are reviewed, and the need for continued research regarding differences in executive functioning between ADHD subtypes is discussed.

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ADHD IN ADULTS

J. MIELKE, S. HALL, R. VELIN, P. BACH, & B. ROCHE. Conners CPT False Positive Rates in a Nonclinical Sample of Adults.

The neuropsychological assessment of attention deficit hyperactivity disorder is assessed in a broad-based approach including self-report, behavioral rating scales, direct observation, and objective measures. The Conners Continuous Performance Test (CPT) has been administered as an objective measure in the analysis, diagnosis, and evaluation of treatment in children with attention deficits. Recently, there has been an increase in the self-report of ADHD symptoms in adults seeking psychological treatment. This study looks at the false positive rates in the performance of a non-clinical sample of adults administered the CPT. The authors of the CPT suggest that the narrative assessment rather than the overall index score may be a preferable means of identifying attention deficits. This study used the overall narrative statement to determine positive diagnosis of attention deficits. Participants were screened for history of medical, neurological, and psychological disorders. Thirty-five adults, 20 males and 15 females, aged 18 to 60, were administered the CPT individually in a distraction free room. Results indicated that 46% of the participants were identified as having attention deficits, or symptoms of attention deficits, requiring ongoing observation. Gender was also evaluated. Results indicated that 67% of females and 30% of males presented with symptoms of attention deficits. The group was then further subdivided into three age categories as follows: 18-31 ($n = 12$), 32-44 ($n = 13$), 45-60 ($n = 10$). Results indi-

cating symptoms of attention deficit for the 3 groups respectively were: 50%, 54%, 30%.

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R.E. SEIFER, W.J. BURNS, V. JOFFE, & A. SELLERS. Continuous Performance Versus Parent/Teacher Rating as ADHD Diagnostic Indicators.

The purpose of this study was to verify the high selection rate of the Test of Variables of Attention (TOVA) with the Conners' Parent/Teacher Rating Scales to discriminate attention deficit hyperactivity disorder (ADHD) in 37 females and 67 males, 5 through 17 years of age. In the neuropsychological assessment of children with ADHD, the TOVA, a continuous performance test, and the Conners' Parent and Teacher Rating Scales, behavioral rating reports by teachers and parents, are frequently used. The TOVA indicates whether there are problems with attention. The more negative the Z score, the greater the problem with attention. The Conners' Parent Rating Scale's cutoff is $\geq T$ score of 65 for a diagnosis of ADHD. Of the 104 participants, 73 (70%) of the sample met criteria for ADHD in the TOVA, whereas only 40 (55%) met criteria on the Conners' Parent Rating Scale for ADHD. The overall agreement between the TOVA and Conners' Parent Rating Scale was only 45%. Of the 33 who met criteria for the TOVA but not for the Conners' Parent Rating Scale, an equal proportion of males and females were selected. But, when the Conners' Parent Rating Scale: Revised and Conners' Parent Rating Scale were compared with one another, the Revised Conners' was found to over select females (chi-squared = 8.365, $p < .004$) and underselect males (chi-squared = 8.365, $p > .004$). In this study mothers were significantly more likely to rate their daughters as meeting threshold ADHD than their sons. Therefore, the TOVA had a higher selection rate than the Conners' for ADHD and the Conners' had a higher selection rate for females.

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G. ANDREWS, J. VAVOLD, & J. IMLAH. Adult Attention Deficit Disorder: Crossed–Uncrossed Reaction Time Differences.

Previous research suggested a relationship between attention deficit hyperactivity disorder (ADHD) and abnormalities of the corpus callosum and interhemispheric interactions. Research suggesting a role of the corpus callosum in attention indicates that callosal problems might be greater in those ADHD individuals who are primarily inattentive (ADHD–I) compared to those who are either primarily hyperactive (ADHD–H) or combined inattentive and hyperactive (ADHD–C). This question was tested in adults with ADHD and controls using the cross–uncrossed response time (RT) differences (CUD), which is a measure of interhemispheric transfer time. Participants included adults diagnosed with ADHD–H (4), ADHD–I (11), ADHD–C (6) and controls (11). Although there were no differences in intelligence scores, the ADHD–H group had a higher WAIS–R digit span mean than controls. The MANOVA revealed no group significant differences in RT for CUD, but controls were the only group to have positive CUDs. All 3 ADHD groups had negative CUDs indicating their RT was faster when the information was presented contralateral to the responding hand. A main effect for responding hand indicated that left hand responses were faster overall. These results do not suggest that individuals with ADHD, or any subgroup of ADHD individuals, have a prolonged CUD (as seen in agenesis of the corpus callosum or commissurotomy patients). Thus, the CUD task provides no evidence for callosal problems in ADHD.

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G. ANDREWS, J. IMLAH, & J. VAVOLD. Adults With Attention Deficit Disorder: Deficits in Bilateral Field Advantage.

Previous research suggested a relationship between attention deficit hyperactivity disorder (ADHD) and abnormalities of the corpus callosum and interhemispheric interactions. Research indicating a role of the corpus callosum in attention would predict that callosal problems might be greater in

those ADHD individuals who are primarily inattentive (ADHD–I) compared to those who are primarily hyperactive (ADHD–H) or combined hyperactivity and inattentive (ADHD–C). This question was tested in adults with ADHD using a test of bilateral vs. unilateral letter and dot-pattern matching. Participants included adults with ADHD–H (4), ADHD–I (11), ADHD–C (6) and controls (11). Group \times Position (unilateral vs. bilateral) repeated measures ANOVAs for errors and response time (RT) indicate possible deficits with ADHD–I participants. Main effects for position were found with shorter RTs for bilateral trials for both tasks, and fewer errors for bilateral trials on letter matching. Significant interactions for Group \times Position were found for the letter-matching tasks, with ADHD–I participants making significantly more errors in both unilateral and bilateral trials than all other groups. Results indicate that ADHD–I participants sacrifice accuracy for speed in the dot-pattern task. Although their speed is not significantly different from the other groups, the ADHD–I participants demonstrate a significant increase in errors for bilateral trials, a bilateral disadvantage. These results suggest that ADHD–I participants demonstrate poorer performance overall than other groups on letter-matching and dot-pattern tasks. Specifically, ADHD–I participants did not benefit from bilateral presentation of the stimuli during the more complex dot-pattern task.

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M. ZUCKER, M. MORRIS, & R. MORRIS. Sex Differences in Primary and Associated Psychological Symptoms in Adults With ADHD.

Sex differences in self-reported symptoms of ADHD and associated psychopathology (assessed dimensionally and categorically) were explored in college-aged adults: 110 (74 males, 36 females) diagnosed with ADHD and 111 (70 males, 41 females) without diagnoses of ADHD. Adults with ADHD were compared to a normative sample in order to determine whether sex differences previously reported for ADHD reflect some aspect of this disorder or represent population-based sex differences in those behaviors used to identify ADHD. Males and females with and without ADHD reported similar levels of inattention, while a trend for women to report more hyperactivity/impulsivity than men was present only in adults with ADHD. In both clinical and normative samples, females reported more internalizing symptoms than males, while males and females did not differ in externalizing symptoms. However, a unique pattern of results was evident for one type of internalizing symptom in that females with ADHD reported more anxiety than males with ADHD, while men and women without ADHD did not differ. In contrast to the dimensional data, analyses indicated no sex differences in rates of categorical diagnoses of mood or anxiety disorders within the ADHD group. Sex differences in self-reported ADHD symptoms in adults with and without ADHD were limited, suggesting that symptoms used to diagnose ADHD manifest similarly in male and female adults diagnosed with the disorder. However, indications of possible sex-based differences in hyperactive/impulsive symptoms and comorbid features of ADHD have important implications for both research and clinical practice.

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L.J. RAPPORT, A. VAN VOORHIS, A. TZELEPIS, & S. FRIEDMAN. Executive Functioning in Adult ADHD.

Few studies have assessed the executive functions of adults diagnosed with ADHD, and findings associated with this research present mixed results. The present study examined the executive abilities of 35 adults diagnosed with ADHD and 32 adults without the disorder ($N = 67$) who were equivalent in age, gender, years of education, and Full Scale IQ. Data were analyzed using multivariate and univariate ANOVA, as well as nonparametric tests where appropriate. The ADHD group performed worse on Stroop Color-Word ($p < .001$, $\eta^2 = .18$) and Interference ($p = .03$, $\eta^2 = .08$), as well as time to complete Trials B ($p = .02$, $\eta^2 = .08$) than did the controls but committed an equivalent number of errors on Trails B ($p = .15$). Analysis of Design Fluency indicated that the ADHD group made more perseverative ($p = .04$, $\eta^2 = .06$) and nonperseverative ($p = .004$, $\eta^2 = .12$)

errors; however, Design Total (novel output) was equivalent for the groups. No group differences were observed on verbal fluency, WAIS-R Similarities, or letter-number span (all $ps > .30$). The distributions of WCST variables showed severe skew associated with high-functioning performance on the test among both groups. Group differences on tests of other cognitive domains were not significant (all $ps > .30$). The pattern of performance among these adults with ADHD suggests the presence of specific deficits in response inhibition, with intact abilities in other cognitive domains, such as primary verbal and visuospatial skills. These findings are consistent with the literature on neuropsychologic deficits among children with ADHD. That persons with ADHD present a primary deficit of behavioral inhibition supports Barkley's theory of ADHD as a deficit in behavioral inhibition, as opposed to Denkla's theory that emphasizes intention and working memory.

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L. LEADBETTER, T. PETROS, C. YEAGER, A. ZEVENBERGEN, & J. SMITH. The Impact of Extended Time on Reading Comprehension in Adults With Disabilities.

The determination of appropriate academic accommodations for college adults with disabilities is an area of considerable debate. Unfortunately, empirical support for the necessity and efficacy of these accommodations is minimal. In one study of the efficacy of extended time for reading, Runyan found a significant difference in Nelson-Denny Reading Comprehension scores between college students with learning disabilities and normally-achieving students under timed conditions but no significant difference under extended-time conditions. The present study examined the impact of extended time on performance on the Nelson-Denny Reading Comprehension subtest in college students with various disabilities. Patient protocols that included a timed and untimed administration of the Nelson-Denny Reading Comprehension subtest were selected from a set of protocols obtained from individuals seeking services from a university-based assessment clinic. The study sample included individuals diagnosed with Reading Disorder (RD; $n = 15$), attention deficit hyperactivity disorder (ADHD; $n = 11$), RD and ADHD ($n = 8$), ADHD and Depression/Dysthymia ($n = 5$), and Depression/Dysthymia ($n = 4$). A one-way ANOVA and follow-up Tukey tests revealed that the two Reading Disorder groups (i.e., RD, RD and ADHD) scored significantly lower than the other three groups on the timed administration of the Nelson-Denny. A one-way ANOVA revealed no group differences when the patients were given unlimited time on the Nelson-Denny. Significant gains in performance on the untimed administration were observed for all but the ADHD-only group. The present results support the findings of Runyan while also suggesting that individuals with ADHD may not benefit from extended time on reading tasks.

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S. EATON, M. JOHNSON, L. FLASHMAN, P. MARTIN, & A. SAYKIN. Neuropsychological Effects of Anxiety in Adult ADHD Before and After a Trial of Methylphenidate.

Adult attention deficit hyperactivity disorder (ADHD) is a heterogeneous psychiatric disorder that initially manifests in childhood and often persists into adulthood. It is often complicated by a comorbid psychiatric disorder resulting in "complex ADHD." This study investigated the impact of comorbid anxiety on the neuropsychological performance of adults with ADHD, and evaluates their response to a trial of methylphenidate. It was hypothesized that at baseline there would be a negative correlation between level of anxiety and neuropsychological performance. It was predicted that following a methylphenidate trial, there would be a decrease in anxiety, which would account for a significant portion of attentional deficits. Thirty-five adults with ADHD received a comprehensive neuropsychological evaluation including cognitive, motor, and affective functioning before and after a trial of methylphenidate. A group of 15 controls received evaluations at yoked time intervals. For ADHD subjects, increased anxiety was correlated with decreased performance in Verbal Memory, Visual Distraction, Processing Speed, and Global neuropsychological func-

tioning. Following a trial of methylphenidate, changes in anxiety were positively correlated with changes in Verbal Memory, Visual Distraction, and Global performance. The ADHD group exhibited a significant decrease in anxiety, although a small number showed an increase in anxiety. These results indicate that increased anxiety decreases the neuropsychological performance of adults with ADHD, highlighting the importance of treating both the anxiety and the symptoms of ADHD. Presence of comorbid anxiety did not hinder the overall effectiveness of methylphenidate treatment of ADHD symptoms; rather, treatment with methylphenidate often simultaneously improved symptoms of anxiety and ADHD.

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J. WEITLAUF, A. CONWAY, J. FINK, & N. PLISKIN. Intraindividual Consistency in Cognitive Abilities in Individuals With ADHD.

A vexing problem has been to identify the specific neuropsychological profile that characterizes adults with attention deficit hyperactivity disorder (ADHD). The authors suggest that group level differences between ADHD patients and controls on tasks of attention and cognition provide only preliminary evidence for differences between these populations. An additional level of analysis that holds promise for diagnostic efficacy may be the intra-person patterns of consistency and variability on such tasks. This pilot study explores patterns of intraindividual consistency across tasks of attention and intellectual functioning in controls and ADHD patients. Participants were 59 adult males; 29 met DSM-IV criteria for ADHD, 30 were controls. All were administered a complete WAIS-R, Stroop Color-Word Test, Trailmaking Test Part A and B, and the PASAT. Variables were first clustered into conceptually related groups for analyses. Consistent with previous research, results of one way between group MANOVAs indicated that controls significantly outperformed ADHD patients on WAIS-R subtests featuring speeded mental processing, and on measures of attention. Measures of attention and intellectual functioning were poorly intercorrelated for ADHD patients, but highly related for controls; hence, while measures of attention were excellent predictors of intelligence in controls, they were unrelated to intellectual functioning in ADHD patients. Within-group analysis indicated that, unlike controls, ADHD patients' performance was characterized by higher variability and scatter. Idiographic analysis of a randomly selected subset of ADHD patients revealed predictable patterns of performance across tasks based on individual difference characteristics including mood and FSIQ. Implications for future research are discussed.

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D. HIGGINS, R. RHODES, B. SHENAL, & D. HARRISON. Quantitative Electroencephalography as an Assessment Tool for ADHD Diagnosis.

Quantitative electroencephalography (QEEG) research data from a case study is analyzed demonstrating the utility of QEEG as a confirmatory test of localization for cerebral dysfunction following a neuropsychological evaluation of a young male (age 19), previously diagnosed with attention deficit hyperactivity disorder (ADHD). During the initial neuropsychological assessment, cerebral dysfunction was evaluated via an ideographic, syndrome analysis approach. QEEG procedures then provided an objective method for further substantiating the conclusions generated from the primary neuropsychological evaluation (where results indicated cerebral dysfunction primarily at the left frontal region). As the hypothesized dysfunction was examined using QEEG, results were consistent with the *a priori* predictions made from the neuropsychological evaluation. Specifically, analysis of the record evidenced consistent slowing (indicated by increased Delta and Theta magnitudes) of the left frontal regions, in comparison to homologous regions at the right hemisphere. Analyses included a within-subject statistical approach to analyze interhemispheric comparisons (left vs. right). Often, DSM-IV criteria for ADHD focus almost exclusively on behavioral observations, without mention of underlying cerebral dysfunction.

That is to say, behaviorally, a patient must show deficits related to inattention (e.g., carelessness, lack of organization, poor follow-through, distractibility) and/or hyperactivity-impulsivity (e.g., fidgeting, excessive running/climbing, difficulty awaiting turn, interrupting others). Whereas, this study illustrates the utility of a neuropsychological assessment with QEEG in localizing cerebral dysfunction in individuals diagnosed with ADHD. It also offers a neuropsychological explanation for ADHD, predominantly inattentive type, suggesting left frontal dysfunction, yielding behaviors indicative of ADHD (e.g., decreased intention to task, decreased initiation, decreased persistence for task completion).

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SCHIZOPHRENIA

W. PERRY, A. MINASSIAN, & I. BHATTACHARJIE. The Effects of Atypical Neuroleptics on Attention in Acutely Ill Schizophrenia Patients. The present study investigated the effects of antipsychotic medication on neuropsychological performance in acutely psychotic patients. Two groups of schizophrenia patients who were admitted to an inpatient facility for acute exacerbation of their psychosis were tested on admission (Session 1) and 2 weeks later once stabilized on atypical antipsychotic medication (Session 2). Participants were tested on four measures of attention: Digit Span (DS), Spatial Span (SS), Letter-Number Sequencing (LNS) and The Trail Making Test (TMT A & B). One group was unmedicated ($n = 12$) and the other group ($n = 13$) were treated with antipsychotics (11 patients on atypical and 2 on typical antipsychotic medications). There were no significant differences on symptom measures between the 2 groups at session 1 or 2. There were no differences between the two groups on DS, LNS, SS or on TMT Part A. On the TMT Part B, unmedicated patients were faster than medicated patients during the initial session ($p < .04$). Both groups improved their performance on DS over the 2 weeks ($p < .05$) and a trend towards improvement between the two sessions for LNS performance ($p < .08$). There was no significant improvement for either group on SS and TMT Parts A and B. These data have implications for the effects of atypical antipsychotic medication on patients with severe symptoms who also demonstrate moderate cognitive impairment.

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S. KINDERMANN, G. BROWN, L. EYLER ZORRILLA, & D. JESTE. Nonverbal Visual Vigilance in Older Patients With Schizophrenia and Controls Using fMRI.

Background: A hallmark of schizophrenia is difficulty with attention. This has been linked to rehospitalization. Do brain activation patterns among middle-aged and older patients and controls differ using a vigilance task? **Method:** As part of an ongoing study, nine older controls (M age = 60.6 years, $SD = 8.68$); 7 older patients with schizophrenia or schizoaffective disorder (M age = 59.1, $SD = 9.15$) were imaged in a 1.5T scanner using BOLD gradient-echo fMRI. In an asymmetrically blocked design, subjects viewed a fixation cross (1s cue, 20s fixation) and a vigilance task (pressing a button when a nonsense design contained a dot; 1s cue, 1s on time, 1s ISI). Data were analyzed using a two-sample t test to determine which foci met a threshold of 3.583 ($p < .0025$) and cluster threshold of 600 μ l. **Results:** Between-group differences in vigilance only are presented. Controls activated more intensely than patients except in posterior cerebellum and temporal gyri where the reverse was true. Significant differences between patients and controls occurred in: *Left:* posterior cerebellum, middle temporal gyrus, cuneus, precentral/postcentral gyrus, inferior parietal lobules, superior parietal lobule, postcentral gyrus/inferior parietal lobule; *Right:* anterior cerebellum, inferior temporal gyrus, thalamus, inferior parietal lobule/supramarginal gyrus/precuneus, medial frontal gyrus, precentral gyrus; and bilateral middle occipital gyrus, midline precuneus. **Discussion:** Despite conservative thresholds, these preliminary data show patients and controls display different activation patterns on the vigilance task. The increased activity among patients is in the temporal lobe

and decreased activity in the prefrontal area agree with findings of disordered frontotemporal connectivity in patients with schizophrenia.

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M. RIVERA MINDT & W. SPAULDING. A Biosystemic Model of Coping in Schizophrenia.

The present study was designed to investigate the neuroendocrinological, neuropsychological, attributional, and behavioral substrates of coping in schizophrenia, and discuss implications for treatment. Study participants included a total of 35 individuals with the diagnosis of a schizophrenia-spectrum disorder as defined by the DSM-IV, and confirmed by a trained psychiatrist and licensed clinical psychologist. Neuroendocrine functioning was assessed with salivary cortisol samples. A comprehensive battery assessed neuropsychological functioning and coping. The results of correlational and multiple regression analyses revealed that better neuroendocrine, neuropsychological, and behavioral functioning is associated with more positive coping attributions. Hypothalamus-pituitary-adrenal (HPA) axis dysregulation (in the form of hypocortisolemia), and impairments in executive functioning, verbal learning and memory; and behavioral functioning all significantly predict escape-avoidant coping attributions in schizophrenia. The relationship with HPA axis dysregulation and coping was marginal, while robust relationships were observed in the domains of neuropsychological and behavioral functioning with coping attributions. The results of this study generally support *a priori* hypotheses regarding the multisystemic nature of coping in schizophrenia. With regard to treatment, it would be expected that pharmacological treatments (i.e., antipsychotic medication and cortisol regulating drugs) and psychosocial treatments (i.e., stress management and coping skills training) might all serve as useful strategies targeting HPA axis and behavioral dysregulation. Future empirical investigation must be undertaken in order to further elucidate these relationships with a larger sample, as well as systematically examine possible treatments to improve coping skills for stress within this population. Correspondence: *Monica Rivera Mindt, 4020 2nd Avenue N.E., Seattle, WA 98105.*

M. LANCA, L. J. SEIDMAN, W.S. KREMEN, S.V. FARAONE, & M.T. TSUANG. Visual Memory and Organizational Deficits on the Rey-Osterrieth in Schizophrenia.

Schizophrenia is a complex neurobehavioral disorder that affects cognitive functioning. Although there is considerable research documenting verbal memory deficits in schizophrenia, few studies have demonstrated visual memory impairments. Long-term memory performance may also be secondary to impaired executive functioning, which is prominent in schizophrenia. Our primary goal was to investigate whether schizophrenics exhibited memory deficits on the Rey-Osterrieth (ROCF) and to examine the relationship between recall accuracy and organization (an executive function) on the ROCF. A second goal was to examine whether deficits were specific to schizophrenia, by comparing the performance of schizophrenics and patients with bipolar psychoses. Eighty-four controls, 79 schizophrenics, and 14 psychotic bipolars, matched on age and expected intellectual ability (based on single-word reading) were tested on their copy and immediate recall of the ROCF. Schizophrenics and bipolars were also similar on age of illness onset and number of hospitalizations. Using multivariate analyses of variance with sex and parental education as covariates, schizophrenics were significantly more impaired than controls on ROCF copy accuracy and immediate recall accuracy. Schizophrenics used a less gestalt approach in their copy than the controls and had more impaired copy and immediate recall organization than the controls. Schizophrenics and bipolars had similar profile patterns in accuracy and organization, but schizophrenics had a more severe impairment than bipolars. These findings show that both recall accuracy and organization are impaired in schizophrenia and that these impairments are more severe, though not qualitatively different, than those manifested in bipolar disorder.

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S. FARELLA-BUSCH, S. BERNIS, J. JAEGER, & J. HALPERIN. Processing Speed in Patients With Positive/Negative Symptoms of Schizophrenia.

Studies suggest that patients with schizophrenia having predominantly negative symptoms process information more slowly than those patients with predominantly positive symptoms. The present study sought to compare these 2 patient subgroups on an information-processing task of sustained attention that varied in the duration of stimulus presentation. It was hypothesized that increasing the stimulus duration would improve performance of patients with predominantly negative symptoms, but not the performance of those with predominantly positive symptoms. Fifty outpatients with schizophrenia were studied and classified with respect to negative and positive subtype based on predominance of respective symptom ratings on the PANSS. Results indicated that both patient groups performed poorly on this test compared to published norms. When the full sample was analyzed our hypothesis was not confirmed. However, when subtypes were defined more rigorously so that approximately half of the sample met criteria for either the positive or negative subtype, results indicated that the negative symptom subgroup benefited more than the positive symptom subgroup when given more time to view the target stimulus. These results suggest that patients with predominantly negative symptoms have difficulty with rapid information processing.

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R.E. HARLAND, R. KRIKORIAN, P.K. SHEAR, & S.M. STRAKOWSKI. The Contribution of Planning Ability to Autonomous Living in Individuals With Schizophrenia.

Individuals with schizophrenia often experience significant impairment in basic self-care skills that limits their ability to live autonomously. Psychiatric symptoms and cognitive deficits have been found to be important predictors of independent living, although the extent to which each of these factors contributes to functional disability remains unclear. Executive function ability represents a fundamental capacity that contributes to autonomous functioning in a variety of neuropsychiatric disorders. The purpose of this study was to determine whether planning ability, 1 component process of executive functioning, accounts for variance in the prediction of autonomous living beyond that accounted for by schizophrenia symptomatology. Thirty community-dwelling individuals (17 females, 13 males, M age = 42.2, SD = 8.2) with SCID-I/P diagnoses of schizophrenia participated in this study. Participants' psychotic, disorganized and negative symptoms were rated using the Scale for the Assessment of Positive Symptoms and the Scale for the Assessment of Negative Symptoms, and autonomous living was rated using the Independent Living item from the Role Functioning Scale. Participants then completed the Tinkertoy test, a constructional task that requires the planning and execution of a complex activity in the context of minimal externally provided structure. Multiple regression analysis indicated that performance on the Tinkertoy planning measure accounted for unique aspects of the variance in autonomous living ($p < .05$) after controlling for the effects of psychiatric symptomatology. This result suggests that planning ability has functional implications not attributable to symptoms, and highlights the potential for utilizing cognitive remediation techniques to improve psychosocial functioning in individuals with schizophrenia.

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D.N. ALLEN, E.L. WARNICK, M.W. GILBERTSON, & D.P. VAN KAMMEN. Neuropsychological Function, Symptoms, and Premorbid Adjustment in Schizophrenia.

The Premorbid Adjustment Scale (PAS) is commonly used to evaluate premorbid functioning in schizophrenia. Confirmatory factor analysis indicates the PAS is composed of two distinct factors that assess Academic and Social adjustment. These factors are differentially correlated with current symptomatology, age of disease onset, premorbid IQ, current IQ, CSF dopamine β -hydroxylase, and treatment response. The current study ex-

amined relationships between the PAS factors and neuropsychological variables to further evaluate validity of the PAS factors. Individuals with SCID diagnoses of schizophrenia ($N = 41$) were evaluated with the PAS, Brief Psychiatric Rating Scale (BPRS), and a battery of neuropsychological tests including the Purdue Peg Board, Continuous Performance Test, Trial Making Test, Wisconsin Card Sort, and Wechsler Memory Scale-Revised. The PAS Social factor was significantly correlated ($p < .05$) with age of disease onset and BPRS disorganization. The PAS Academic factor was significantly correlated with memory and attention measures, as well as BPRS disorganization and years of education. The total average PAS score was not significantly correlated with any of the neuropsychological variables. These results further support the distinction between PAS Academic and Social factors. Use of the PAS factors allowed detection of significant correlations that were not evident when the Total Average score was used. Academic premorbid adjustment is associated with current neuropsychological functioning but not with age of disease onset. This finding may suggest that cognitive deficits present in schizophrenia prior to disease onset have greater detrimental effects on premorbid academic adjustment compared to premorbid social adjustment.

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J. WARD, D. MOSER, D.S. O'LEARY, A. TRANEL, S. ARNDT, & N.C. ANDREASEN. Cognitive Functioning in Patients With Schizophrenia at 9-Year Follow-Up.

Deficits in cognitive functioning have been associated with schizophrenia since the first description of this illness. Numerous longitudinal studies have addressed neuropsychological test performance at 2 and 5 years post initial episode of illness but fewer have reported on patients' abilities beyond this range of time. With the maturation of longitudinal studies at several institutions, understanding of the long-term impact of schizophrenia is increasing. The current study assessed cognitive functioning in 28 patients with schizophrenia-spectrum diagnoses who have been followed at the University of Iowa Mental Health Clinical Research Center for 9 years. Neuropsychological measures were grouped into cognitive domains for the purpose of analyzing test performance across three assessment periods. Cronbach's coefficient alpha analyses, indicating the degree to which the test measures comprising these domains were related, resulted in alpha values between .71 and .90 for this patient sample. Given that previous findings have suggested possible improvement in cognitive functioning at 2-year follow-up and the risk of regression to the mean of test data after intake assessment (when patients may perform at their worst due to severity of illness), comparisons of changes in cognitive domain scores were made between intake and 9-year follow-up and between 2-year follow-up and 9-year follow-up. The relationships between neuropsychological test data and psychiatric symptoms at each assessment period were also investigated, as was any possible affect of neuroleptic dosage on test performance. Results will be discussed with regards to the longitudinal course of cognitive functioning in patients with schizophrenia.

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R. GOLDSTEIN, T. GIOVANNETTI, M. SCHULLERY, H. WU, J. LIEBERMAN, D. ROBINSON, W.B. BARR, & R.M. BILDER. Psychiatric and Neuroanatomical Correlates of Cognitive Function in Schizophrenia.

This study investigated the association of verbal fluency and conceptual shifting with thought disorder in individuals with schizophrenia. An additional objective was to examine the neuroanatomical correlates of the responses on these neuropsychological (NP) tests, as they are frequently associated with focal brain anomalies. Canonical correlation was used to assess the relationships between 6 measures of NP and psychiatric function in 62 patients with first-episode schizophrenia. In addition, partial correlations were performed between the NP tests and volumetric measures of the frontal and temporal cortices in the patients and 22 normal controls.

One significant canonical correlation emerged ($r = .57$; $p < .01$) which was defined by perseverative responses on the Wisconsin Card Sort Test ($r = .86$) and animal word list generation ($r = -.76$) on the NP variate, and SANS latency of response ($r = .74$), SADS derailment ($r = .57$) and impaired understandability ($r = .42$) on the psychiatric canonical variate. In contrast, an index of the semantic relatedness of animal word list generation responses (AI), was associated with this canonical correlation to a relatively minor extent ($r = -.30$). Several significant correlations between the selected NP variables and frontal and temporal cortical volumetric measures were documented. However, all correlations disappeared once total cortical volume was partialled out. The first of our findings, although tentative, points to the dysexecutive nature of thought disorder and raises concerns regarding the use of animal word list generation as a measure of semantic processing. Our second finding warns against the use of individual NP measures as indices of localized brain function in schizophrenia.

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T. GIOVANNETTI, R. GOLDSTEIN, M. SCHULLERY, W. BARR, & R. BILDER. First-Episode Schizophrenia Patients Show Preserved Semantic Knowledge on WLG.

Schizophrenia patients show impaired semantic processing on animal word list generation (AN-WLG). However, these results have been obtained from chronic patients using methods that analyze only a subset of WLG output (e.g., multidimensional scaling), AN-WLG performance was explored in 62 first-episode schizophrenia (SCH) participants and 31 controls. Fifty-nine left temporal lobe epilepsy (LTLE) participants were included as a control group with known temporal lobe damage and semantic deficits. Tests of language and executive functioning were administered. The Association Index (AI), which measures the semantic relatedness of all AN-WLG responses, was calculated. Significant group differences were observed for total output [$F(2) = 42.8$, $p < .01$], and AI, [$F(2) = 7$, $p < .01$]. *Post-hoc* Scheffé tests showed SCH and LTLE participants produced fewer WLG responses than controls. There was no difference between SCH and controls for the AI, but the LTLE group obtained lower scores than the other groups. Correlations between WLG total output and neuropsychological tests showed a significant relationship between all measures for SCH participants ($r_s = .36-.59$, all $p_s < .01$). For LTLE participants, only the Boston Naming Test correlated with WLG ($r = .44$, $p < .01$). In conclusion, total output on AN-WLG is reduced in first episode schizophrenia; however, semantic knowledge is relatively preserved. Executive deficits or non-specific global cognitive dysfunction may best explain WLG deficits in this population.

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M. GAROLERA, B.M. PARDO, F.X. FARRE, V. VALLES, L. DELGADO, J. SETOAIN, J.R. GARCIA, & J. ALBERNI. Activation SPECT Before and After Risperidone Treatment in Schizophrenic Patients.

A pilot study in 8 neuroleptic-naïve schizophrenic patients and 5 healthy control subjects was designed, to determine the changes in regional cerebral blood flow (rCBF) during an activation task for cognitive flexibility and selective attention evaluation. Activation ^{99m}Tc -ECD brain SPECT was performed before and after 6 weeks of treatment with Risperidone, in the patients group. Resting and activation ^{99m}Tc -ECD brain SPECTs were performed in normal controls. Several ROIs were examined (frontal, cingulate, temporal, striatum, and cerebellum). A comparison between resting and activation conditions in the control group suggests an implication (increased rCBF) of left posterior frontal (motor, premotor, and supplementary motor areas) and bilateral anterior cingulate areas in task performance. The cerebellum showed a higher right hemisphere activation compared to the left hemisphere. Patients in pretreatment condition, as compared to controls in activation condition, presented hyperactivation of right posterior frontal, right posterior temporal and left cerebellar areas, and hypoactivation of left temporal anterior and left cingulate anterior areas. The changes

found comparing pre- and posttreatment conditions in the patients group include increased rCBF in left cingulate and temporal lobes, which is associated with a significant improvement in task performance and clinical rates, whereas the global rCBF pattern remains abnormal. These results suggest a complex global abnormal pattern of rCBF rather than a local isolated deficit in schizophrenia. A global pattern of right hemisphere hyperactivation and left hemisphere hypoactivation, with an inverse pattern in the cerebellum, may point to an abnormal brain lateralization.

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M. GAROLERA, B.M. PARDO, F.X. FARRE, I. DE MARIA, F. ALIAGA, V. VALLES, L. DELGADO, & J. ALBERNI. Cognitive Performance in Schizophrenia Before and After Neuroleptic Treatment.

A study on the cognitive performance of young neuroleptic-naïve first episode schizophrenic patients ($n = 14$) is presented. The performance of schizophrenic patients in several neuropsychological tests and various clinical variables were assessed at the onset of the disease and after 6 weeks of neuroleptic treatment. Wilcoxon tests were performed to compare clinical and neuropsychological rates at different stages. Most of cognitive deficits that are present at acute phase improve after 6 weeks of neuroleptic treatment ($p < .05$), but fail to reverse completely. Despite a significant clinical improvement of patients (PANSS: positive syndrome: $p < .002$; negative syndrome: $p < .03$), important posttreatment deficits were found involving verbal fluency, attention and verbal memory rates. As for fluency and digit memory, we fail to detect any significant improvement at all. Spearman correlation coefficients between neuropsychological performance clinical rates were not significant. The results suggest that the reported neuropsychological variables account for a primary cognitive deficit, which is independent of the patient clinical state, whereas other cognitive deficits seen in an acute phase, may be secondary to clinical symptoms.

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C. MILLIKIN, B.K. CHRISTENSEN, G. REMINGTON, & C.M. SHAMMI. Cognitive Effects of Clozapine Treatment: The Role of Motor Functioning.

Improvements in attention, verbal frequency, and psychomotor speed have been demonstrated in patients with schizophrenia treated with clozapine, an atypical antipsychotic medication. However, most of these studies have compared clozapine-treated patients with those on typical neuroleptics. Moreover, few studies have adequately measured visual memory or included parallel test forms to attenuate practice effects. The present study examined cognitive changes over 12 weeks of clozapine treatment in 23 (15 male, 8 female) patients with poor response to at least one other atypical antipsychotic. Patients were tested within 1 week of starting clozapine ($M = 6.2 \pm 5.2$ days) and after 12 weeks ($M = 11.8 \pm 1.5$ weeks) at a dose of at least 300 mg. Significant improvement was detected on the Digit Symbol test, Continuous Performance Test, semantic fluency test, Trail Making Test, speed of word reading and color naming on the Stroop Test, and Grooved Pegboard Test (GPT). No significant change was observed for measures of memory or executive functioning. A second set of analyses was conducted on residualized test scores to determine if improvements in other tests could be accounted for by improved fine motor speed/coordination. After controlling for variance accounted for by GPT performance, previously significant differences on tests of cognition were greatly reduced (i.e., to nonsignificant levels). This suggests that many of the cognitive improvements associated with clozapine can be linked to improvements in motor functioning. These results will be discussed in relation to clozapine's relatively negligible action on Dopamine type-2 receptors.

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S. PURDON, N. WOODWARD, A. MINTZ, & A. LABELLE. Procedural Learning Improvements Following 6 Weeks of Treatment With Clozapine.

Procedural learning has been used to describe the gradual acquisition of a cognitive routine or motor skill that can be performed independently of

conscious recollection. Psychometric investigations and brain imaging studies in normal and pathological samples have implicated the dorsal striatum in procedural learning. The dorsal striatum is heavily innervated by dopaminergic inputs arising from the substantia nigra, and as such, may be functionally compromised by first generation antipsychotics, which are effective dopaminergic antagonists and can induce extrapyramidal motor disorders. The second generation of antipsychotic treatments appear to have lower affinities for dorsal striatum structures relative to first generation antipsychotic treatments. Thus, psychometric evaluations of procedural learning in schizophrenia may prove to be a valuable predictor of extrapyramidal syndrome liability and cognitive improvement observed with antipsychotic medications. Nine patients with schizophrenia completed the Tower of Toronto Test, at baseline while receiving predominantly first generation antipsychotic medication, and again after 6 weeks of treatment with clozapine, the prototypical second generation antipsychotic treatment. A sample of 9 normal healthy controls matched to the patient sample by age was also examined on a single occasion. As anticipated, patients exhibited baseline impairment on the Tower of Toronto that showed significant improvement after six months of treatment with clozapine. Treatment with clozapine appears to have a beneficial effect on procedural learning, possibly due to less residual detrimental effects on structures of the dorsal striatum or perhaps due to a more beneficial effect on subcortical or cortical cerebral physiology.

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S. PURDON & N. WOODWARD. Neuroleptic Effects on Atypical Sensory and Motor Asymmetries in Schizophrenia.

The recent introduction of several novel antipsychotic agents has contributed to a renewed interest in potential medication-induced cognitive changes in schizophrenia. A cerebral mechanism for the changes is not yet available, however, an investigation of motor and sensory changes to treatment may provide a useful approach toward an understanding of cerebral involvement that may also allow for the careful extraction of secondary factors. The approach was suggested from prior studies showing consistent auditory, haptic, and visual sensory system asymmetries in unmedicated schizophrenia patients that is diminished or reversed after first-generation (i.e., typical) neuroleptic treatment. We conducted two experiments using a unihinal test of olfactory acuity and a hand force persistence test to assess the presence of similar asymmetrical changes with second generation neuroleptic treatment. Experiment 1 confirmed the sensitivity of the instruments to the left hemisphere dysfunction in unmedicated schizophrenia; patients exhibited a relative impairment of the left nostril and the right hand. Experiment 2 confirmed in a prospective design the expected amelioration of the asymmetry after 4 weeks of second-generation neuroleptic treatment; patients showed remarkable improvement in both left nostril acuity and right hand force persistence. The present results support the left hemisphere deficit model for schizophrenia and suggest that reduced asymmetry may represent an important parameter in cerebral models developed to explain the apparent unique effects of novel treatments on cognitive skills.

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N. WOODWARD & S. PURDON. Gender Differences in Cerebral Volume Reductions in Schizophrenia.

Cerebral volume reductions have been well documented in schizophrenia but potential differential cerebral involvement relating to gender remains equivocal. Schizophrenia in females tends to have a later onset, less severe symptoms, and a better prognosis when compared to schizophrenia in men, suggesting that affected men may have more cerebral pathology than women. Recent examinations of this hypothesis have been inconclusive, with several investigators reporting temporal lobe and parietal lobe volume reductions in male, but not female patients, and others reporting no significant gender, cerebral volume interactions in schizophrenia. The equiv-

ocation may relate to the small samples used in prior studies and the wide variability in methods for volumetric assessment. The present investigation examined frontal and temporal lobe volumes and ventricle to brain ratios, as revealed by planimetric analysis of computed tomographic scans in 50 (37 males, 13 female) patients with schizophrenia and 105 (40 male, 65 female) age matched controls. Compared to the male controls, the male patients with schizophrenia exhibited reduced volume in the left frontal and bilateral temporal lobes, as well as an increase in right ventricle to brain ratio. Female patients with schizophrenia also demonstrated a volume reduction in the left frontal lobe, but they failed to show a difference in the temporal lobes. The females also showed an increase in ventricle to brain ratio, but the effect was bilateral. The present results suggest that temporal lobe pathology may be linked to the early onset, severe manifestation, and poor prognosis associated with male, relative to female, schizophrenia.

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Symposium 2/1:30–3:15 p.m.

NEUROBEHAVIORAL OUTCOMES OF TRAUMATIC BRAIN INJURY IN CHILDREN

Chair: Maureen Dennis

Organizer: H.S. Levin

H.S. LEVIN, M. DENNIS, G. HANTEN, S.B. CHAPMAN, K. PURVIS, L. EWING-COBBS, & A. LANSING. Neurobehavioral Outcome of Traumatic Brain Injury in Children.

With an incidence about 100:100,000 traumatic brain injury (TBI) is the most frequent cause of acquired brain insult in children. Despite recovery of most severe TBI patients to the normal range of traditional tests of intellectual and language functions, executive function (EF) deficits frequently persist and contribute to residual disability affecting an estimated 17,000 children annually in the US. This symposium reports longitudinal and cross-sectional studies from an ongoing project that examines the nature of EF deficits and how EF outcome is moderated by age, time, and biological variables in long-term survivors of TBI. We examine component processes of EF, including working memory, inhibition, and metacognition in academic achievement and adaptive behavior in long term survivors of pediatric TBI. We hypothesize that the integrity of these components of EFs is crucial to the development of discourse processing, academic achievement, and adaptive behavior while inhibition and metacognitive are also related to psychiatric outcome of TBI in children. Studies comprising this symposium address how TBI affects discourse processing, metacognition, inhibition, and more generalized impact on academic skills and adaptive behavior. The study of metacognition also evaluates the effects of working memory load on language comprehension, assesses knowledge appraisal, and reallocation of learning resources according to shifts in reward value. Our discussion integrates and interprets the findings from the perspective of interactions of the child's injury severity with the environment, particularly the family.

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G. HANTEN, M. DENNIS, & H.S. LEVIN. Knowing About Knowing: Metacognition After Childhood Closed Head Injury.

The term 'metacognition' refers to the ability to appraise and manage knowledge. In this presentation we review data on 2 components of metacognition, knowledge appraisal and knowledge management, in children with closed head injury (CHI). Knowledge appraisal was assessed within 2 cognitive domains, language comprehension and working memory. In the language domain, a sentence anomaly detection and repair task was used in

which children had to appraise semantic, pragmatic, and grammatical appropriateness. In the memory domain, children had to estimate their ability to learn words prior to study of a list for recall, and to assess how well they had learned the words after studying the list. Knowledge management in the language domain was assessed using a referential communication requiring the management of unambiguous or ambiguous instructions. Within the memory domain, a selective learning paradigm was used in which children had to manage their memorial resources for selecting and remembering high point items over low point items in a list-learning task. Children with CHI displayed poorer metacognitive abilities than age-matched controls in both appraisal and management tasks, within both the language and memory domains. Younger children performed more poorly than did older children in both groups. In general, metacognitive performance was related to severity of injury as measured by the Glasgow Coma Scale, with age-at-injury, and lesion location affecting some, but not all, measures.

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S.B. CHAPMAN, M. DENNIS, H.S. LEVIN, L. MCKINNON, & G. SPARKS. Longitudinal Outcome of Discourse in Pediatric Traumatic Brain Injury.

Traditional measures of language fail to detect the cognitive-linguistic deficits that emerge after traumatic brain injury (TBI) in children, particularly at later stages postinjury. The vulnerability of children with severe TBI to pragmatic and discourse-level language deficits has recently been observed in both longitudinal and cross-sectional studies. We conducted a longitudinal study comparing narrative discourse abilities in children with mild ($n = 40$) versus severe ($n = 31$) TBI. Children with TBI were assessed at intervals of 3, 12, 21 and 36 months postinjury. Not surprisingly, the children with severe injury showed greater improvement over time as compared to children with mild injuries, because of their lower performance initially. Even at three years postinjury, however, children with severe TBI continued to show greater impairment in restructuring the central meaning of the story and in organizing the content than was evident in their recovery in retelling story details and use of language. Discourse recovery was mediated to some degree by age at injury and loci of brain lesions. We conducted cross-sectional studies of pragmatic communication in children with mild or severe TBI sustained several years previously. Children with severe TBI performed more poorly than those with mild TBI on tests of standard pragmatic communications (e.g., speech acts), and also on tests of non-standard pragmatic communication (e.g. metaphor, deception). Findings are discussed in terms of models of discourse processing which have implicated a key role of cognitive processes of working memory, metacognition, and self-regulation. These findings have implications for diagnosis and rehabilitation.

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K. PURVIS & R. SCHACHAR. Inhibitory Deficit and ADHD Following Closed Head Injury.

Attentional disturbance and behavioral disturbance, in particular deficient inhibition and ADHD, are common complaints after closed head injury (CHI) in children. Among children without head injury, ADHD is strongly and specifically associated with a deficit in inhibition. This deficit has been interpreted as the fundamental deficit and an indicator of neuropathology of the disorder. We tested the hypothesis that deficient inhibition is associated with ADHD rather than injury severity or psychopathology in general among children with CHI. Participants were 83 children with CHI; 41 mild, 14 moderate, 17 severe injury, and 27 normal children (NC). Scores on parent and teacher ratings were used to classify children as ADHD and overanxious. Children performed the stop signal paradigm, a laboratory measure of inhibitory control operationalized as the ability to stop a speeded, prepotent motor response. ADHD (33%) and anxiety (40%) were both more prevalent in children with CHI than in NC. Injury severity did not predict inhibition. However, children with ADHD had significantly worse inhibition than children without ADHD regardless of injury severity. By con-

trast, children with anxiety had somewhat better inhibition than those without. These results indicate that ADHD is a specific marker of an inhibition deficit regardless of CHI. The association between cognitive and behavioral outcomes of CHI may inform both the nature of ADHD and the cognitive abnormalities arising after CHI.

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L. EWING-COBBS, J. SONG, M. BARNES, H.S. LEVIN, & J.M. FLETCHER. Growth Curve Modeling of Academic Achievement Scores After Pediatric Head Injury.

Despite the importance of academic skills for school and vocational integration, there is little information regarding academic skill development in children and adolescents after traumatic brain injury. We examined prospective, longitudinal academic achievement scores in youth with impaired consciousness persisting <24 hr ($n = 42$) or ≥ 24 hr ($n = 50$). Each child was evaluated on a minimum of 3 occasions occurring .25, .5, 1, 2, 3, 4, and/or 5 years after injury. The severity groups were comparable on age at injury, socioeconomic status, and gender. Individual growth curve models fitted time since injury, age at injury, duration of impaired consciousness, and interaction effects to longitudinal reading recognition, reading comprehension, spelling, and arithmetic standard scores. Time since injury was significant; all academic scores increased modestly over time. The second order effect for time indicated nonlinear recovery of arithmetic scores. Age at injury was significant only for arithmetic and reading comprehension scores, which were higher in children than in adolescents. The Time \times Age interaction was significant for arithmetic scores; age became less predictive of arithmetic scores as the injury-test interval increased. Adolescents had lower initial arithmetic scores and showed greater initial increases than younger children. Children with impaired consciousness for ≥ 24 hr showed persistent deficits on all achievement scores relative to children with impaired consciousness resolving within 24 hr. Severe head injuries in childhood result in significant and persistent academic skill deficits. Severely injured children clearly require long-term interventions that enhance cognitive factors underlying skill acquisition and promote the development of academic skills.

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A. LANSING, J. SONG, J. SMITH, & J. MAX. Predictors of Adaptive Functioning After Childhood Closed Head Injury.

Predictors of adaptive functioning (AF) after closed head injury (CHI) in children are complex and may involve injury severity, cognitive functioning, and psychosocial factors. One hundred fifty-five children were studied: 39 healthy control (21m/18f), 57 mild CHI (35m/22f), 19 moderate CHI (13m/6f), and 40 severe CHI children (27m/13f). Means for time since injury were 5.6 (2.07) years for mild group, 5.88 (1.87) years for moderate group, and 5.07 (1.84) years for severe group. The mean age at injury was 5.64 (2.90), 6.62 (2.39), and 7.25 (2.93) years for mild, moderate, and severe injured children respectively. Outcome measures were the Vineland Adaptive Behavior (VAB) Scales and parent/teacher Ontario Child Health Study (OCHS) scores. ANOVA models were fitted to test group effect on outcome measures. Significant differences were followed-up with Duncan. The severity effect for AF on OCHS was tested with Wilcoxon-Mann-Whitney. Regression models evaluated GCS, SES, and the Gray Oral Reading Test-3 (GORT-3) sum of standard scores. Group effect on AF was significant for the OCHS (parent) and VAB Composite/Socialization domains. Controls had significantly higher functioning than mild, moderate and severe injured children. Significant relationships occurred between AF scores and OCHS measures of psychopathology. Only GORT-3 was significant in predicting VAB Composite and Communication domain scores in regression models. Adaptive functioning in the chronic stage after CHI (across severities) was worse than uninjured controls. Retrospective designs may result in recruitment of less functional mild CHI children, obscuring the expected effect of injury severity. How-

ever, neurocognitive/behavioral variables appear to be better predictors of AF in later postinjury years.

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Symposium 3/1:30–3:15 p.m.

ETHICAL ISSUES IN NEUROPSYCHOLOGY: KEEPING YOURSELF AND OTHERS “HONEST” IN ADVERSARIAL CASES

Organizer and Chair: **Christopher Grote**

C. GROTE, J. J. SWEET, W. G. VAN GORP, & G. LARRABEE. *Ethical Issues in Neuropsychology: Keeping Yourself and Others “Honest” in Adversarial Cases.*

A recent survey indicated that attorneys are the leading source of referrals among neuropsychologists in independent practice. Such referrals, including those from disability and workers' compensation agencies, offer alternative sources of income at a time when reimbursement from other payors has declined. These financial pressures, in combination with the adversarial nature of these cases, may bring either subtle or overt pressure for the consulting neuropsychologist to produce opinions that are favorable to the referring attorney or agency. Awareness of, and appropriate reaction to, these potential biasing factors typically are not included in the curriculum of the graduate and training programs of psychologists. This symposium will present three papers that review means of identifying and responding to potential bias in your work as well as that of your colleagues. Case examples will often be used, as we make the following points: (1) the goals of referral sources often vary, depending on their relationship to the patient; (2) psychologists must recognize and respond to the “natural” impulse to present opinions that will satisfy or please a referral source; (3) which steps can be taken to minimize the potential for bias; (4) psychologists have an ethical and legal duty to take appropriate steps when they perceive that other psychologists have not acted in a competent or ethical manner.

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W. G. VAN GORP. *Potential Sources of Bias in Forensic Neuropsychological Evaluations.*

Few settings present the clinical neuropsychologist with the pressures or actual encouragement for the expression of bias as that encountered in the medicolegal arena. With the proliferation of litigation in which neuropsychology plays a potential critical role, often resulting in large awards based upon the claim of “brain damage,” pressure may be put on the neuropsychologist to present ‘favorable’ findings to the party retaining him/her. It is important, therefore, for the expert to be highly attentive to the potential sources of bias in forensic neuropsychological evaluations, and to highlight conditions and behaviors that should be avoided in the practice of these evaluations to ensure that high ethical standards are upheld. This presentation will discuss many potential sources of bias in forensic neuropsychological assessment and testimony: financial incentives, initial expert/attorney contact, record review, interview, normative data utilized, interpretation of data, and postevaluation feedback. Methods to become more aware of, and potentially reduce, these sources of bias will be discussed. Case examples will be used to illustrate the points raised in the general symposium.

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J. J. SWEET. *Toward Minimizing Bias in Adversarial Assessments.*

Neuropsychological evaluations performed within the context of administrative (e.g., disability determination, worker's compensation) and litigated (e.g., personal injury, medical malpractice, criminal) proceedings are

potentially adversarial. As is true for all health care professionals who engage in adversarial assessments, the need for objectivity on the part of ‘retained’ and ‘treating’ expert neuropsychologists understandably has become an important concern. While it has been cogently argued that an actuarial approach is superior to clinician-based judgment, until and unless more sophisticated and complete actuarial approaches are formulated clinicians will continue to play a key role in interpreting the results of objective cognitive, behavioral, and personality measures. Therefore, efforts to increase objectivity and minimize bias can be placed reasonably with the individual neuropsychologist. This portion of the symposium will focus on prospective attempts to debias adversarial opinions, based largely on review and discussion of techniques and suggestions put forth in the literature by Sweet and Moulthrop, Martelli, Zasler, and Grayson, Garb, Binder & Thompson, Borum, Otto, and Golding, and Brodsky. The delineation of these suggested techniques, will emphasize that (1) the available techniques are not exhaustive—continued development is expected; (2) although one strives to reach a goal of 100% objectivity—realistically, this is not possible in any human endeavor; (3) a dilemma in minimizing bias is a lack of consensus regarding what constitutes insufficient clinician-based objectivity; and (4) the difficulty in determining whether bias is deliberate or unintentional does not have to be an obstacle to amelioration of the problem.

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C. GROTE. *Ethical and Legal Considerations in Responding to Perceived Unethical Practices of Others.*

Neuropsychologists often review the work of colleagues who have performed a neuropsychological evaluation. At times, these reviews may cause one to believe that a colleague acted in an unethical or incompetent manner. Indeed, unethical or unprofessional practice among psychologists is a relatively frequent reason for disciplinary action, when such action has been taken by professional organizations and regulatory agencies. However, it can be difficult for a neuropsychologist to determine what to do if they encounter unethical conduct on the part of another neuropsychologist. Impediments to contacting a colleague or filing a complaint may include the fear of being counter-reported or sued, or at least creating an unpleasant, hostile, or even adversarial relationship with the other neuropsychologist. On the other hand, failure to address perceived unethical behavior could result in patients being misdiagnosed and mistreated, insurance companies being billed for unnecessary services, or the patient being denied compensation or treatment. Perhaps as important, the public's perception of the practice of neuropsychology may be diminished if unethical practices are ignored by psychologists who should have attempted to stop such practices. This presentation will provide examples of potential unethical practices in neuropsychology. We will demonstrate that one may be required to do something if it is suspected that a colleague has acted in an unethical manner, and that one should not be unreasonably fearful that attempted legal reprisals from a colleague will prevail. We conclude with a series of recommendations and options as to when and how one should proceed in such situations.

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Paper Session 4/3:30–5:15 p.m.

EPILEPSY

E. LERITZ, L. GRANDE, R. GILMORE, S. ROPER, & R. BAUER. *Conceptual and Perceptual Priming in Temporal Lobe Epilepsy.*

Priming refers to speeded processing of a stimulus due to prior exposure of a related or identical stimulus. Research with both normal and neurologically-impaired individuals indicates that priming involves both conceptual and perceptual processes. The existing literature suggests that perceptual and conceptual priming may depend on different neural structures. The present study examined conceptual and perceptual priming pro-

cesses in patients with intractable temporal lobe epilepsy (TLE) after resective surgery for seizure relief. Fourteen patients who had received a right ($N = 9$) or left ($N = 5$) anterior temporal lobectomy participated in the study. The priming task consisted of prime and target word pairs or picture pairs that were either related, unrelated, or identical to each other, presented with an SOA of 600 ms. After presentation of the target, participants responded by making a lexical (word vs. nonword) or an object (real vs. nonreal) decision. Results indicate that left TLE patients did not demonstrate any priming in the object decision task, but exhibited both conceptual and perceptual priming in lexical decision. In contrast, right TLE patients demonstrated significant priming across all tasks with the exception of impaired conceptual priming in the lexical decision condition. The pattern of impairments for left and right TLE groups may reflect selective impairments in form-specific semantic information, as well as the possibility of the operation of alternative processing strategies.

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K. GETZ, C. DOW, B. BELL, D. O'LEARY, S. ZIEBELL, R. SHETH, P. RUTECKI, A. WOODARD, M. SEIDENBERG, & B. HERMANN. Cognitive Correlates of Negative Symptoms in TLE.

Recent studies have shown that positive and negative symptoms, core features of schizophrenia, are also evident in neurologic patient groups. The frequency and nature of positive and negative symptoms in temporal lobe epilepsy (TLE) has yet to be systematically examined. Among a prospective series of 60 patients with TLE, positive symptoms were very rare while negative symptoms were more prevalent (17%). A group of TLE patients with negative symptoms only ($n = 10$) were compared to an age, education and gender matched group of TLE patients without negative symptoms ($n = 10$) and healthy controls ($n = 10$) across a battery of neuropsychological measures. As expected, both epilepsy groups differed from controls across a broad set of cognitive measures. Beyond that, patients with negative symptoms showed significantly poorer performance compared to TLE patients without negative symptoms on measures of processing speed (Sternberg slope, Trails A and B), working memory (WMS-III), and visuospatial abilities (Benton Line Orientation, WAIS-III Performance IQ). There were no differences between the groups on measures of self-reported mood state (BDI) or psychiatric symptomatology (SCI-90-R). The two epilepsy groups were also comparable in age of onset and duration of epilepsy. These results show that negative symptoms sometimes occur in TLE. Similar to other patient groups, the presence of negative symptoms in TLE appears to have implications for the efficiency of frontal/executive functioning.

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S. KORTENKAMP, R. BAUER, D. BOWERS, B. CROSSON, E.B. FENNEL, & R. GILMORE. Verbal Distraction During the CFT: An Attempt to Increase the Sensitivity to Right TLE.

The Complex Figure Test (CFT) is often used in neuropsychological evaluations of patients with temporal lobe epilepsy (TLE) as a measure of nonverbal memory. While it has been assumed that individuals with right TLE would have impaired memory for the nonverbal stimuli, in actuality, the CFT has not been shown to consistently discriminate between patients with right and left TLE. One possibility for the lack of significant greater impairment after right temporal lobe damage is that right TLE patients are able to encode the figure by utilizing verbal compensatory strategies, thus reducing their reliance on visuospatial memory strategies. In this study, the CFT was presented to 26 patients with TLE (15 right, 11 left) who were asked to perform a verbal distractor task designed to prohibit verbal encoding of the figure concurrent with the copy trial. It was hypothesized that the right TLE patients would demonstrate worse delayed memory for the figure following the verbal distractor because they would no longer be able to rely on verbal encoding. Parallel complex figures were also presented with either a nonverbal distractor (tone sequence) task or no distractor. Results indicated that, while both right and left TLE groups had

significantly worse memory for the figures presented with verbal or nonverbal distraction, there were no significant between groups differences after any of the distractor conditions. These findings suggest that right TLE patients are in fact not utilizing verbal encoding strategies to compensate for poor visual-spatial memory. Other explanations are explored.

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C. DOW, L. SEARS, B.P. HERMANN, M. SEIDENBERG, B. BELL, D. O'LEARY, V. MAGNOTTA, P. RUTECKI, R. SHETH, A. WOODARD, & G. WENDT. Delayed Eyeblink Classical Conditioning and Cerebellar Atrophy in TLE.

Animal and human research has shown the cerebellum is associated with specific types of procedural learning, including particular paradigms of classical conditioning. Cerebellar atrophy is a known neuroanatomic abnormality in chronic temporal lobe epilepsy (TLE), the neuropsychological consequences of which remain to be determined. Patients ($N = 31$) with TLE underwent delay eyeblink conditioning (CS = 500 ms 79 db 1-KHz tone, UCS = 100-ms 5 psi airpuff to the left eye, UCS onset 400 ms after CS onset, CS and UCS terminating together) followed by extinction. Total cerebellar and segmented intracranial and regional volumes were derived using semiautomated quantitative MR volumetric software. Partial correlations, corrected for total intracranial volume, examined relationships between cerebellar volume, classical conditioning efficiency (proportion of CRs), and performance on neuropsychological tasks not considered uniquely dependent on cerebellar function. Decreased cerebellar volume was associated ($r = .32, p = .07$) with poorer classical conditioning, this relationship especially strong among patients with early epilepsy onset ($r = .57, p = .02$). There were no significant associations between cerebellar volume and intelligence, declarative memory, response inhibition, speeded psychomotor processing, or attention. Extra-cerebellar brain volumes were not associated with classical conditioning performance. In conclusion, cerebellar atrophy in TLE is associated with one form of procedural learning, delay eyeblink conditioning. This structure-function relationship appears to be specific to region (cerebellum) and task (classical conditioning). Thus, volumetric abnormalities outside the epileptogenic temporal lobes appear to have neuropsychological consequences.

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Paper Session 5/3:30–5:15 p.m.

ADHD

S. MOSTOFSKY, W. KATES, B. FOLLEY, M. DENCKLA, G. PEARLSON, & W. KAUFMANN. Volumetric MRI Analysis of Frontal Lobe Subdivisions in ADHD.

Abnormalities in frontal-subcortical circuits are hypothesized to be fundamental in the pathogenesis of attention deficit hyperactivity disorder (ADHD). Supportive evidence comes, in part, from anatomic magnetic resonance imaging (MRI) studies of ADHD that have shown smaller volumes of brain regions corresponding to the entire frontal or prefrontal cortex. Volumetric analyses of anatomically-defined subregions of the frontal lobes have not been previously reported. In this study, a manual parcellation technique was used to subdivide the frontal lobes into five subcompartments: prefrontal, premotor, motor, anterior cingulate, and deep white matter. Participants included 15 boys with ADHD and without comorbid diagnoses (ages 9.2 ± 1.2 years) and 15 normal control boys matched for age (ages 9.7 ± 1.2 years). A multivariate analysis of variance (MANOVA) with diagnosis as a factor and frontal lobe subdivision measurements as dependent variables was significant ($p = .04$). *Post-hoc* analyses revealed that children with ADHD had significantly smaller volumes of prefrontal ($p = .01$) and deep white matter ($p = .006$) subdivisions; there were no significant differences in the sizes of premotor, motor, and anterior cingulate regions. The results lend further support to the proposal that ADHD is

an intentional disorder secondary to abnormalities in circuits involving the frontal lobes, and provide further specificity with regard to the localizations of these abnormalities.

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J. CROSBIE & R. SCHACHAR. Inhibition as a Marker for Familial ADHD.

Objective: to investigate whether deficient inhibitory control, as measured by the stop-signal paradigm (SSP), delineates a distinct subgroup of attention deficit hyperactivity disorder (ADHD). *Method:* Participants were 54 ADHD children defined as having poor or good inhibition based on performance on the SSP, and 26 normal control children. *Poor inhibition, good inhibition, and normal control groups* were compared on the prevalence of family history for ADHD, and measures of neurobiological and psychosocial risk. *Results:* A significantly higher rate of family history for ADHD was found in the poor inhibition group (48.1%) compared to the good inhibition group (19.2%), and the normal controls (7.7%). No differences were found between the groups on neurobiological or psychosocial risk. *Conclusions:* deficient inhibition delineates a familial subtype of ADHD. Neither psychosocial or neurobiological factors were associated with good or poor inhibition groups, and environmental risk and inhibition did not act conjointly to increase the risk for ADHD in the poor inhibition group. This study demonstrates that cognitive measures such as a laboratory measure of inhibition can serve as phenotype markers for genetic analyses.

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J. ROVET & S. HEPWORTH. Visual Search for Features and Conjunctions in Children With Attention Disorders

Visual search tasks are ideal for studying attention strategies in children with different etiologies of attention disorder. We compared 35 7–12-year-old children with attention deficit hyperactivity disorder (ADHD), 29 children with congenital hypothyroidism (CH) and 56 age-matched normal control children on a computer-generated visual search paradigm based on Treisman. The task conditions involved color, orientation, or color-orientation conjunction feature searches in 4-, 16-, and 36-item arrays. Stimuli were colored rectangular bars oriented vertically or $\pm 60^\circ$, with the vertical blue bar designated as target. Accuracy results indicated the groups performed equivalently on single color or orientation searches while children with ADHD, and to a less degree CH, performed below controls on conjunction searches. RTs were notably slower in the color and orientation target-present conditions for children with ADHD and in most conditions for children with CH. Analyses of RT slopes by array size, which provided information about search strategy, showed all groups used a parallel strategy for orientation searches and a serial strategy for conjunction searches, but that, unlike the other groups, the ADHD group used a serial strategy for color searches. The groups also erred for different reasons with ADHD terminating their searches too early and CH, who were generally slower, being considerably less efficient. Additional analyses by age of child revealed selective developmental lags for ADHD and CH depending on type of feature searched. We believe these results will be helpful in designing specific interventions to improve visual search in children with different attention disorders.

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J. CROSBIE, A. ICKOWICZ, R. TANNOCK, & R. SCHACHAR. Does Aggression of CD Account for the Inhibitory Control Deficit in ADHD?

Deficient inhibition as measured by the stop signal paradigm (SSP) is considered central to ADHD. However, the specificity of this relationship has been challenged: deficient inhibition may also be associated with conduct disorder (CD) and aggression (Ag). *Objective:* To compare inhibition of groups of normal (NC), ADHD with and without Ag, and ADHD+Ag+CD on the SSP. One hundred two rigorously-assessed 7–12

year olds were assigned to one of 4 groups: (1) NC, (2) ADHD–Ag–CD, (3) ADHD+Ag–CD, (4) ADHD+Ag+CD. *Results:* NC had significantly better inhibition than the ADHD–Ag–CD and the ADHD+Ag–CD groups. The ADHD–Ag–CD and the ADHD+Ag–CD did not differ significantly. The ADHD+Ag+CD group had significantly better inhibition than the ADHD–Ag–CD and ADHD+Ag–CD groups, and were not significantly different from NC. Results were similar for physical and verbal aggression. *Conclusions:* These results confirm an inhibition deficit in ADHD and demonstrate that aggression does not account for the observed deficit. ADHD children with CD perform like normal controls whether or not they exhibit aggression. ADHD+CD appears to be a phenocopy of ADHD rather than a hybrid of ADHD and CD.

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R. ROTH, H. WISHART, L. FLASHMAN, H. RIORDAN, L. HUEY, & A. SAYKIN. Contribution of Executive Functions to Memory Deficits in Adults With ADHD.

Evidence for verbal learning and memory deficits in adults with attention deficit hyperactivity disorder (ADHD) has been inconsistent. Recent research suggests that these deficits, when present, may be in part due to executive dysfunction. In the present study, 28 unmedicated adults with ADHD (DSM–IV criteria) and 34 healthy control participants completed the California Verbal Learning Test, Continuous Performance Test, and several tests of executive functions (Stroop Test, Trail Making Test, Digits Backward, as well as semantic organization on the CVLT). Participants were excluded if they met criteria for major depressive disorder. Groups were equivalent for age, education, and estimated baseline verbal intellectual ability. Results revealed poorer performance by the ADHD group for CVLT total correct Trials 1–5, short and long delayed recall, total semantic clustering across CVLT Trials 1–5, as well as all executive function measures. For both groups, using executive variables and CPT as predictors of verbal learning and memory in regression analyses indicated that only semantic clustering predicted a significant portion of variance in learning and delayed recall. Although the ADHD group was more depressed and anxious, and performed worse on the CPT, neither affective distress nor attention could account for the results. Findings are consistent with previous observations of impaired verbal learning and memory and executive functions in adults with ADHD. The pattern of findings suggest that impaired verbal learning in adult ADHD is accounted for in part by executive dysfunction as reflected by poor semantic organization of recall.

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Poster Session 4/3:30–5:15 p.m.

EFFECTS OF SYSTEMIC DISEASES

R.D. VANDERPLOEG & K.M. KIEFFER. The Effects of Mild Hypertension on Cognition in Middle-Aged Men.

Recently the Department of Veterans' Affairs (DVA) published a position statement regarding elevated systolic blood pressure (B/P) as an equal or more important marker than diastolic B/P for future hypertensive complications. In the current study we evaluated the effects of elevated systolic versus diastolic B/P on neuropsychological functioning in a large sample of middle-age male veterans. High versus low B/P groups were equated on age ($M = 38.4$), education ($M = 13.0$), and military enlistment General Technical score ($M = 103.1$; this is a measure of verbal aptitude highly correlated with FSIQ and on the same metric). Blood pressure measurements and neuropsychological testing were conducted approximately 20 years after military discharge. Four groups were identified: Systolic pressure ≥ 140 ($N = 376$) versus systolic pressure ≤ 110 ($N = 376$); and diastolic pressure ≥ 95 ($N = 553$) versus diastolic pressure ≤ 75 ($N = 553$).

The effects of systolic and diastolic hypertension were evaluated separately and the effect sizes were compared. MANOVAs were used to compare elevated *versus* normal pressure groups on eight neuropsychological measures (dominant hand Grooved Pegs, PASAT, CVLT Long Delayed Free Recall, Rey-Osterrieth Delayed Memory, FAS, Animal Semantic Fluency, WAIS-R Block Design, and WCST number of sorts). Both elevated systolic and diastolic B/P were associated with poorer neuropsychological functioning [Systolic: $F(8,737) = 2.39, p < .02$; Eta-Squared = .025; Diastolic: $F(8,1092) = 2.85, p < .005$; Eta-Squared = .020]. Systolic and diastolic B/P accounted for approximately equal amounts of variance in neuropsychological functioning. These results support the DVA position regarding treating either systolic or diastolic hypertension.

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K. WILLIAMS, C. PEPPER, L. BANK, E. KRACKOW, A. MILLER, R. PERNA, M. GEORGETSON, T. McDONALD, B. ASKEY, R. LEVINE, S. MEIER, S. LYNN, N. SPEAR, P. DONOVICK, & R. BURRIGHT. Cognitive Functioning in an HCV Patient Undergoing RCT Treatment.

Over 4.5 million Americans are infected with chronic hepatitis C (HCV). The current treatment for HCV is Rebetron Combination Therapy™ (RCT), interferon + Ribavirin. Research has documented cognitive deficits associated with interferon treatment in cancer patients. To date, no research has examined the possible impact of RCT on the cognitive functioning of HCV patients undergoing treatment. Participants were 13 ($M_{\text{age}} = 44$; range 28–73) interferon-naïve patients who met the strict drug protocol screening standards (ALT, liver biopsy, viral load). Participants were administered a battery of neuropsychological assessments to establish baseline IQ, memory, mental processing speed, selective attention, concentration, and verbal fluency abilities prior to treatment (T1) and following 1 month of RCT treatment (T2). At T1, participants' mean IQ = 100 ($SD = 9.77$). WMS general memory index = 95 ($SD = 4.21$). Results demonstrated no significant differences between T1 and T2 performances on COWA and RAVLT. However, a MANOVA with Trails A, Trails B, and Stroop Color and Word (Dodrill) as dependent variables revealed an overall main effect [$F(4,9) = 12.89, p < .001$]. Further analysis indicated that Trails B, and Stroop Color time decreased from T1 to T2, $M_{\text{trails B}} = 64$ s vs. 30 s, respectively and $M_{\text{stroop color}} = 280$ s vs. 230 s. There were no significant differences in Trails A and Stroop Word between times. These improvements in cognitive functioning were not found in HCV controls (not currently undergoing RCT treatment). Results will be discussed in terms of underlying mechanisms associated with changes in cognitive functioning following RCT treatment.

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R. HILSABECK, S. HICKMAN, B. BOLAND, B. WILLIAMS, C. BOYD, T. HASSANEIN, & W. PERRY. The Pattern of Memory Deficits in Patients With End-Stage Liver Disease.

Memory impairment in patients with end-stage liver disease (ESLD) has not been well characterized. Recent research suggests that cognitive impairments of patients with cirrhosis are parsimonious with a subcortical pattern of deficits. Therefore, we hypothesized that California Verbal Learning Test (CVLT) performances of ESLD patients would be suggestive of subcortical dysfunction (i.e., impaired learning with relatively intact recall and recognition). Participants were 33 outpatients with ESLD, who were administered the CVLT as part of a larger battery of neuropsychological tests. Average age was 48.45 years ($SD = 6.35$), and average education was 11.73 years ($SD = 3.31$). Most patients were White (78.8%), and 48.5% were male. This sample obtained an average T score of 36.52 ($SD = 15.01$) for CVLT Total (Trials 1–5), with 57.6% of patients obtaining T scores < 40 . Approximately 76% of patients performed ≤ -1 SD on Trial 1. In contrast, only 27.3% of patients exhibited a loss of more than 20% following

a delay, and 30.3% performed ≤ -1 SD on the discriminability index. The results of this study suggest that patients with ESLD generally demonstrate a subcortical pattern of memory dysfunction. A small percentage of ESLD patients, however, exhibit significant loss of learned information following a delay.

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R. HILSABECK, T. HASSANEIN, & W. PERRY. Attention and Memory Impairment in Noncirrhotic Patients With Liver Disease.

Cognitive impairment in patients with cirrhosis has been well established. However, it often takes 20+ years of chronic hepatic injury before the liver develops cirrhosis and its complications. During this time, liver functioning is slightly impaired and might have an adverse impact on brain functioning. The purpose of this study was to investigate cognitive functioning in noncirrhotic patients with chronic liver disease. Participants were 19 males and 14 females ($N = 33$). Average age was 44.97 years ($SD = 8.52$), and average education was 13.67 years ($SD = 1.74$). Chronic hepatitis C was the most common etiology of liver disease (84.9%), and the mean estimated duration of illness was 25.5 years ($SD = 9.7$). Average IQ as estimated by the Shipley Institute of Living scale was 98.83 ($SD = 14.16$). All patients completed a brief screening battery consisting of a modified version of the Rey Complex Figure Test (RCF), Digit Cancellation (DC), Symbol Digit Modalities Test (SDMT), and Trail Making Test (TMT). No patient had difficulty on the RCF copy trial. On indices of learning and forgetting, however, 33.3% and 15.2% of patients, respectively, performed in the impaired range. On the DC task, 57.5% obtained an impaired total time and 24.3% made an abnormal number of errors. On SDMT and TMT–Part A, 24.2% of patients performed in the impaired range, while 18.2% performed in the impaired range on TMT–Part B. These results indicate attention and memory impairment occurs in some noncirrhotic patients with chronic liver disease. These findings have important implications for early detection and treatment of liver disease.

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R. HILSABECK, S. HICKMAN, B. BOLAND, B. WILLIAMS, C. BOYD, T. HASSANEIN, & W. PERRY. Neuropsychological Functioning of Patients Evaluated for Liver Transplantation.

Cognitive deficits have been documented in some patients with end-stage liver disease (ESLD). The prevalence of cognitive impairment in patients awaiting liver transplantation has not been systematically evaluated. The purpose of this study was to examine the neuropsychological functioning of patients being evaluated for liver transplant. Participants were 55 consecutively referred patients (32 males and 23 females) with ESLD. Average age was 49.96 years ($SD = 7.60$), and average education was 10.87 years ($SD = 4.00$). Twenty-eight patients (50.9%) were White, 24 (43.6%) were Latino, and 3 (5.5%) were of other ethnicity. All patients completed neuropsychological measures of verbal ability, verbal and nonverbal learning and memory, attention, motor functioning, sequencing, and initiation. On measures of verbal ability, about 25–30% of patients performed in the impaired range. Approximately 40–50% of patients performed in the impaired range on tests of learning and memory, visuospatial organization, and visuomotor functioning. Patients performing in the impaired range on measures of attention ranged from 25.5% on a measure of simple attention to 67.3% on a measure of sustained attention and concentration. To explore whether or not ethnicity and language issues might account for some of these findings, we compared proportion of impairment in White and non-White patients and found no significant differences between the two groups. These results strongly suggest that cognitive functioning is impaired in many patients awaiting liver transplantation. Attention and concentration difficulties are most prevalent, while verbal abilities are least impacted. The relationship between pretransplant cognitive status and post-transplant functioning needs to be clarified.

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R. PAUL, R. COHEN, & J. GILCHRIST. Clinical Significance of Cognitive Complaints in Myasthenia Gravis.

Myasthenia gravis (MG) is an autoimmune-mediated neuromuscular disorder that results from antibody-mediated destruction of nicotinic receptors. Fatiguability of voluntary muscles is the cardinal symptom of the disease, but most patients also complain of memory difficulties. Studies have shown that MG patients perform more poorly on measures of verbal learning than controls, however the clinical relevance of these findings has not been examined. In the current study we investigated the clinical significance of memory complaints in 25 individuals with generalized MG. Performance on the California Verbal Learning Test-Revised was compared to normative data. Results revealed that 60% of the sample performed below expectations (T score < 43), with 20% of the performances falling in the impaired range (T score < 34). Disease duration, daily dose of prednisone and ratings of mood disturbance did not predict performance on the CVLT-R. However, approximately 50% of these individuals were either taking moderately high doses of steroids or had a comorbid disease that may have affected their performance. Collectively the findings suggest only mild memory difficulties among individuals with MG. Further, the results indicate that for some individuals the cognitive difficulties may not represent direct manifestations of the disease.

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R. LAW, P. BROUWERS, K. KRULL, S. BOTTOMLEY, & Z. DREYER. Performance of Childhood Cancer Survivors on a Brief Neuropsychological Battery.

Long-term survivors of childhood cancer may experience changes in neurocognitive function, particularly when their cancer or its treatment may involve the central nervous system (CNS). In the current study, 109 children, adolescents, and young adults who are long-term survivors received a brief neuropsychological assessment including the Trail Making Tests, Grooved Pegboard, Verbal Fluency, and WISC-III Digit Span. Scaled scores and difference scores (number of digits forward minus backward) were calculated for the Digit Span subtest. The effect on neurocognitive functioning of disease type, age at diagnosis and treatment, and length of treatment was assessed. The patients were subdivided into 3 groups: (1) children with acute lymphoblastic leukemia (ALL) diagnosed before age 5, (2) children with ALL diagnosed at 5 years of age and older, and (3) children diagnosed with cancers without CNS involvement. Longer cancer treatment was associated with lower scores on the Trail Making Test-Part B. Children diagnosed and treated at older ages displayed larger Digit Span difference scores, primarily as a result of poorer backward digit span performance; no differences were seen for Digit Span forward. The late ALL group showed significantly greater Digit Span difference scores than the other 2 groups, even when covaried for age at time of screening. These results suggest a relationship between age at time of cancer treatment and length of treatment with the neurodevelopment of executive systems involved in working memory and set shifting performance.

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M.C. CHEUNG, A. CHAN, & C.K. LAW. Volume of Radionecrosis Associated With Specific Cognitive Deficits.

One complication of radiotherapy for nasopharyngeal carcinoma (NPC) is occurrence of radionecrosis in brain areas including frontal lobe, temporal lobe and basal ganglia. A recent study showed that NPC patients with radionecrosis, when compared with NPC patients without radionecrosis and normal controls, demonstrated impaired verbal memory, visual memory, language, motor ability, planning and abstract thinking. This study further examined the effects of radionecrosis on cognitive deficits by investigating the relationship between volume of the necrosis and the severity of the cognitive deficits. Twenty-three NPC patients who had received radiotherapy for at least one year and had then developed radionecrosis were included. Volumes of the lesions, as evidenced by their T2 MRI scans, were calculated by the summation of the lesion areas multiplied by slides' thickness. The cognitive domains being evaluated included general cognitive

function, memory, language, motor-coordination and executive function. The results indicated that the patients' lesion volumes were negatively correlated with their general cognitive function ($r = -.55, p < .01$) as measured by the Mini Mental Status Examination. The patients' lesion volumes on the left hemisphere were significantly correlated ($r = -.49, p < .05$) with their verbal memory as measured by the Hong Kong List Learning Test. However, no significant correlation between their visual memory and their lesion volumes on the right hemisphere. The patients' performance on the language, motor and executive function tests and their lesion volumes were not significantly correlated. These results suggested that the volume of radionecrosis might affect various cognitive domains differently. Correspondence: Agnes S. Chan, Department of Psychology, The Chinese University of Hong Kong, Shatin, Hong Kong, China.

I. TORRES, A. MUNDT, P. SWEENEY, S. LLANES-MACY, L. DUNAWAY, M. CASTILLIO, & R. MACDONALD. Partial Brain Radiation Effects on Longitudinal Neuropsychological Functioning.

The present study was designed to investigate the effects of fractionated partial brain radiation therapy on longitudinal neuropsychological functioning. Seventeen consecutive adult patients with supratentorial brain neoplasms who underwent either biopsy or tumor resection and adjuvant fractionated partial brain radiation therapy (RT) were tested at pre-RT baseline, and at 3, 6, and 12 months post baseline. No patients received whole brain RT. Serial neuropsychological assessments were conducted using alternate forms of the Selective Reminding Test, 10/36 Spatial Recall Test, and Symbol Digit Modality Test (Oral, Written), as well as the Shipley Scale (baseline only), WAIS-R digit span, Trailmaking Tests A, B, and the SCL-90. Two of 17 participants received surgical treatment only and thus served as controls to help evaluate practice, test form, or other potential non-RT effects. Of the 15 patients treated with RT, 12 remained free of disease throughout the study period while 3 developed recurrent disease. Repeated measure analyses failed to reveal evidence of decline on any measure in patients without disease recurrence. In contrast, patients with disease recurrence evidenced more substantial decline in memory function. Our results suggest that partial brain fractionated RT is not associated with adverse neuropsychological effects after the 1st year of therapy. Results also emphasize the importance of identifying patients with progressive disease in RT treated samples, as this subset of patients may be more likely to show poorer neuropsychological outcome. Patients are currently undergoing subsequent testing to determine whether deficits arise with longer follow-up.

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E. KOZORA & C. RANDOLPH. Cognitive Deficits in Patients With Mild COPD Using the Repeatable Battery of Neuropsychological Status (RBANS).

Cognitive deficits have been detected in patients with mild levels of chronic obstructive pulmonary disease (COPD) using comprehensive neuropsychological testing. However, screening measures such as the Folstein Mini Mental Status Examination and the Orientation Memory Concentration Test have lacked sensitivity in this population. A new screening instrument, the RBANS has been developed and has demonstrated sensitivity and specificity in several neurological populations. In this study, 21 patients with mild COPD and 19 healthy normal controls were compared on the 5 index scores and individual subtests of the RBANS. There was no significant difference between the 2 groups in terms of age or education. COPD patients had a mean age of 67.8 and 14 years of education; healthy controls were 65 and 14.2 respectively. Significant differences in gender were found ($p = .04$) with 12 females and 9 males in the COPD group and 15 females, 4 males in the control group. A MANOVA across the 5 index scores (Immediate Memory, Visuospatial/Constructional, Language, Attention and Delayed Memory) was performed and was not significant ($F = 0.98, p = .44$). T tests across individual subtests indicate that COPD patients were significantly lower than the controls on Figure Copy ($t = 2.23, p = .028$), Semantic Fluency ($t = 2.44, p = .02$) and Coding ($t = 2.43, p = .02$).

These results indicate that subtests from the RBANS are sensitive to cognitive dysfunction in patients with COPD. Due to the brevity and repeatability of this test, it may be useful in the clinical management of COPD patients.

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E. KOZORA, C. ROSE, & L. NEWMAN. Descriptive Analysis of Cognitive Functioning in Patients With Sarcoidosis.

Diffuse inflammation or mass lesions of the nervous system occur in 10–30% of patients diagnosed with sarcoidosis, a granulomatous disease. This study examined the frequency of cognitive impairment in 20 patients (4 male) diagnosed with sarcoidosis and sequentially referred for a clinical evaluation. The average age was 50.0 ($SD = 13.6$), and mean educational level was 14.2 ($SD = 2.1$). Across the entire sample, the average length of sarcoidosis was 6.2 years and 8 were taking prednisone. Using demographically corrected data, individual tests below a T score of 40 were considered impaired. Results indicate that 53% of the sarcoid patients were impaired in learning and recall–Story Memory Test; 40% impaired on PASAT; 30% impaired on FAS verbal fluency, BDAE Complex Ideational Material and Digit Vigilance Test and 29% impaired in learning trials–CVLT and learning–Figure Memory Test. Twenty to twenty-five percent of the sarcoid patients were impaired in WAIS–R Digit Span, Arithmetic, and Digit Symbol, Trails B, Boston Naming Test and Animal Fluency. Approximately 25% of the group had a BDI score above 15 suggesting depressive symptomatology and 60% of the group were prescribed psychotropics. Clinical judgement considering neuromedical history, clinical interview and comprehensive evaluation classified 4 patients as average, 12 mild, 3 mild to moderate, and 1 moderate in overall neuropsychological dysfunction. These findings suggest a high incidence of cognitive dysfunction in sarcoidosis patients being referred; however, the presence of other medical disorders and prior neuropsychiatric symptoms may have contributed to these deficits. Larger studies with select sarcoid and medical control subjects are recommended.

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E. KERR, A. MARTIN, M. SOLOMON, & I. MACLUSKY. The Neuropsychological Sequelae of Lung Transplantation: A Case Study.

Bilateral lung transplantation (LT) is an established therapy for end-stage lung disease. While the physical sequelae are well documented, the neurological and neuropsychological outcomes are less frequently considered. A range of cognitive and behavioral changes have been associated with neuropathological outcomes of cerebral anoxia and memory and executive control deficits have been observed in young adults with end-stage CF awaiting LT. Post-transplantation neuropsychological functioning has significant implications for rehabilitation efforts and for the recipient's quality of life. We present the neurological and neuropsychological results of an 8-year-old boy with CF who experienced severe complications following bilateral LT including acute rejection of his transplanted lungs, deep vein thromboses, raised intracranial pressure, and seizure activity. An MRI scan revealed cortical and subcortical lesions in the left frontal, parietal and occipital regions. Subsequently, a comprehensive neuropsychological protocol was administered. Degree of deficit was determined quantitatively based on the number of standard deviations below the mean (i.e., 1–2 $SD = mild$, 2–3 $SD = moderate$, $\geq 3 = severe$). Based on parent report, overall adaptive functioning was very limited and behavior became socially offensive following LT. Fine motor strength, speed, and precision were moderately to severely impaired, while working memory, focused attention and learning were moderately impaired compared to both his average verbal intellectual ability to age peers. This illustrative case study argues for the importance of examining neuropsychological functioning in all patients pre- and post-LT, a practice which has since been established at our center.

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D. BADENES, S. ZARAGOZA, O. GELONC, & M. AGUILAR. Ecologic Neuropsychological Assessment for Intensive Care Unit Patients.

We present the results from the assessment of a tetraplegic patient with mutism and a serious communication impairment. An assessment of the patient's comprehension was requested to determine his potential capability to understand the clinical situation and the environmental events. The patient stayed in the Hospital Intensive Care Unit for 4 months, and suffered from several heart attacks followed by reanimation. In view of the limited communication capabilities, different methods were studied. Several methods using "easy answer" ways of answering were checked, i.e., 1 vs. 2 eye-blinking or looking to the left side vs. right side in order to answer 'yes' or 'no.' These methods were discounted because other functions were involved, i.e., working memory. The use of an observational method was considered to monitor the patient's interaction with others, his relatives and hospital staff such as nurses. A systematic observation was carried out during 2 days. From the method verbal and non-verbal communication capabilities were recorded. The study showed quite a fluctuating alert status ranging from very low to a hyperarousal state. The reaction suggested some level of comprehension, although a quality statement was not available. This ecological assessment method contributed to improving the drug prescription made by the doctors in charge. Palliative treatment was started. This 1-case study demonstrates the utility of a nonaggressive assessment technique more adapted to patients suffering from multisystem disease.

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M. WILLIAMS, A. SKLAR, P. SHAH, M. SOLLMAN, R. BURRIGHT, & P. DONOVICK. A Comparison of the Effects of Hemodialysis and Peritoneal Dialysis on Memory Function.

The uremic syndrome results from the kidneys' inability to maintain homeostasis of the volume and chemical constituents of body fluids. One consequence of uremia involves deficits in memory performance. Although dialysis has been shown to improve memory deficits resulting from uremia, little is known about potential temporal variation in memory measures between hemodialysis treatments. In the current study we examined dialysis patients for possible fluctuations in memory performance using the Rey Auditory Verbal Learning Test (RAVLT). Twenty patients undergoing hemodialysis on a thrice weekly schedule were tested at time intervals of 1, 24, and 67 hr postdialysis. For purpose of comparison we studied ten peritoneal dialysis patients at identical time intervals. Results showed that hemodialysis patients demonstrated the greatest memory impairments at 67 hr post last dialysis session. Patients undergoing hemodialysis experienced significant changes in memory performance for both immediate [$F(1, 19) = 15.882, p < .01$], and delayed [$F(1, 19) = 35.854, p < .01$] recall. In comparison, peritoneal patients demonstrated a stable performance in these memory measures across a 67-hr time period. These results suggest that hemodialysis patients experience a significant change in memory performance on the RAVLT between dialysis sessions, with the greatest impairment seen at 67 hr post dialysis. However, peritoneal dialysis patients demonstrated a stable performance on memory measures. We conclude that patients with end-stage renal disease who are receiving peritoneal dialysis demonstrate cognitive stability on these memory measures whereas hemodialysis patients show significant temporal fluctuations in memory performance.

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L. DUNAWAY, P. COMO, C. THORNTON, C. BARBIERI, R. MOXLEY, J. BUHLER, & S. DAMASKE. An Open Label Trial of DHEAS on Cognitive Function in Myotonic Dystrophy.

Myotonic dystrophy (DM) is the most common form of muscular dystrophy with no treatment to reverse or prevent the characteristic progressive muscle wasting. Neuropsychological studies of DM have yielded inconsistent results with deficits reported in a variety of domains. Dehydroepiandrosterone sulfate (DHEAS), a steroid hormone that promotes muscle strength and bulk, is markedly reduced in DM. The purpose of this open

label trial was to examine the effects of oral DHEAS on cognitive and psychological functioning in a sample of 11 DM patients (8 males, 3 females, M age 43 ± 8 years). A comprehensive neuropsychological battery was administered to subjects at baseline, after 8 weeks on a replacement dose of DHEAS, and again after 8 weeks on an increased pharmacologic dose. Alternated forms of the battery, where available, were used. Paired sample t tests were performed to compare test performance across 3 testing sessions. Statistically significant improvements from baseline to final visit were seen on measures of (1) sustained verbal and visual attention, (2) cognitive flexibility, (3) verbal fluency, and (4) nonverbal abstraction and problem solving. No significant differences were noted on measures of psychological stability or fine motor function. These findings suggest that the observed cognitive improvement does not appear to be due to improved mood or physical strength. These results also suggest that DHEAS may facilitate improvement in sustained attention and executive function, however, these findings need to be confirmed in a controlled clinical trial with a larger sample size.

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K. GOODALL & M. VRBANCIC. Individual Differences in Memory Function After Carotid Endarterectomy.

As part of a larger neuropsychological battery, the California Verbal Learning Test was administered to 11 patients undergoing endarterectomy for severe unilateral stenosis of a carotid artery. Severity of the stenosis was determined by NASCET criteria. Indices of encoding and retrieval functions were examined for preoperative impairment and postoperative change 6 to 8 weeks after surgery. Preoperatively, the patient group scored within the normal range on both the encoding and retrieval indices. Postoperatively, the patient group showed no significant change on either index. However, a potential cancellation effect was identified by examining each patient's scores using the Reliable Change Index. Results for the encoding index indicated that postoperatively 8 patients showed no change and 3 patients showed deterioration. Results for the retrieval index indicated that postoperatively 3 patients showed no change, 3 patients showed improvement and 5 patients showed deterioration. These findings suggest that grouped data on endarterectomy patients masks important individual differences in postoperative outcome on encoding and retrieval functions.

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J.L. NANSON, K. GILLETA, T. MOORTHY, K. LITKE, C. PETERSON, & K. SOLES. The Role of Depression in Possible Cognitive Decline in Friedreich's Ataxia: A Case History.

Friedreich's ataxia (FA) is an inherited mitochondrial disease, which causes progressive muscle weakness, ataxia and cardiac disease. Research into cognitive functioning in FA has produced contradictory results. Some authors describe deficits in attention and memory whereas others have reported no cognitive deficits. We present a patient with FA, who has had serial neuropsychological evaluations. Sequential assessments allow for the trajectory of the disease to be assessed. K.S. is a 23-year-old college student with FA. She requested a neuropsychological assessment to assist with career planning. Assessment results showed slowed information processing, and delayed recall deficits for visual and verbal material, and depression. Over the subsequent year, she has experienced a decrease in physical functioning, necessitating use of an electric wheelchair. Follow-up assessment 1 year later showed no deficits in speed of information processing, visual or verbal memory, and a decrease in her depression. She attributes the lifting of her depression and improvements in cognitive functioning to increased social support, as she became more involved in disability issues on campus. It appears that as her social supports increased, her depression lightened leading to an improvement in attention and memory. Thus, depression appears to be a mediating variable in cognitive functioning in FA. It is possible that the contradictory findings in FA exist because of differences in depression levels across subjects. Future re-

search in FA should include measures of depression as a covariate of cognitive functioning.

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K. BUSICHIO, L.A. TIERSKY, J. DELUCA, & B. NATELSON. Neuropsychological Impairment in Patients With Chronic Fatigue Syndrome.

Individuals with chronic fatigue syndrome (CFS) have consistently been found to perform significantly below healthy individuals on neuropsychological measures. However, the clinical significance of this level of performance remains unclear. Simply performing at a level below healthy individuals is not necessarily clinically relevant. The present investigation examined the clinical significance of neuropsychological impairment by examining the failure rate of CFS patients on several neuropsychological measures. Failure was defined as scoring below the 5th percentile with respect to healthy data. In addition, we examined the percentage of CFS subjects performing 1 and 2 standard deviations below normative values on each test administered. Finally, we examined if CFS patients were more likely to fail the measures in specific cognitive domains than healthy persons. One hundred forty-eight patients, who met the case definition criteria for Chronic Fatigue Syndrome, and 76 healthy controls (ages 18–55), were recruited into the study. A neuropsychological battery that included measures of the following was administered to all participants: attention (concentration), speed of information processing, motor speed, and executive (higher order) processing. Results indicated (Fischer exact tests) that CFS participants failed (performance below the 5th percentile) more of the neuropsychological measures than healthy controls ($p < .01$). Moreover, CFS participants performed 1 or 2 standard deviations below the healthy norm on 12 of the 16 tests administered. Finally, CFS participants were more likely than healthy controls to fail at least 1 test in each of the following domains: memory ($p < .05$), concentration ($p < .01$), speed of information processing ($p < .01$) and motor speed ($p < .01$). The results suggest that CFS patients are clinically impaired on neuropsychological measures. Further research should examine the role that neuropsychological impairments play in the maintenance of disability in this unexplained fatiguing illness.

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R. J. MATHEIS, L.A. TIERSKY, B.H. NATELSON, & J. DELUCA. Effects of Psychopathology on Neuropsychological and Functional Outcomes in CFS.

Individuals with CFS demonstrate neuropsychological, emotional, and functional impairment. While the CFS symptomatology alone contributes to these deficits, the effect of comorbid psychiatric illness on these factors is not well understood. This is an important issue as psychiatric illness is prevalent in CFS and impacts on neuropsychological functioning in this population. The present study investigated the effects of psychiatric history in CFS patients on measures of neuropsychological, emotional, and physical ability. Four groups were compared: CFS patients with psychiatric illness beginning prior to CFS (PrePsych), CFS patients developing psychiatric illness after CFS (PostPsych), CFS patients with no psychiatric illness (NoPsych), and healthy controls. Patients with a psychiatric diagnosis were divided into two groups (PrePsych and PostPsych) because it was hypothesized that onset of psychiatric illness relative to CFS onset would differently effect outcomes. Across measures, the healthy control group significantly outperformed all CFS patients. The PrePsych group was the most impaired on neuropsychological outcomes, followed by the PostPsych group. In addition, PrePsych individuals performed worse than all other groups on a measure of neuroticism and a measure of mood ($p < .001$). As expected, the NoPsych group demonstrated less impairment than the other CFS patients on measures of emotional functioning ($p < .001$). However, on measures of physical functional status, the NoPsych group performed worse than the PostPsych group ($p < .01$). These findings suggest that psychiatric history does differently effect neuropsychological, emotional and functional status in CFS, indicating that psychiatric history should

be considered when attempting to understand factors maintaining disability in CFS.

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J.L. SCHISSEL & M.R. BASSO. Age of Onset Predicts Neuropsychological Dysfunction in Non-CNS Systemic Lupus.

Systemic lupus erythematosus (SLE) is a chronic, often debilitating autoimmune disease that has been shown to diminish cognitive functioning, even in individuals without obvious central nervous system (CNS) involvement. Among patients with no CNS symptoms, patient characteristics predicting neurobehavioral declines are poorly defined. However, there are indications that cognitive status may be related to age of disease onset. For example, among children with SLE, earlier age of disease was associated with diminished sensory perception and intellectual ability. As yet, however, these findings have not been replicated in adults. Accordingly, the aim of the current study was to investigate the association between age of diagnosis and degree of cognitive impairment in SLE. Forty-two participants with non-CNS SLE provided a detailed disease history, and were administered a neuropsychological screening battery covering 4 areas of cognitive function: attention, executive function, memory, and sensory-motor functioning. Partial correlations were computed in which the potentially confounding effects of age and estimated IQ were controlled. To protect against Type I error, a modified Bonferroni of $p < .01$ was chosen to determine statistical significance. Results demonstrated that age of diagnosis was significantly correlated with performance on Trailmaking Test B, California Verbal Learning Test Trials 1–5 Total Score, and Stereognosis Errors, with earlier age of diagnosis predicting poorer performance. This suggests that earlier age of diagnosis may contribute to the presence of subtle cognitive deficits, even in the absence of obvious CNS involvement. Implications of these findings for clinical practice and future research are addressed.

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L.A. TIERSKY, V. ANSELMINI, & T. SCHWARTZ. Neuropsychological Rehabilitation in a Case of Dual Diagnosis: CFS and MTBI.

The efficacy of a neuropsychological rehabilitation program in the treatment of the cognitive and emotional difficulties, which often accompany chronic fatigue syndrome (CFS) and mild traumatic brain injury (MTBI) was evaluated using a single-subject, pre- and post-test design. The focus of the investigation was Ms. D., who sustained a MTBI (diagnosed according to the ACRM criteria) and who was then years later diagnosed with CFS according to the 1994 case definition criteria. She received three, 1-hr sessions of cognitive-behavioral psychotherapy (CBT) and three, 1-hr sessions of cognitive remediation per week, for 11 weeks. The CBT component focused on the following: somatic symptom management, relaxation training, cognitive restructuring, mood management, assertiveness training, and relapse prevention. Topics specific to CFS and MTBI, such as grief over loss of functional ability as well as activity and rest scheduling were also addressed. The remediation protocol included the teaching of compensatory strategies as well as the practice of exercises drawn from the Attention Process Training Program. She was evaluated at baseline 1, 3, and 6 weeks pretreatment and immediately, 1, and 3 months posttreatment. Ms. D.'s somatic and affective symptoms as well as general functional ability were noted to improve. Clinical observations are used to highlight the challenges encountered in treating a patient with dual debilitating somatic conditions. Managing a patient who was often highly resistant to psychotherapeutic interventions is also discussed. Finally, the somatic symptom presentation of these 2 conditions are compared and discussed within the context of treatment.

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M. PISKOPPOS, T. SCHWEIZER, & D. GEIGER. Cholinergic Effects on Neuropsychological Performance in Herpes Encephalitis.

Herpes simplex viral encephalitis is a disease that typically results in secondary neurobehavioral sequelae ranging from severe dementia to amnesia

or a mild impairment in memory performance and speech. Pharmacological intervention with cholinergic drugs to effect these neurobehavioral sequelae had not previously been attempted. This intervention was presently undertaken to determine whether certain neuropsychological functions and clinical presentation could be positively affected. Using a pre-post single-case design, 1 year post onset a cholinergic drug was administered for a 3-month trial period. The patient's neuropsychological pre- to post-test result comparisons showed overall reduced post-test performance on timed intellectual nonverbal functions (Picture Completion, Picture Arrangement and psychomotor speed). A deterioration or no change in memory performance and a mild increase in perseverative performance was also observed. Logical Memory for first trial presentation declined from 56% retention on pre-test to 12% retention on repeat assessment. Long-term Logical Memory was consistent in that no information was retained over a half-hr interval. A similar performance pattern was observed in long-term retention for the Rey Auditory-Verbal Learning test, hard-paired associates, Rey-Osterrieth Complex Figure and visual reproductions. These findings suggest that this cholinergic drug did not positively influence neuropsychological test performance and, in some instances, had a detrimental influence on performance. Correspondence: M. Piskoppos, 348A King St. East, Cambridge, ON N3H 3M8, Canada.

R. J. HOUSTON, K.W. GREVE, D. ADAMS, M.S. STANFORD, F. RABITO, K. J. BIANCHINI, & A. CLANCY. Neurobehavioral Consequences of St. Louis Encephalitis Infection: A Case Report.

St. Louis encephalitis (SLE) is perhaps the most common type of viral encephalitis. However, the SLE literature presently lacks any comprehensive accounts of neurobehavioral consequences of infection. Thus we present a high functioning woman (18 years education) whose cognition was extensively evaluated during the subacute phase of the illness and again at 1 year post-infection. Subacutely, general intelligence, language, and academic abilities appeared consistent with premorbid levels. Deficits included mild to moderate impairment on tasks measuring attention and psychomotor speed, high level verbal disorganization, and slight deficits in nonverbal problem solving. At follow-up, the patient reported a return to her previous full work schedule though she complained of a diminished range of activity as compared to premorbid levels. This attenuation was physiologically corroborated via evoked potential (P1-N1-P2) evaluation. Cognitively, she demonstrated considerable improvement (to well above average on some tasks) on nearly all previously impaired tasks with exceptions in some aspects of working memory and high level attention. She showed variability in performance on some memory tasks suggestive of continued susceptibility to fatigue. In general, the follow-up evaluation suggested a return to premorbid function levels. However, it appears that level of function was only achieved with greater effort. This evaluation provides comprehensive documentation of the subacute and 1 year post-infection cognitive sequelae of SLE infection. In addition, important aspects of the neuropsychological evaluation of high functioning individuals are illustrated.

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TBI

B.S. KAUDER, P.D. NEWMAN, & R.A. HANKS. Cognition and Functional Rehabilitation Status of Urokinase-Treated TBI Patients.

Urokinase's lytic properties have been investigated for numerous medical applications. However, its efficacy as an intervention to ameliorate the secondary effects of TBI-related intraventricular hemorrhage (IVH) has yet to be addressed. It was postulated that urokinase treatment of patients with IVH would help to clear the blood and mitigate neurocognitive impairments. Accordingly, 12 TBI patients with IVH who received urokinase acutely (M GCS = 8.0, SD = 4.4) were compared with a mixed group of 117 TBI patients without IVH who did not receive the drug (M GCS = 10.3, SD = 4.5). All patients were continually rated for their functional independence across length of inpatient rehabilitation admission, and they

were administered comprehensive neuropsychological examinations both upon clearing of posttraumatic amnesia and at 1-year follow-up. At admission and discharge, IVH patients had poorer functional outcomes than those without IVH. However, despite having significantly lower mean GCS scores ($p \leq .05$), the results indicate that the drug-treated group had significantly better visual discrimination and working memory than the non-IVH group upon initial testing (Visual Form Discrimination; $p \leq .03$ and Backwards Digit Span; $p \leq .05$). Significant group differences were not found on initial testing for any other neurocognitive measures. Notably, no group differences were detected on any of the neurocognitive measures at 1-year follow-up. It appears that urokinase may ameliorate select neurocognitive deficits acutely, possibly due to improvement of secondary effects of TBI. A fruitful line of further inquiry is replication with larger samples of patients with TBI-related IVH.

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W.J. HE, A.S. CHAN, & W. POON. Verbal Memory of Patients With Mild Head Injury in Random and Organized Word Lists.

Although memory impairment is a most common complaint of individuals with mild head injury (MHI), empirical studies reported inconsistent results regarding whether MHI associates with clinically significant memory impairment. One possible reason for this discrepancy may be that most studies did not focus on examining the underlying nature of the deficit. To further examine this issue, the present study investigated cognitive processing of memory (learning, retention and recognition) in MHI patients. Furthermore, there has been increasing interest in memory intervention for MHI patients, thus another purpose is to evaluate the effect of external organizational cues on memory of these patients. Seventeen MHI patients and 17 age and education matched normal control (NC) participants were recruited. The Hong Kong List Learning Test (HKLLT) which consists of a randomly presented word list (i.e., random condition) and a categorical organized word list (i.e., blocked condition) was employed. There are three learning, one 10-min delay, one 30-min delay and one recognition trials in each condition. The MHI patients demonstrated impaired retention and retrieval but not acquisition. A discriminant function analysis on the performance of MHI patients and NC participants on the HKLLT yielded a 90% discriminability. The retention of the MHI patients was significantly improved with external organizational cues, although the improvement was less than that of the normal individuals. In summary, the HKLLT has been shown to be sensitive in differentiating MHI patients from NC participants, and organizational cues may be a useful intervention for memory deficits of MHI patients.

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R. PERNA, K. WILLIAMS, D. DURGIN, & S. GELLER. Mild Traumatic Brain Injury: MHI and Neuropsychological Findings.

The prevalence of neurocognitive dysfunction following mild traumatic brain injury (MTBI) is a controversial issue. Many persons report persistent postconcussive symptoms such as memory problems and headaches yet very often have negative findings on MRI. Though research has demonstrated that brain injury can be present in the absence of positive MRI findings, many health care providers and insurance carriers continue to feel that MRI is the definitive test for brain injury. This study looks at 58 consecutive persons who sustained a MTBI and completed a neuropsychological assessment. The sample has a mean age of 40.7 years, 70% reported persistent pain at the time of testing, 49% were involved in litigation, 47% were involved in motor vehicle accidents, 68% of the sample had negative MRI findings, and the mean number of MMPI-2 elevation (proxy for emotional distress) was 4.5. Though 11 participants had positive MRI findings, 41 received a diagnosis suggesting cerebral dysfunction, based on neuropsychological findings. All those with positive MRI findings had neuropsychological impairments. When *t*-test comparisons were performed between MRI groups (positive vs. negative findings) across

all neuropsychological and demographic variables the only significant differences were on general memory and diagnosis of cerebral dysfunction. Neither MRI findings nor diagnosis of cerebral dysfunction correlated significantly with any neuropsychological variables. Findings suggest that while positive MRI findings may be a good indication of cerebral dysfunction, the dysfunction can often occur in the absence of MRI findings. Neither MRI status nor diagnosis correlated significantly with any neuropsychological measure, a finding perhaps suggesting a low positive predictive value of any one-test score.

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A. ALDERSON & T.A. NOVACK. Evaluation of Orientation as a Neuropsychological Intervention.

Implementation of cost-effective neuropsychological interventions is an important focus in head injury rehabilitation. This prospective study examined the role of regular, serial evaluation in promoting recovery of orientation among 52 individuals with traumatic brain injury (TBI). Participants were predominantly males (75%) with moderate to severe TBI (Glasgow Coma Scale score <13 ; 76%), who were completing inpatient comprehensive rehabilitation. All participants were administered the Orientation Log (O-Log), which provides an overall measure of orientation recovery, as well as graded assistance with orientation items. All patients were disoriented at admission. The O-Log was administered daily to 26 patients and twice weekly to the remaining 26 patients. There was no difference in age ($M = 53$ years), education ($M = 12.3$ years), or injury severity between the groups. Evaluation of maximum achieved O-Log scores did not reveal group differences. Analysis of the rate of orientation recovery also did not reveal differences between groups; those patients receiving twice weekly orientation evaluations and cues achieved full orientation at the same rate as those receiving daily assessments. These results suggest that recovery of orientation may be independent of specific orientation cuing, and assessment of orientation recovery can be accomplished adequately with twice weekly O-Log evaluations. The assessment itself does not appear to serve as an effective intervention in speeding recovery of orientation in an inpatient rehabilitation setting. Unfortunately, the specific contribution of cuing to orientation recovery was difficult to evaluate as orientation information was provided in multiple other rehabilitation therapies.

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U. SATISH, S. STREUFERT, M. SUMAS, & P.J. ESLINGER. Simulation-Based Cognitive Rehabilitation Following Mild-Moderate Head Injury.

Approximately 15–27% of mild to moderate closed head injury (CHI) persons recover incompletely or slowly. Preliminary research with CHI subjects has shown that a quantitative cognitive simulation technique (strategic management simulation) can detect and characterize residual deficits in executive functioning that are not (or no longer) evident on standard neuropsychological tests. This simulation technique has been previously established to provide reliable and valid quantitative assessment of decision-making and executive capacities but only recently has been applied to brain injury research. Levels of performance on 25 simulation measures (including Activity, Speed, Responsiveness, Initiative, Emergency Handling, Breadth or Approach, Planning, Strategy, etc.) are obtained and raise the possibility of time—and cost-effective retraining since efforts can be focused on specific processing deficits. Here we report the results of initial cognitive retraining studies with patients in the chronic recovery phase after CHI. Stage 1 is completion of the simulation assessment and discussion with the patient about particular deficit areas. Comparisons of simulation experiences and real-world problems reinforce understanding and generate the basis for retraining. In Stage 2 patients are provided vignettes which focus on their specific skill deficits. As relearning takes place, vignette challenges increase. Competence of response continues to be evaluated. In Stage 3, participants are re-evaluated with an alternate simulation. Results indicate that postretraining data are significantly improved from

baseline and relate to changes reported in everyday functioning. Findings suggest that the cognitive simulation/vignette approach can provide potentially effective remediation of cognitive impairments after CHI.

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S. DIKMEN, J. MACHAMER, & N. TEMKIN. Mild Traumatic Brain Injury: Facts and Artifacts.

There is continued interest in neuropsychological consequences of mild TBI. While most would agree that such injuries are indeed associated with early problems, disagreement exists regarding their persistence and whether they are the cause of disabilities experienced by some. The aims of this study were to determine early and late impairments as a function of TBI and the contribution of other factors to outcome. *Methods:* One hundred seventy-eight nonselect, hospitalized cases with GCS 13 to 15 and 120 trauma controls were prospectively studied at 1 and 12 months after injury on neuropsychological measures. Both groups contained subjects with and without pre-existing conditions. Brain injury effects were explored in groups defined by progressively more stringent criteria with the mildest group restricted to those with GCS 13 to 15, coma less than 1 hr, post traumatic amnesia 1 day or less and normal CT. *Results:* The results indicate early impairment in memory, which decreases at 12 months post injury and in groups more stringently defined. The contribution of head injury to outcome is larger in more severely injured mild cases and at 1-month post injury. The contribution of TBI decreases in more stringently defined groups and at 1-year post injury while the contribution of demographics increases substantially as a function of these dimensions. *Conclusions:* Mild TBI is associated with neuropsychological impairments. However, the magnitude of late impairments is small as compared to the contribution of demographics of the brain injured or the groups to which they are compared. Subtle variation in the demographics of the brain injured or the comparison subjects can be sufficient to mimic or mask mild brain injury effects.

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C. BOAKE, S.R. McCAULEY, H.S. LEVIN, & J. SONG. Postconcussional Disorder in Brain and Nonbrain Trauma: DSM-IV versus ICD-10.

Objective: To investigate the agreement between diagnosis of postconcussional syndrome as defined by the International Classification of Diseases-10th edition (ICD-10) and postconcussional disorder (PCD) as defined by the Diagnostic and Statistical Manual-IV (DSM-IV). *Patient sample:* 80 patients with mild-moderate traumatic brain injury (TBI) and 53 with trauma not involving the brain who were recruited from the emergency department and inpatient wards of a level-1 trauma center. *Design:* Inception cohort study. *Outcome measures:* A structured interview of postconcussional symptoms was administered at 3 months postinjury. Diagnosis of PCD was made separately using ICD-10 and DSM-IV diagnostic criteria and the results were compared. The DSM-IV loss/alteration of consciousness criterion was relaxed to investigate if general trauma patients with possible whiplash injuries met other DSM-IV criteria. *Results:* Prevalence of PCD was higher using ICD-10 than the modified DSM-IV criteria. Agreement between the ICD-10 and modified DSM-IV diagnoses was moderate ($Kappa = .47$). Agreement for the 5 symptoms shared by the DSM-IV and the ICD-10 diagnoses (fatigue, sleep disturbance, headaches, dizziness/vertigo, irritability/aggression) was high ($Kappa = .82-.89$) despite different threshold criteria. PCD using either ICD-10 and modified DSM-IV criteria was diagnosed in general trauma as well as TBI patients. *Conclusions:* The 2 major sets of diagnostic criteria for PCD result in different prevalence estimates of PCD. Most of the ICD-10 and DSM-IV diagnostic criteria for PCD are not specific for TBI.

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B.P. KOLITZ, R.D. VANDERPLOEG, & G. CURTISS. Development and Validation of a TBI Behavioral Outcome Instrument.

We describe the development and validation of the Key Behaviors Change Inventory (KBCI), an instrument designed to assess behavioral changes following traumatic brain injury (TBI). It is easily completed by caregivers or relatives of individuals who have sustained a TBI. The initial item pool consisted of 203 items, rated on a 4-point scale, reflecting behaviors identified in the literature as occurring frequently in the TBI population. These items comprised eight *a priori* scales (*Inattention, Impulsivity, Interpersonal Difficulties, Apathy, Unawareness of Problems, Communication Problems, Somatic Difficulties, and Emotional Adjustment*). Item reviews by collateral-informant, bias review, and expert panels resulted in some item wording and scale membership changes. KBCI ratings on 75 normal controls and 25 TBI survivors were then utilized for item analysis. The final version of the KBCI contained 8 scales of 10 items each. Coefficients alpha for these scales ranged from .86 to .92. Criterion-related validity was examined in a sample of 30 TBI survivors, 20 multiple sclerosis (MS) patients, and 50 normal controls equated on age and gender (control protocols were completed by the same raters). A MANOVA comparing the three groups on the 8 KBCI scales was significant. Subsequent univariate ANOVAs and Tukey's HSD comparisons revealed that both the TBI and MS groups were rated significantly higher on all KBCI scales than the control group. In addition, the TBI group was rated significantly higher than the MS group on the Inattention, Impulsivity, Unawareness of Problems, and Communication Problems scales. These findings provide initial validity support for the KBCI.

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W.M. HIGH, JR., J.S. WEFEL, A.M. SANDER, C. BOAKE, K. ROBINSON, C. CONTANT, & H.J. HANNAY. Comparison of the Glasgow Outcome Scale and Disability Rating Scale as a Measure of Outcome After TBI.

The Glasgow Outcome Scale (GOS) is the most widely used outcome scale in neurosurgery for traumatic brain injury (TBI). The scale has been criticized for lack of sensitivity and is not widely used in rehabilitation settings. The Disability Rating Scale (DRS) has been used in both neurosurgical and rehabilitation studies. Few studies have compared the scales in the same population. Two hundred and one persons with primarily severe (60%) TBI were evaluated 1 year post-injury with both scales. Participants were admitted to inpatient rehabilitation following acute care (average age 31.3 years). Participants began to follow simple motor commands 22.7 days (avg.) after injury. The DRS score was significantly correlated with severity of injury as measured by the initial Glasgow Coma Scale (GCS) score ($Rho = .40, p < .0001$) and days until follows commands ($Rho = .47, p < .0001$). Although DRS score was significantly correlated with GOS category ($Rho = .82, p < .0001$), a range of DRS scores was found within each GOS category. Within the Good Recovery category of the GOS ($n = 106$), 40% of the DRS scores were consistent with no disability, 45% indicated mild disability, and 15% were in the partial disability range. For the Moderate Disability category of the GOS ($n = 59$), 63% were rated as having partial disability by the DRS, 31% had scores in the moderate range, and 6% were in the moderately severe range. In the severe category of the GOS ($n = 33$), 55% had DRS scores in the moderate range, 27% in the moderately severe range, and 18% were in the severe to extremely severe range. Three patients were rated as vegetative by both scales. The DRS has the potential of being a more sensitive measure of outcome following TBI. Correspondence: *Walter High, Jr., Brain Injury Research Center, 4007 Bel-laire Boulevard, Suite EE, Houston, TX 77025.*

R. PERNA, K. WILLIAMS, D. DURGIN, & S. GELLER. Mild Traumatic Brain Injury and Loss of Consciousness.

Loss of consciousness (LOC) has been useful in the classification of head injury, and at an intuitive level may appear to be a good indicator of possible brain dysfunction, despite research to the contrary. At a minimum, LOC is bonafide evidence of a concussion though research has not clari-

ified if the presence of a LOC is a stronger predictor of cerebral dysfunction than no LOC in the context of MTBI. This research analyzes the relationship between LOC and other neuropsychological variables of 27 consecutive MTBI patients. LOC occurred in 6 individuals and 21 had no LOC. Of those individuals who experienced no LOC, 95% were diagnosed with cerebral dysfunction based on assessment findings. When LOC was correlated with all measured variables, it had small nonsignificant correlations with most neuropsychological variables including headache ($r = .12$), MRI findings ($r = -.08$), reports of memory dysfunction ($r = .12$), and diagnosis of brain dysfunction ($r = -.19$). LOC correlated best with Trails B ($r = .21$). This is an unusual finding since LOC does not appear to be an indicator of cerebral dysfunction, though may indicate the disruption of certain neurocognitive systems. In fact, a higher proportion of those who did not experience LOC were diagnosed with cerebral dysfunction. Additionally, 26% of those patients with no LOC had (+) MRI whereas 17% of those with a LOC had (+) MRI. More research needs to clarify these issues, LOC should not be given too much predictive utility as an indicator of severity in MTBI despite its use for other purposes. Correspondence: Robert Perna, Ph.D., 200 Front Street, Vestal, NY 13850.

H. J. HANNAY, R. COLLINS, J. CASS, A.B. VALADKA, & W. HIGH. Outcome of Complicated Mild Head Injury Subtypes.

A mild head injury can produce quite varied outcome. The term complicated mild head injury has been introduced into the literature as a way of distinguishing mild head injured patients who have abnormalities on a CT scan or MRI and/or an abnormal neurological examination from those who do not. We compared the global outcome of 2 groups of head injured patients with a complicated mild head injury. Group 1 never had a GCS score lower than 13–15 in the Level I Trauma Center and in their first 48 hr in the Neurosurgery Intensive Care Unit (NICU) of an acute care hospital. Group 2 from the same setting had a GCS score that temporarily fell below 13 as a result of such variables as alcohol, anesthetic, sedation for agitation or intubation, and ecchymosis. The groups did not differ on the basis of age, education, gender, or ethnicity. Group 2 had a significantly worse outcome as measured by the GOS at discharge and 1 month post injury; these comparisons were almost significant with the DRS. Group 2 had a significantly higher rate of ETOH on admission, cranial surgery, intubation, ecchymosis, and sedation for agitation. However, the groups were similar in their global outcome at 3 and 6 months post injury.

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G. SCHRIMSHER, H. J. HANNAY, J. CASS, & C. ROBERTSON. Symbol Digit Modalities Test Performance Following Traumatic Brain Injury.

The Symbol Digit Modalities Test (SDMT) is commonly used for assessment of attention and concentration, but to date there has been no evaluation of subsequent impairment in SDMT performance across the Glasgow Coma Scale (GCS) range. TBI patients ($n = 123$) were classified into *complicated mild*, *moderate* or *severe* groups based on postresuscitation GCS and CT scan abnormalities taking into account the effects of alcohol, surgery, sedation for agitation, intubation and ecchymosis. Patients were tested on the SDMT three months \pm 2 weeks postinjury. Patient age and education were covariates in the analysis. Injury severity significantly predicted SDMT performance three months post TBI uniquely accounting for 18.1% and 23.9% of variance for the written and oral SDMT respectively ($p < .0001$). There were no significant interactions between injury severity, age, or education. The written SDMT score (i.e., number correct) did not differ between the complicated mild ($43.5 + 12.2$; $n = 35$) and moderate ($43.2 + 16.3$; $n = 11$) groups. However, both the complicated mild ($p < .0001$) and moderate ($p < .005$) groups had better written SDMT performance than the severe group ($28.3 + 13.8$; $n = 74$). The oral SDMT score did not differ between the complicated mild ($53.7 + 15.5$; $n = 34$) and moderate ($53.5 + 21.3$; $n = 11$) groups, but both the complicated mild ($p < .0001$) and moderate ($p < .0005$) groups had better oral SDMT performance than the severe group ($33.6 + 15.1$; $n = 70$). These findings substantiate the report by Williams et al. that patients with complicated mild TBI are sim-

ilar to those with a moderate TBI on neuropsychological measures including attention and emphasize the idea that mild TBI is a heterogeneous category.

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N. PASTOREK, H. J. HANNAY, & C.S. ROBERTSON. Outcome Prediction From Acute Care Testing With Severe Head Injury.

Neuropsychological assessment traditionally starts after PTA has resolved. However, the potential research and clinical utility of initiating sequential testing shortly after a patient regains consciousness warrants the search for neuropsychological measures for use during early recovery. Patients who are still in PTA, as indicated by a GOAT score of less than 76, often are able to understand and complete some psychological tests. These tests include measures of language comprehension and attention. Twice as many severely head-injured patients were able to complete these tests compared to full neuropsychological testing before discharge. The current study evaluated the usefulness and prognostic utility of these tests during the early stages of recovery from severe head injury. Test data collected at 1 month post injury and global outcome data collected at 6 months post injury from 85 severely head-injured patients were analyzed. Attention (Auditory and Visual Number Search Tests) and language comprehension tests (Mini-Token Test and Complex Ideational Material from the BDAE) were included. Of these patients 59%, 65%, 74%, and 78% were able to complete the tests at 1 month, respectively. Depending on the specific test, 38% to 51% of patients who completed the tests had a GOAT score of less than 76, indicating PTA. The tests of language comprehension, separately and together, were significantly correlated with 6-month outcome as measured by the GOS and DRS. Early testing may aid treatment planning and collection of useful research information before patient discharge.

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S.D. PLUTH, S.R. McCAULEY, & H. J. HANNAY. Growth Curve Analyses: DRS and GOS Prediction of Neuropsychological Performance After CHI.

Previous studies found both the linear and curvilinear recovery curve components of the DRS following closed-head injury are strongly predictive of ratings of cognitive severity and burden at 6 months post injury. The current study used growth curve analyses of the Disability Rating Scale (DRS) and Glasgow Outcome Scale (GOS) scores at acute hospital discharge, 1, 3, and 6 months post injury. Outcome measures were based on 6 month neuropsychological composites of immediate memory, delayed memory, visual focused attention, and a balanced composite of auditory and visual focused and divided attention measures. Performance on both of the attentional composite measures was associated with the level of severity of the acute DRS and GOS scores. Neither the linear nor the curvilinear components of the DRS or GOS curves was predictive of performance in the attentional domain at 6 months post injury. Performance on both memory composites was associated with the level of severity of the acute DRS and GOS scores. Neither the linear nor the curvilinear components of the GOS curves was predictive of memory performance at 6 months post injury. In contrast the linear, but not curvilinear, component of the DRS recovery curve was strongly associated with both the immediate and delayed memory composites. These findings suggest that the linear aspect of the rate of recovery curve for the DRS is predictive of later neuropsychological test performance in memory. Furthermore, results show that the DRS is more sensitive to cognitive aspects of recovery following a closed head injury than is the GOS.

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J.E. CASS, H. J. HANNAY, A.B. VALADKA, & C.S. ROBERTSON. Wisconsin Card Sorting Test Performance in Adult Closed-Head Injury Patients.

Wisconsin Card Sorting Test (WCST) performance has been reported to be sensitive to frontal dysfunction in a variety of clinical populations. Per-

formance has been examined with primarily heterogeneous populations. Few studies including closed-head injury (CHI) patients have controlled for time post injury or explored the effects of variables such as injury severity, lesion location, and lesion type. The current study examined WCST performance in adult CHI patients during the first 6 months post injury. Patients were tested at 3 and 6 months post injury (± 2 weeks) and were assigned to severity groups based on post-resuscitation Glasgow Coma Scale scores and CT scan abnormalities taking into account the effects of alcohol on admission, surgery, sedation, entubation, and ecchymosis. Repeated measures analyses revealed interactions of age and education with time post injury, but no effects of focal lesion location (frontal, nonfrontal, frontal plus nonfrontal) or type (focal, diffuse). A more severe injury was associated with greater perseveration. Analyses on the larger sample of patients with data at 3 months post injury showed that patients with frontal lesions performed similarly to those with nonfrontal damage; participants with frontal plus nonfrontal damage performed significantly the worst. Severity and lesion location did not affect performance at 6 months post injury. Lesion type in severely injured participants influenced performance only at 3 months post injury. These results highlight the importance of demographic variables, time post injury, and injury severity on WCST performance and emphasize limitations in utilizing the WCST to infer frontal dysfunction. Findings related to education support the cognitive reserve hypothesis.

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R.N. THOMPSON, M. SHERER, S.A. YABLON, R. KENNEDY, & T. NICK. Confusion Following TBI: Inspection of Indices of Delirium and Amnesia.

Much debate exists regarding the state of altered consciousness following traumatic brain injury (TBI). No study has yet described the relationship between indices of confusion, amnesia, agitation and delirium in a TBI sample. The purpose of this study was to compare TBI inpatients across traditional indices of posttraumatic amnesia (PTA) and delirium. Forty consecutive TBI Model System patients rated as RACHOS IV and above during inpatient rehabilitation were prospectively evaluated (M age 37.57; 82.5% male). All participants were rated on the Delirium Rating Scale (DeIRS), Agitated Behavior Scale (ABS), DSM-IV Delirium Diagnostic Criteria (DDC), Cognitive Test of Delirium (CTD), and Galveston Orientation Amnesia Test (GOAT). Twenty-four individuals met DDC (D+) on initial ratings. Sixteen individuals not meeting DDC (D-) did not differ significantly from the D+ group on age, initial Glasgow Coma Scale, or coma duration. Univariate logistic regression analyses revealed significant interquartile odds ratios for the GOAT, ABS, DeIRS, Attention, Vigilance, and Memory Subscales of the CTD. Specific effect sizes revealed that individuals scoring at the 75th percentile on the ABS were 19 times more likely to be classified as being in delirium as patients scoring at the 25th percentile. Similarly, patients scoring at the 75th percentile on the GOAT error points (less oriented) were 6.5 times more likely to be classified as being in delirium as patients scoring at the 25th percentile. Findings support that PTA, as measured by the GOAT, fails to capture the full spectrum of cognitive and behavioral disturbance seen in patients during this confusional state.

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Y. ITO, T. HATTA, Y. NAKAI, J. ABE, Y. NAGANO, & H. KABA-SAWA. Can Subtests in WAIS-R and RBMT Predict Cognitive Disorders of TBI Patients?

The purpose of this study was to investigate the requirement to develop a screening test battery, which predicts cognitive disorders of TBI patients. The relationships between cognitive disorders of 49 patients and subtest scores in WAIS-R and Rivermead Behavioral Memory Test (RBMT) were analyzed by the multiple regression analyses. The criterion variables were 4 facets of cognitive ability, declining of scholastic ability, memory, attention and information processing speed, which were rated by four medical

staffs independently who were engaging in TBI patients' rehabilitation. The explanatory variables were sub-test scores of WAIS-R (11-item) and RBMT (14-item). Multiple regression analyses showed that the subtest of Vocabulary and Digit Symbol in WAIS-R could predict the declining of scholastic ability. However, the other subtest scores in WAIS-R did not predict any cognitive disorders. Further, the analyses showed that the subtests of RBMT, Appointment, Delayed Story Recall and Belongings could predict the declining of scholastic ability. The subtest of Appointment in RBMT could predict the declining memory. The analyses also suggested that no subtest in WAIS-R and RBMT predict attention and information processing speed disorders. Based upon these results, a screening test battery, which predicts cognitive disorders of TBI patients, is proposed.

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W.B. BARR & M. MCCREA. Sensitivity and Specificity of Standardized Neurocognitive Testing Immediately Following Sports Concussion.

Neuropsychology, with its emphasis on standardized and empirically based methods, has made a number of scientific contributions to address growing concerns about concussions resulting from sports injuries. This study employs a test-retest paradigm to determine the immediate effects of concussion in high-school and college athletes. The Standardized Assessment of Concussion (SAC) was administered to 1,313 male athletes during baseline testing prior to the beginning of the competitive season. Reliable change indices and multiple regression models were computed on retest scores obtained from 68 noninjured athletes who were readministered the SAC at either 60 or 120 days following baseline testing. Receiver operating characteristic (ROC) curve analyses were used to test these models with data obtained on 50 athletes who were tested immediately following concussion. The results indicate that a decline of 1 point on the SAC at retesting classified injured and noninjured participants with a level of 94% sensitivity and 76% specificity. The RCI and multiple regression models provided comparable levels of group classification, but provided cutoff scores that may be too conservative for use with this population. The results support and extend previous research findings indicating that the SAC is a valid instrument for detecting the immediate effects of mild traumatic brain injury.

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G. REHKEMPER, M. MCCREA, C. JOHNSON, G. HAUSER, & K. SETNES. A Prospective Study of Delirium in Ultradistance Runners.

Hyponatremia and metabolic abnormalities are increasingly being recognized as complications of ultraendurance athletic competition. Confusion is said to occur among a host of general symptoms. However, there have been no formal studies examining the association between metabolic and mental status abnormalities in these athletes. Seventeen male runners of a 100-mile race participated in this prospective study. Mean age was 44.59. Pre-race, mid-race (~85 miles), and post-race mental status testing was performed. Weight and metabolic status (serum sodium and hematocrit) were evaluated pre- and post-race. A statistically significant change was observed in sodium and hematocrit levels from pre- to post-race ($t = 2.86$ and 3.68 , respectively, $p < .01$), yet none of the values fell below clinical laboratory criteria for abnormality. Weight was not significantly different from pre- to post-race. A statistically significant change was observed on a brief measure of delayed memory from pre- to post-race ($t = 2.67$, $p < .05$), and the total score on the larger gross measure of mental status was therefore declined ($t = 2.48$, $p < .05$). No other significant differences were observed on cognitive measures from pre- to post-race. Subtle cognitive changes in ultradistance runners are likely due to the combined effects of fatigue and subclinical metabolic alterations. These effects are mitigated by environmental factors, such as consumption during the race and race-day temperature.

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L.D. RAVDIN, W.B. BARR, F. GOULD, & N.R. RELKIN. Recovery From Acute Head Trauma in Professional Boxers.

In recent years, large-scale studies have been initiated to examine neuropsychological deficits associated with sports related head injuries. There are a number of sports considered high-risk for head trauma, yet none parallel boxing, where rendering an opponent unconscious is the primary goal. The nearly ubiquitous occurrence of head trauma among boxers provides a rare opportunity to prospectively assess the neuropsychological effects of acute head injury. We administered neuropsychological testing to boxers ($N = 18$) before and after (within 72 hr, 1 week, and 1 month) a professional bout to examine recovery of function following acute head trauma. A series of repeated measures ANOVAS was carried out followed by pairwise comparisons (Bonferroni). Results revealed significant differences in psychomotor speed (Trails A & B; $p = .035$ and $p = .021$, respectively) and verbal fluency performance ($p = .003$). *Post hoc* analyses suggested significant differences between time 1 and time 4, with scores 1 month following the bout showing significantly better performance. Although practice effects may partially explain this result, the use of alternate test forms suggests other pre-bout conditions (i.e., sparring, rapid weight loss, pre-bout anxiety) likely contributed to the results. Our findings of recovery to a level above the baseline indicate that baseline assessment taken during intense training periods are likely confounded by other factors and do not represent true baseline abilities. These findings have implications for assessing recovery of cognitive functions following acute head injury in players of other high-risk sports and issues such as the determination of return to play following an injury.

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TBI FUNCTIONAL STATUS

R. STEGMAN & D. HENDERSON-LARIBEE. Predictive Validity of Independent Living Scales.

The Independent Living Scales (ILS), a measure of independent activities of daily living, was evaluated for use with geriatric medical inpatients as a predictive instrument for functional levels. The ILS consists of 5 subtests (Memory/Orientation, Managing Money, Managing Home and Transportation, Health and Safety, and Social Adjustment) that are reduced to 2 factors. Problem Solving, the main ILS factor, measures abstract reasoning and common sense thinking. The Performance/Information factor uses hands on, real world types of tasks. Participants, 40 men and 1 woman who were near discharge from intermediate or extended care units, were administered the ILS prior to discharge. Approximately one month after discharge, a knowledgeable informant (29 family members, 2 friends, and 9 professional care providers) of each participant's functional level was interviewed via telephone using the Activities Scale of the Record of Independent Living (RILA) (Weintraub, 1986). A higher functional level on the RILA (defined by a lower score) correlated significantly with the ILS Full Scale ($r = -.491, p = .001$) and with the ILS Performance/Information factor ($r = -.543, p < .001$), but not with the ILS Problem Solving factor ($r = -.163, p = .308$). The significant relationships were not due to age, education, or number of depressive symptoms. Such data are consistent with literature that suggests measures of general intellectual abilities are poor predictors of specific functional levels. However, performance with specific tasks related to everyday life has predictive value.

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T. ERGH, R. COLEMAN, L. RAPPORT, R. HANKS, R. WHITMAN, & C. KOVIK. Predictors of Distress Among Caregivers of Patients With Traumatic Brain Injury.

Caregivers and families play an important role in the rehabilitation process of individuals with traumatic brain injury (TBI). Understanding the dynamics and patient characteristics that influence caregiver distress can guide the development of interventions that may lead to improved patient

rehabilitation and family functioning. Patient and caregiver factors were examined as predictors of caregiver psychological distress among 60 pairs of former patients who had sustained a moderate to severe TBI and their caregivers/significant others ($N = 120$). Both the former patients and their caregivers were administered self-report questionnaires during interviews conducted at the patients' homes. Time since injury ranged from 4 months to approximately 10 years ($M = 4.84$ years, $SD = 2.65$). The former patients' current neurobehavioral and affective functioning (NBAP), alcohol use (CAGE), awareness of deficit (PCRS discrepancy score), and time since injury and the caregivers' perceived social support (SPS) were entered into a standard multiple regression with caregiver psychological distress (BSI General Severity Index) as the outcome. Results revealed that the predictor model accounted for 34% of the variance in caregiver distress. Neurobehavioral and affective functioning of the patient was the best predictor, accounting for up to 26% of the variance followed by caregivers' perceived social support ($sr^2 = 4%$). The results are discussed in the context of identifying characteristics of former patients and their caregivers that might lead to improvement in the quality of life of caregivers.

Correspondence: *Tanya Ergh, Department of Psychology, Wayne State University, 71 W. Warren, Detroit, MI 48202.*

A.M. SANDER, J.S. WEFEL, W.M. HIGH, JR., & C. CONTANT. Impact of Family Functioning on Community Integration After TBI.

While most persons with severe traumatic brain injury (TBI) exhibit impairment, variability in disability and handicap has been noted. Variability is partially attributable to injury severity and demographic characteristics. However, a portion of the variance in patients' functional outcome remains unaccounted for. Family functioning has been shown to be predictive of outcome after pediatric TBI, but has not been investigated in the adult population. The purpose of the current study was to determine the relationship between family functioning and patients' community integration after TBI. Participants included 63 patients with primarily severe TBI (M age = 29 years; 60% high school education or less). Patients' outcome was assessed by the Community Integration Questionnaire (CIQ), which yields 3 scales (Home Competency, Social Integration, Productive Activity) and a total score. Family functioning was assessed by a battery of self-report questionnaires. Principal components analysis of the family measures yielded 4 components: Relationships; Distress/Burden; Active Coping; Passive Coping. The 4 family factors, along with patients' age, education, injury severity, and a financial resource index, were entered into a multiple regression equation. Backward deletion was used to determine the additional variance accounted for by the family factors. Together, the family factors explained an additional 8% of the variance in CIQ Total scores, 18% of Home Competency, 7% of Social Integration, and 3% of Productive Activity. Family Distress/Burden and Passive Coping made a unique contribution to CIQ Home Competency scores. Trends were noted for relationships between Family Relationships and Social Integration scores, and between Distress/Burden and CIQ Total scores.

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S. DIKMEN, J. MACHAMER, & N. TEMKIN. Functional Status at 3 to 5 Years Following Traumatic Brain Injury.

Functional limitations are prevalent following traumatic brain injury and constitute the most significant impediment to return to normal life. Very limited information exists, however, about the nature and magnitude of long-term difficulties in representative samples. The purpose of this study is to describe functional status in various areas of everyday life in 192 moderate-to-severely brain-injured persons, enrolled within 24 hours of their injury and prospectively studied 3 to 5 years later. The Functional Status Examination was used to evaluate changes in nine areas of everyday life as a function of the traumatic brain injury. A substantial number of people reported limitations at 3 to 5 years post injury and the percentage of cases with continued difficulty varied by activity area. The area most recovered was personal care with approximately 70% of the cases reporting being back to normal. The areas least recovered included work, school and recreation, with approximately 60% of the cases reporting continued

difficulty in these activities. The most common types of limitations reported were difficulty in performing the activity, performing the activity less frequently or needing some help from others. Total dependency on others or total inability to perform the activity were rare in nearly all areas except resumption of work or school in approximately 20% of the cases. Needing help from others or performing the activity less frequently was rated as more bothersome than being independent but having difficulties performing the activity. In conclusion, a large proportion of people with moderate to severe TBI still report varying levels of functional limitations at 3 to 5 years post injury.

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REHABILITATION FOLLOWING TBI

N.W. PARK, B. CONROD, K. MURPHY, D. REWILAK, & S.E. BLACK. Assessing Treatment of Impaired Automatic Evaluative Processing.

The purpose of this study is to describe and assess the treatment of A.M., an individual, who has difficulty evaluating negative aspects of situations and accurately identifying potentially harmful actions of people, in spite of above average general intellectual functioning. About 9 years ago A.M., a 49-year-old businessman, sustained a severe traumatic brain injury that resulted in bilateral frontal and temporal lobe damage including damage to the amygdala. We have established experimentally that A.M. has a positivity bias, and is much more likely than normal individuals to evaluate as positive simple objects designated by words. Further experiments have established that A.M. appears to have impaired automatic processing of negative, but not positive evaluative information, but has relatively spared controlled or strategic processing of negative and positive evaluative information. Based on these findings we reasoned that A.M. would function more effectively if he used controlled processing to evaluate alternative possible courses of action. Using didactic instruction and modelling procedures, we taught A.M. to use strategic processing to evaluate alternatives prior to making decisions. Several notable changes have occurred since this treatment was initiated. A.M.'s earnings have increased, his partner reports that he is more realistic in his evaluation of business opportunities, and is less likely to break minor rules such as parking illegally. We have also established experimentally that A.M.'s positivity bias in evaluating single words was abolished when he was directed to explicitly retrieve positive and negative evaluative information about the object prior to its evaluation.

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S. HENDERSON, D. LAMB, & P. KLONOFF. Cognitive Factors Contributing to Return to Work or School Following TBI.

Factors predicting return to work after traumatic brain injury (TBI) include severity of injury, age, and education. We attempted to control for these factors and examine which neuropsychological tests may predict return to work post-injury. While most studies simply evaluate returning *versus* not returning to work, we attempted to evaluate outcome in a more refined manner by comparing return to the same work/school *versus* different (less demanding) work/school. Patients up to 5 years post discharge from a postacute rehabilitation program were utilized in this study. A group of patients ($N = 9$) with TBI who returned to the same work or school as preinjury without modifications (Group 1) were compared to a group of patients ($N = 11$) who did not return to work or school at the same level as preinjury (Group 2). These two groups were matched in terms of severity of injury as measured by Glasgow Coma Scale score, age, and education. Dependent variables were test scores from a large battery of neuropsychological tests (including less structured measures of executive systems functioning) given at admission to our rehabilitation program. Mann-Whitney U nonparametric analyses were performed to compare groups. Group 1 demonstrated significantly better scores on tests of speeded

thinking, high level mental flexibility, motor speed, and verbal memory. These results may help identify which cognitive domains are more likely to compromise the level of work or school to which patients may be able to return following TBI.

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K.R. BONESTEEL, R.E. HANLON, & J.P. KELLY. Mild Traumatic Brain Injury: Impact of Attribution on Postconcussive Symptoms.

Attribution, which involves the process by which individuals explain the occurrence of events, can impact psychological recovery from a traumatic event. Although the impact of victims' attribution on recovery has been investigated for such traumatic events as rape, motor vehicle collisions, heart disease, and cancer, this issue has been neglected with respect to traumatic brain injury (TBI). The present study attempted to ascertain how emotional and neuropsychological adjustment is impacted by the degree of causality, preventability, and responsibility that could be reasonably ascribed to a head trauma victim. Two independent raters reviewed 86 accident reports and patient accounts of their accident, and categorized each case as follows: (1) internal attribution (i.e., victim caused, could have reasonably prevented, and was responsible for the accident), (2) external attribution (victim did not cause, could not have prevented, nor was responsible for the accident), or (3) mixed attribution for the accident. The results indicate that mild TBI patients with external attribution for the accident, reported a significantly higher degree of postconcussive symptoms ($p < .05$), even after controlling for injury related characteristics (e.g., neuroimaging findings, posttraumatic amnesia, loss of consciousness). There were no differences among these groups with respect to neuropsychological test performance, depression and/or subjective distress. These findings suggest that the psychological attribution process following head trauma may increase the vulnerability for developing postconcussive symptoms. Correspondence: *Robert Hanlon, 675 N. St. Clair Street, Suite 20-250, Northwestern Medical Faculty Foundation, Chicago, IL 60611.*

K. GORDON, L. TERRYBERRY-SPOHR, & T. LIST KALNINS. Predicting Rehabilitation Outcome Using Full and Reduced Versions of the RBANS.

Rehabilitation settings often require neuropsychological assessments that are brief in nature and yet predictive of functional outcome. The current study investigates the utility of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) as well as the ability of the indexes and subtests, to predict functional outcome as measured by the Functional Independence Measure (FIM). 124 acute rehabilitation inpatients [TBI ($N = 33$), CVA ($N = 60$), other ($N = 31$)] were administered the RBANS during their hospitalization. FIM ratings were completed by the multidisciplinary team at the time of discharge. Across the entire group as well as for each of the diagnostic categories, regression models were developed using index and subtest scores as predictors of motor and cognitive outcome. This 2-factor FIM model of disability (motor *vs.* cognitive) emerged in previous factor analytic studies. Nested and nonnested models were then compared to determine whether the entire RBANS measure was more predictive of outcome as measured by the FIM than particular index or subtest scores. Results indicated that the most predictive subtests and indexes varied between diagnostic groups, but that these specific subtests and indexes were equally as effective at predicting motor or cognitive outcome as the entire RBANS measure. Overall, this study suggests that when an extremely brief assessment is necessary, utilizing individual subtests based on diagnosis, can be as predictive of rehabilitation outcome as the index scores or the full RBANS measure.

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E.H. KARBONIK, T. CHRONOPOULOS, T. KUNTZ, W.J. BURNS, & D.D. MONTGOMERY. Serial Neuropsychological Assessment of Longitudinal QEEG Feedback Therapy.

The purpose of the study was to evaluate the effect of QEEG rehabilitation neurotherapy with the aim of understanding recovery from stroke, and to

explore the nature of brain–behavior relationships. The participant, a 51-year-old male, suffered a right midcerebral artery infarct in December, 1996. General cognitive and memory skills were regained by March, 1997, as measured by a baseline neuropsychological assessment. It is theorized that audio–visual stimulation (AVS) entrainment stimulates dendritic regrowth following a traumatic brain injury through the increase in brain electrical activity. In addition to significant improvement in various areas as measured by neuropsychological assessment, results of the QEEG data indicate that EEG dominant frequencies shift as a result of AVS entrainment. Based on the assumption that abnormal spontaneous EEG following an injury causes the brain to become limited in the ability to recover the functioning of normal EEG patterns, dominant-frequency EEG entrainment presents audio–visual stimulation in an effort to expand this narrow EEG range, allowing a more normal reorganization of functioning to occur. Research indicates that EEG patterns shift toward audio–visual stimulation, presenting possibilities for neurological rehabilitation. Initially, this protocol consisted of 14 min of neurofeedback, with alternating minutes of 0% driving and –10% driving in response to a high-average dominant frequency. During the last 7 months of treatment, the entrainment was adjusted to –50% driving to determine whether an increased level of stimulation would result in differences in response or rate of recovery. Analysis of the data reflected that shifts in dominant-frequency EEG consistently occurred during the first several minutes of AVS stimulation, with an overall average reduction of dominant frequency throughout the course of each session. Despite intact cognition and memory, baseline neuropsychological assessment reflected impairment in areas such as motor skills, tactile discrimination, naming, visual–spatial ability, arithmetic and reading comprehension. Subsequent assessments utilizing a sensitive neuropsychological test battery reflected normal or near-normal levels of functioning by March, 2000, suggestive of functional changes in frontal and temporal regions, sites particularly affected by the infarct. Therefore, it is hypothesized that continued recovery for this participant over a 3-year period following the infarct is at least partially in response to EEG dominant-frequency feedback, as measured by comprehensive neuropsychological assessment.

Correspondence: Elaine Karbonik, Nova Southeastern University, Center for Psychological Studies, 3301 College Avenue, Ft. Lauderdale, FL 33314.

P. GANDHI, E. BIGLER, E. WILDE, D. RYSER, & S. JOHNSON. Quantitative Lesion Analysis, FIM, and Neuropsychological Test Performance in TBI.

Besides being a predictor of outcome, neuropsychological (NP) testing has also been regarded as an outcome measurement. Outcome is defined in many ways but functional outcome (FO) has been regarded as a major goal of rehabilitation. An instrument that has been developed for the specific purpose of measuring FO in this setting is the Functional Independence Measure (FIM). This study examined the effect of lesion type and size on various components of NP test results and FO measures as determined by the discharge FIM. Quantitative magnetic resonance imaging (QMRI) of 3 lesion types was obtained: lesions manifest as signal hyperintensities (1a), residual hemosiderin lesions (1b), and parenchymal-displacing extra-axial lesions (2) such as resolved subdural hematomas in terms of volume. Lesion analysis was performed on scans obtained prior to 90 days post injury and NP data was obtained at least 6 months post injury. For lesion analysis and NP measures, it was found that the primary lesion was significantly correlated with all WAIS–R indices, ROCFT delayed recall, Digit Symbol and Trails B. The largest of these was with WAIS–R VIQ ($r = -.39$). For lesion analysis and FIM, significance was found with the primary lesion volume and both Cognitive Total and FIM Total measurements of independence ($r = -.32$). Differences between non-lesion diffuse axonal injury (DAI) and those found with focal lesions were significant. The results indicate that functional outcome and NP impairment are associated with size and type of lesion in TBI and the effect is beyond that attributable to DAI alone. Accordingly, presence of focal lesions add to the lesion burden of DAI and result in a worse outcome than what is the case for TBI patients with no focal lesions and only DAI.

Correspondence: Erin Bigler, 1001 SWKT-BYU, Provo, UT 84602.

R. DOWLER, A. ALDERSON, & T.A. NOVACK. The Cognitive Log: Bedside Screening of Higher Cognitive Functions.

Reliable serial assessment is valuable in documenting the rapid changes in cognitive–behavioral functioning that can occur during brain-injury rehabilitation. The Cognitive Log (C-Log) is a brief 10-item instrument that can be used to provide information regarding the recovery of higher neuro-cognitive processes, including verbal recall, attention, working memory, motor sequencing, and response inhibition. Each item is scored on a 3-point scale, with partial credit awarded based on responsiveness to cueing or number of errors. The C-Log was administered to 117 individuals with traumatic brain injury (TBI; 67% with GCS < 13) and 83 individuals without a history of TBI (NC). Controls were generally younger ($M = 23$ years) than individuals with TBI (M age = 45), but education did not differ statistically between groups (TBI = 12 years, NC = 14 years). Reliability analysis of C-Log items demonstrated strong inter-rater reliability across items (Spearman's Rho .787–.995) and high internal consistency (Cronbach's alpha = .994). Individuals with TBI performed more poorly than controls on all C-Log items and obtained lower total scores ($p < .001$). There was also a significant improvement in C-Log scores across administrations in the TBI group ($p < .001$). C-Log scores were independent of age, education, gender, race, and initial injury severity (GCS). However, amongst normal controls, individuals with higher estimated IQ's received higher C-Log scores. These results suggest that although the C-Log is a reliable tool for assessing *intra*-individual changes in higher cognitive functioning, additional scale development and investigation of IQ differences is essential before valid *inter*-individual comparisons can be made.

Correspondence: Amy L. Alderson, Ph.D., UAB Department of PM&R, 619–19th Street, South, SRC 530, Birmingham, AL 35249-7330.

C. EVANS & C. BOAKE. Early Prediction of Posttraumatic Amnesia Duration Following Traumatic Brain Injury.

Duration of posttraumatic amnesia (PTA) has been demonstrated to be the best predictor of functional outcome in conscious survivors of traumatic brain injury (TBI). The study investigated the relationship of PTA with demographic and injury related variables in order to predict PTA duration earlier in recovery. A second goal was to compare measurement of PTA starting from the time of injury *versus* from the time of following commands. Participants were 665 TBI patients in acute rehabilitation centers who were enrolled in the TBI Model Systems project. Duration of PTA was measured prospectively by the Galveston Orientation and Amnesia Test. Survival analyses based upon Cox's proportional hazards model replicated earlier findings that longer duration of loss of consciousness (LOC), lower Glasgow Coma Scale score, poor pupillary response, and older age predicted longer durations of PTA. Seizure activity and elevated intracranial pressure also contributed significantly to the model. Measurements of PTA with and without the period of LOC were highly correlated ($r = .91$) and were predicted by the same variables. In univariate analyses, a number of other injury variables such as subdural and intracerebral hemorrhages, and intracranial infections also predicted duration of PTA. Results support the view that PTA duration reflects overall injury severity. Clinicians can use the proposed acute injury and demographic variables collected early in recovery from TBI to estimate patient length of stay in acute rehabilitation, how long they will need close supervision, and their eventual functional outcome.

Correspondence: Corwin Boake, Ph.D./ABPP, TIRR, 1333 Moursund, Houston, TX 77030-3405.

TBI AND PSYCHIATRIC SEQUELAE

T. HART, J. BOGNER, J. WHYTE, & M. POLANSKY. Attribution of Blame in Violent and Nonviolent TBI.

Attribution of blame for catastrophic injury predicts some aspects of psychosocial adjustment in persons with physical disability (e.g., spinal cord injury). We studied blame attribution in acute traumatic brain injury (TBI), to determine: (1) the reliability of such judgments for persons with cognitive deficits and amnesia for the event; and (2) the differential effects of

accidental (nonviolent) *versus* intentional (violent) injuries. Participants (Ss) were 55 persons with traumatic brain injury (TBI) who were interviewed and tested at a median 30 days post injury, and retested within 3 weeks. All were fully oriented and grossly aware of their injury circumstances (as verified by chart review). All had sustained moderate to severe TBI (M GCS = 8) with residual cognitive deficit; most had amnesia for the injury. Participants completed the Blame Attribution Questionnaire (BAQ), in which they assigned proportions of blame to themselves, others, the environment, and chance, and indicated their degree of concern with the cause of injury. Test–retest reliability of the BAQ was good, with moderate to high item correlations and few extreme response changes across sessions, even for the most severely injured Ss. Internal consistency was also good; for example, 2 items assessing self-blame were correlated at .80. Ss with intentional injuries ($n = 15$) blamed others significantly more than those with accidental injuries ($n = 39$), while the opposite pattern was seen for blaming chance. Self-blame was high in both groups. Results suggest that attribution of blame is reliable and meaningful in persons with cognitive deficit and amnesia for the injury.

Correspondence: Tessa Hart, Ph.D., Moss Rehabilitation Research Institute, 1200 W. Tabor Road, Philadelphia, PA 19141.

M.F. GREIFFENSTEIN & W.J. BAKER. Descriptive Analysis of Premorbid MMPI–2 Profiles in Chronic Postconcussive Claimants.

We examined the preinjury MMPI–2 profiles of 25 chronic postconcussive claimants attributing personality change to minor head injuries. All denied similar pre-existing problems. The average lag between MMPI–2 and injury was 3.2 years. The social composition was 15 females and 10 males with a mean education of 13 years. The modal injury was benign head trauma. All profiles were valid ($F < 100$ and $L < 85$) and 100% abnormal (any scale $> 65T$ excluding 5 and 0). Validity scales showed higher levels of acute distress ($F > 65-T = 44.5\%$) than defensiveness ($L > 65-T = 8.7\%$ and $K = 4.3\%$). Scales 1, 2, and 3 were the most frequently elevated ($87\% > 65-T$), Scales 7 and 8 intermediate (68 and 73%) and Scales 6 and 9 least frequent (47.3 and 43.5%), all exceeding standardization sample base rates. The group mean profile was 123 (78). The modal 2-point code of 13/31 (32%) was more common in females, while males were more likely to exhibit 4-codes. Profile classification into dominant symptom patterns (after Lachar) showed a premorbid somatoform trend in 78.3% (1 or 3 in code type), mood/anxiety trend in 28% (either 2 or 7), conduct trend in 22.2% (with 4) and a schizotypal trend (scale 8) in 22.2%. The main conclusion is that persistent PCS claimants were expressing similar symptomatology premorbidly. The mean premorbid MMPI profile was consistent with the multisystem complaints of PCS complainants. Persistent PCS may represent a false attribution of longstanding problems to a single current event.

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K.W. GREVE, L. SHERWIN, M.S. STANFORD, C. MATHIAS, J. LOVE, P. RAMZINSKI, R. HOUSTON, & J. LEVY. Neurocognitive and Personality Correlates of Impulsive Aggression in Chronic Severe TBI.

This study addresses a common outcome of severe traumatic brain injury (TBI), disinhibited aggressive behavior. This behavior has been classified in the aggression literature as *impulsive aggression* (IA). Persons who exhibit IA are more impulsive and hostile, have decreased verbal abilities, deficient strategic planning and problem-solving, and consistent ERP changes. These findings have been replicated across a variety of populations including convicted felons, neuropsychiatric patients, and college students. The present study sought to (1) characterize those TBI patients who are likely to be an aggression risk; and (2) determine if TBI patients with IA demonstrate personality style and neurocognitive performance similar to that seen in other IA groups. Participants were 45 survivors of severe TBI (26 with persisting IA) who were clients of a residential brain injury treatment facility. IAs had a higher incidence of premorbid aggressive behavior, were younger, had a shorter tenure in the program, and were more impulsive, irritable, and antisocial than the non-

aggressive controls. Unlike past research, no neurocognitive differences were found. This study suggests that the best markers for risk of post-traumatic IA are premorbid history of impulsive and/or antisocial behavior, particularly problems with aggression, and irritable impulsiveness. IA in TBI survivors seems to reflect a premorbid coping style which, with brain damage, has become disinhibited and relatively inflexible. As such, especially with early identification, it can be the focus of specifically targeted behavioral and pharmacological interventions, thus reducing physical risk to patients and staff and enhancing the possibility of a more satisfying long-term outcome.

Correspondence: Kevin Greve, Department of Psychology, U.N.O.–Lakefront, New Orleans, LA 70148.

S.R. McCAULEY, H.S. LEVIN, C. BOAKE, & J.X. SONG. Depression, Anxiety, and Social Support as Risk Factors for PCD.

Objective: To investigate risk factors (major depression, posttraumatic stress disorder, poor social support) for developing postconcussional disorder (PCD) as defined by the Diagnostic and Statistical Manual–IV (DSM–IV). *Patient Sample:* 80 patients with mild-moderate traumatic brain injury (TBI) and 53 with trauma not involving the brain who were recruited from the emergency department and inpatient wards of a level-1 trauma center. *Design:* Inception cohort study. *Outcome measures:* Structured interview of postconcussional symptoms, Center for Epidemiological Study of Depression questionnaire, the Structured Clinical Interview for the DSM–IV (SCID), and the 6-item version of the Social Support Questionnaire were administered at 3 months post injury. The DSM–IV loss/alteration of consciousness criterion was relaxed to investigate if general trauma patients with possible whiplash injuries met other DSM–IV criteria for PCD. *Results:* 31 patients met modified DSM–IV criteria for PCD including 8 patients with nonbrain injuries. Logistic regression indicated that patients with past major depressive episodes were 2.5 more likely to develop PCD at 3 months postinjury. Patients with CES–D scores suggesting depression (>16) at 1 month were 6.8 times more likely to develop PCD. Patients meeting criteria for PTSD at 3 months were 2.9 more likely to have PCD. Patients with PCD reported fewer persons on whom they could depend ($p < .007$) and poorer quality of perceived support from them ($p < .01$). *Conclusions:* Previous and concurrent episodes of depression, concurrent anxiety disorder, and poor social support are strongly related with the presence of PCD at 3 months post injury.

Correspondence: Stephen McCauley, Ph.D., Baylor College of Medicine, 6560 Fannin, Suite 1144, Houston, TX 77030.

L. TIERSKY, V. ANSELMINI, & T. SCHWARTZ. Neuropsychological Rehabilitation in Mild TBI: A Case of Psychiatric Comorbidity.

The efficacy of a neuropsychological rehabilitation program in the treatment of the cognitive and emotional difficulties following a mild traumatic brain injury (MTBI) was evaluated using an A/B, pre- and post-test, single-case design. Ms. M., who sustained a MTBI and suffered from Axis I and Axis II psychopathology, underwent a treatment program that was preceded by a “waiting” or control period. During this control phase, she received 1.5 hr of basic clinical contact for 11 weeks (i.e., .5 hr per month). These meetings were psychoeducational and were designed to not have therapeutic benefit. During the treatment phase, she received three 3-hr cognitive-behavioral psychotherapy (CBT) sessions and three 1-hr sessions of cognitive remediation per week, for 11 weeks. The CBT component focused on somatic symptom management, relaxation training, cognitive restructuring, mood management, assertiveness training, and relapse prevention. Topics specific to MTBI, such as grief over loss of functional ability were also addressed. The remediation protocol involved teaching compensatory strategies as well as practicing exercises drawn from the Attention Process Training program. Ms. M. was evaluated at baseline, 1, 3, and 6 weeks pretreatment, and immediately, 1 and 3 months post-treatment. Testing during the control phase was completed at similar intervals. Measures of neuropsychological and emotional functioning as well as functional status were included in each evaluation. Overall, her affective and somatic symptoms as well as functional capacity improved. Clin-

ical observations are used to highlight effective interventions as well as the difficulties encountered in treating a patient with comorbid conditions. Correspondence: *Lana Tiersky, School of Psychology, Fairleigh Dickinson University, 1000 River Road, T-WH1-01, Teaneck, NJ 07666.*

Symposium 4/3:30–5:15 p.m.

**CONNECTING NEUROPSYCHOLOGY
WITH MEDICAL GENETICS:
THE HUNTINGTON DISEASE MODEL**

Organizer and Chair: Julie Stout

J. STOUT. Connecting Neuropsychology With Medical Genetics: The Huntington's Disease Model.

Neuropsychologists are actively developing methods for the detection of subtle cognitive changes that herald the development of disease symptoms. At the same time, we are witness to rapid progress in the identification of the genetic bases of diseases. Given these circumstances, the time is ripe for neuropsychologists to forge connections with geneticists and neurobiologists to build models for preventing and treating neurodegenerative diseases. Huntington's disease (HD) is becoming a prime example of the benefits to be obtained from such collaboration. Genetic progress, especially the identification of a single dominant gene that causes HD, has paved the way for progress in identifying neurobiological markers that herald onset of HD pathology. Neuropsychologists are using genetic information to discover cognitive changes in people at risk for HD, but who are not yet manifesting clinical disease. Pharmacological interventions to delay the onset of HD or slow disease progress are in development, and neuropsychologists are taking active roles in designing clinical trials. For this symposium, four neuropsychologists will describe research on people who are presymptomatic but genetically at risk for HD: (1) Dr. Jane Paulsen will describe a collaborative multi-site study with the Huntington's Study Group; (2) Dr. Julie Stout will describe the Indiana case-control, double blind longitudinal study; (3) Dr. Jason Brandt will describe neuropsychological studies of people estimated to be either close to or far from clinical disease onset; and (4) Dr. Elizabeth Aylward will describe magnetic resonance imaging studies of the basal ganglia in people at risk for HD.

Correspondence: *Julie C. Stout, Ph.D., Indiana University, Department of Psychology, 1101 East 10th Street, Bloomington, IN 47405-7007.*

J.S. PAULSEN. Cognitive Decline Prior to Huntington's Disease Diagnosis: Implication for Clinical Trials.

It is increasingly clear that neuropsychological declines can be detected prior to the neurological diagnosis of Huntington's disease. For example, in a longitudinal multisite study using the brief cognitive battery included in the Huntington's Study Group's Unified Huntington's Disease Rating Scale (UHDRS), there were 260 persons at risk for HD by virtue of having an affected parent. Although on the initial neurological exam these participants did not have manifest disease, repeat UHDRS data obtained an average of 2 years later showed that by the time of followup, 70 persons had been given a neurological diagnosis of HD. Examination of baseline cognitive data revealed that the group who had received the diagnosis by followup were significantly worse than those who did not convert to diagnosis. These findings suggest that neuropsychological methods have utility as markers of the disease process prior to clinical neurological manifestations if persons can be identified who are proximal to manifest HD. Unfortunately, methods for determining proximity to onset have been of limited utility. Although several reports have used estimations of onset involving a combination of predictors, such as age, parental onset age, and CAG repeat length, the standard error on such estimations remains large. Better prediction of onset age would make therapeutic interventions possible in the presymptomatic or earliest stages of disease when quality of life remains high. Strategies for improved onset prediction and the role of neuropsychology in such prediction will be addressed. Correspondence: *Jane S. Paulsen, Ph.D., Associate Professor of Psychiatry, The University of Iowa, 1-289 MEB Iowa City, IA 52242-1000.*

J. STOUT. Longitudinal Cognitive and Motor Changes in Presymptomatic Huntington's Disease.

Clinical diagnosis of Huntington's disease (HD) is made on the basis of unequivocal motor signs (i.e., chorea) on neurological examination, along with a family history of Huntington's disease. Since the identification of the gene responsible for HD in 1993, knowledge of genetic status (gene-positive or negative), if known to the clinician, is also an unavoidable consideration in diagnosis. Given the potential for bias in examining patients when family or gene status is known, it is difficult to obtain objective assessment of the presentation of neurological and neuropsychological symptoms in clinical setting prior to diagnosis. In this talk, data will be presented from the Indiana University School of Medicine longitudinal case-control, double-blind study (principal investigators J.C. Christian, T. Foroud) of persons who were, at baseline, asymptomatic and risk for HD. At the current time, a small subset ($n = 42$) of the original sample ($n > 600$) has been studied for more than 10 years, and are, on average, approaching the end of their 5th decade. A series of studies on this longitudinal cohort will be described, including (1) a comparison of neuropsychological, neurological, and motor data on gene-positive and gene-negative groups from the original cohort; and (2) our longitudinal followup of a subset of 42 individuals an average of about 4 years later. The findings will be discussed in terms of the identification of neurological and neuropsychological measures with the greatest sensitivity for detecting declines in presymptomatic HD, along with the implications of using these measures for early detection of disease initiation.

Correspondence: *Julie C. Stout, Ph.D., Indiana University, Department of Psychology, 1101 East 10th Street, Bloomington, IN 47405-7007.*

J. BRANDT. Neuropsychological Detection of Disease Onset in Persons With the Huntington's Mutation.

Several studies have shown that asymptomatic people at risk for Huntington's disease (HD) who carry the genetic mutation responsible for this disorder have smaller basal ganglia and/or metabolic deficits in the striatum. In spite of this, most carefully-done studies attempting to find neuropsychological impairments in clinically-healthy "mutation-positive" persons have yielded negative results. For example, we compared 75 asymptomatic mutation-positive persons (with ≥ 37 CAG repeats) to 128 mutation-negatives on a series of cognitive tasks, many very sensitive to clinical HD. There were no significant differences between the 2 groups at baseline (prior to disclosure of genetic test results). Furthermore, the groups remained essentially indistinguishable at 2-year follow-up. To determine whether a subset of the mutation-positive group—those nearing disease onset—showed cognitive impairment, we developed an algorithm to estimate proximity to onset using the participant's age, CAG repeat length, and age of onset of the affected parent. Compared to mutation-positive participants judged to be far from onset, those close to onset performed significantly more poorly on a large number of cognitive measures, even though the groups did not differ on their neurological exam scores. These data suggest that the Huntington mutation is "turning on" and affecting cognition before the illness can be detected clinically.

Correspondence: *Jason Brandt, Ph.D., Professor of Psychiatry and Behavioral Sciences, The Johns Hopkins University School of Medicine, 600 N. Wolfe Street, Meyer 218, Baltimore, MD 21287-7218.*

E. AYLWARD. Decline in the Basal Ganglia Volumes Prior to Clinical Diagnosis With Huntington's Disease.

Neuropathological changes in clinically diagnosed Huntington's disease are manifested in the basal ganglia, within both the caudate nuclei and the putamen. Given current evidence that cognitive decline can be detected in groups of presymptomatic carriers of the HD gene mutation, close to either estimated or actual disease onset, we predicted that atrophy in the basal ganglia structures may also be detectable prior to clinical diagnosis. In this talk, methods for measuring basal ganglia volumes using magnetic resonance images (MRI) will be described, along with a series of studies of basal ganglia volumes in presymptomatic HD gene-positive and gene-negative people. These studies span 10 years of data collection in a group of at-risk individuals (offspring of HD parents) who have had gene testing and multiple MRI scans. Results from several studies will be presented,

including those that demonstrate (1) smaller basal ganglia in presymptomatic gene-positive persons, in comparison with gene-negative controls, (2) an association between basal ganglia volume and estimated years-to-onset for gene-positive individuals, (3) lack of significant atrophy in individuals who are greater than 10 years from their estimated onset, and (4) significant longitudinal change over a period of 30 months in gene-positive participants who are within 10 years of their estimated onset. Methodological issues and findings from these studies will be considered within the context of evaluating the potential utility of MRI measures in clinical trials of presymptomatic HD.

Correspondence: Elizabeth Aylward, Ph.D., Department of Radiology, Box 357115, University of Washington, Seattle, WA 98195.

Award Winners/5:30–6:30 p.m.

Butters Award

PREDICTING VERBAL MEMORY DECLINE AFTER ANTERIOR TEMPORAL LOBECTOMY (ATL)

E. Stroup

E. STROUP, J. LANGFITT, W. PILCHER, P. COMO, & M. BERG. Predicting Verbal Memory Decline After Anterior Temporal Lobectomy (ATL).

Ten to sixty percent of patients experience verbal memory decline after anterior temporal lobectomy (ATL). Individual risk factors have been identified, but there is no current method for combining risk factors to reliably predict memory outcome for an individual patient. We present a multivariate risk factor model for predicting post-operative verbal memory decline in 132 consecutive ATL patients. Inclusion criteria were (1) >16 years of age at the time of surgery, (2) estimated preoperative FSIQ > 69, (3) unilateral language dominance based on the intracarotid amyltal procedure (IAP), (4) neuropsychological testing at baseline and at least 6 months postoperatively ($M = 1.2$ years). Risk factors for postoperative verbal memory decline were defined as (1) dominant hemisphere resection, (2) absence of unilateral mesial temporal sclerosis (MTS) based on clinical reading of the preoperative MRI, (3) intact preoperative neuropsychological verbal memory [CVLT Long Delay Free Recall (LDFR) > sample mean of 9.8], and (4) intact contralateral injection IAP memory (>67% correct). Verbal memory outcome was defined as presence or absence of a statistically reliable decline on LDFR, using published reliable change indices. The numbers of patients who experienced a significant verbal memory decline were (in ascending order by total number of risk factors [(0–4): 0/16 (0%), 4/41 (10%), 8/35 (23%), 10/26 (38%), and 12/14 (86%) (Fisher's exact, $p < .0000$]). Results were similar using WMS-R Logical Memory. A simple logistical regression equation using these factors will be presented that can be used reliably to predict an individual patient's risk for postoperative verbal memory decline.

Correspondence: E. Stroup, Strong Epilepsy Center, 601 Elmwood Avenue, Box 673, Rochester, NY 14642.

Rennick Award

PRESURGICAL fMRI PREDICTS MEMORY OUTCOME FOLLOWING ANTERIOR TEMPORAL LOBECTOMY

D. Casasanto

D. J. CASASANTO, G. GLOSSER, W.D.S. KILLGORE, F. SIDDIQI, M. FALK, A. ROC, J.A. MALDJIAN, I. LEVY-REIS, G. BALTUCH, & J.A. DETRE. Presurgical fMRI Predicts Memory Outcome Following Anterior Temporal Lobectomy.

Anteromesial temporal lobectomy (ATL) is the most common surgical treatment for patients suffering from medically refractory temporal lobe epi-

lepsy (TLE). Presurgical assessment of cognitive function is critical to ensuring favorable postsurgical outcome. Previously, our laboratory has shown that functional magnetic resonance imaging (fMRI) can be used preoperatively to detect seizure laterality and predict seizure outcome. The goal of the present study was to determine whether preoperative fMRI can predict postoperative memory outcome. A complex visual scene memory task was administered to 11 unilateral TLE patients (8 left, 3 right) before and after ATL. It has been demonstrated with fMRI that visual scene encoding elicits nearly symmetrical bilateral mTL activation in healthy subjects, but lateralized activation in unilateral TLE patients, for whom attenuated activation is observed in the epileptogenic mTL. The hemispheric asymmetry of activation associated with memory encoding in the anterior mTL was quantified during pre-ATL fMRI, and correlated with post-ATL change in recognition memory performance. A significant positive correlation was found between the magnitude of the hemispheric asymmetry of activation in the amygdalo-hippocampal ROI and subjects' change in recognition memory performance ($r = .69, p < .03$). With one exception, patients whose presurgical activation was greater in the contralateral ROI showed a postsurgical memory increment, whereas patients whose presurgical activation was greater in the ipsilesional ROI showed a postsurgical memory decrement. Findings are consistent with recent studies showing a correlation between IAT asymmetry and postoperative neuropsychological outcome. Results suggest a role for fMRI as a noninvasive complement to current methods of presurgical evaluation.

Correspondence: Guila Glosser, Department of Neurology (Gates 3), University of Pennsylvania, Medical Center, 3400 Spruce Street, Philadelphia, PA 19104-4283.

Cermak Award

HIPPOCAMPAL AND PARAHIPPOCAMPAL VOLUMES AND MEMORY RETENTION INTERVALS IN TLE

H. Griffith

H.R. GRIFFITH, R. PYZALSKI, D. O'LEARY, V. MAGNOTTA, P. RUTECKI, R. SHETH, B. BELL, C. DOW, G. WENDT, M. SEIDENBERG, & B.P. HERMANN. Hippocampal and Parahippocampal Volumes and Memory Retention Intervals in TLE.

It is increasingly recognized that volume loss is evident in extrahippocampal regions among patients with mesial temporal lobe epilepsy. Little information exists regarding the structural and functional status of the parahippocampal gyrus. Given its proximity and interconnectivity with the hippocampus, the parahippocampal gyrus may be particularly vulnerable to the effects of temporal lobe seizures. Several contemporary models of memory implicate this region in human declarative memory. This study investigated the relationships of parahippocampal gyrus and hippocampal volumes with memory performance in 35 temporal lobe epilepsy patients and 20 healthy controls. All subjects were administered verbal and non-verbal memory measures which spanned immediate, 30-min and 24-hr delays. MRI volumes of hippocampus and parahippocampus were manually traced using standardized criteria. As expected, temporal lobe patients had reduced volumes of both hippocampus and parahippocampal gyrus compared to controls. Significant associations ($r_s = .29-.42$) were observed between declarative memory measures (both verbal and nonverbal) and volumes of the left parahippocampal gyrus and hippocampus. Irrespective of type of material, left parahippocampal gyrus was more closely associated with recall after relatively shorter delays while left hippocampus was more closely associated with recall after longer delays. The relationship between memory performance and right hippocampus and parahippocampus was equivocal. These data suggest that the parahippocampal gyrus is affected in temporal lobe epilepsy. Further, parahippocampal gyrus and hippocampus appear to make differential contributions to memory performance across varying retention intervals.

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FRIDAY MORNING, FEBRUARY 16, 2001

Plenary Session 2

UPTIGHT, LAID-BACK, AND JUMPY MONKEYS/
9:00–10:00 a.m.

Stephen J. Suomi

NEURAL BASES OF SOCIAL BEHAVIOR:
INSIGHTS FROM AUTISM/10:00–11:00 a.m.

Geraldine Dawson

Poster Session 5/9:00–10:45 a.m.

VASCULAR DEMENTIAS

Y. KANG, J. PARK, D.L. NA, & J.H. CHIN. Serial Position Effects of Alzheimer's Disease and Vascular Dementia.

Both the dementia of the Alzheimer's type (DAT) and vascular dementia (VaD) present prominent memory impairments. The present study was conducted to find the differences in the characteristics of memory deficits between DAT and VaD by comparing the serial position effects. We administered the Korean-Hopkins Verbal Learning Test (K-HVLT) to 102 DAT, 64 VaD, and 104 healthy elderly (NC). The groups did not differ in age and education. There was no difference between DAT and VaD in the severity of dementia ($CDR = 1.19 \pm .71$, $K-MMSE = 19.48 \pm 6.01$). Immediate recalls (Trials 1–3), delayed recall, and recognition for primacy and recency items of the K-HVLT were assessed. For primacy items, immediate recall of DAT did not differ from that of VaD across all learning trials, although NC showed a significantly better performance on both recalls and recognition than DAT and VaD. However, after a 20-min delay period, DAT recalled significantly fewer primacy items than VaD [$t_{(163)} = -3.27$, $p < .01$], with a significantly smaller retention rate than VaD [12.67% vs. 48.19%; $t_{(119)} = -4.49$, $p < .001$]. An ANCOVA, with response bias as the covariate, also yielded a significant difference between DAT and VaD for primacy-item recognition hits. For recency items, however, DAT and VaD did not show any differences in recall and recognition, although the two groups showed significantly worse performance than NC. These results indicated that DAT had more deficits in primacy effect, but not the recency effect, than VaD. It suggests that the secondary memory of DAT is more impaired than VaD because of more deficits in retention process.

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J. TSCHANZ, I. SKOOG, B. JOHANSSON, & S. BERG. White Matter Lesions Contribute to Cognitive Decline in Dementia.

Periventricular white matter lesions (WMLs) reportedly contribute to cognitive decline in elderly individuals. However, their effects have not been well investigated in dementia. In the present study of 85-year-olds, participating in the H70 Study in Gothenburg, we examined the effects of WML's on cognitive decline over a 3-year interval. Dementia diagnoses were determined by psychiatrist exam, informant interview, and medical records review. Participants also completed a battery of neuropsychological tests. Of the 494 initial participants, 238 underwent CT scanning. WMLs were rated by trained neuroradiologists, blind to subject diagnoses. Cognitive decline was assessed by difference scores (age 85 score \times age 88 score) for the Mini-Mental Status Exam (MMSE), Perceptual Speed (PS), Digit Span Forward (DSF), Digit Span Backward (DSB), Block Design (BD), Synonyms (S), Coin Math (CM) and Clock Drawing (CD). The effects of dementia and WMLs on cognition were examined in a series of

2-way analyses of covariance models, incorporating baseline scores with the following covariates: gender, APOE 4, education, ventricular brain ratio, dementia severity, and cortical or lacunar strokes. Demented individuals continued to decline on most cognitive measures, in contrast with nondemented individuals who showed little change over the 3 years. Two-way interactions were present for MMSE [$F(1, 123) = 5.7$, $p = .019$], DSF [$F(1, 109) = 12.4$, $p = .001$], and CM [$F(1, 85) = 8.6$, $p = .004$]. Follow-up ANCOVAs conducted separately on persons with and without dementia showed that WMLs contributed to cognitive decline in demented individuals only and did not affect cognition among the nondemented.

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D. NYENHUIS, P. GORELICK, S. FREELS, & D. GARRON. Cognitive and Functional Decline in African Americans With VaD, AD or Stroke Without Dementia.

Objective: To compare the rates of cognitive and functional decline in African American patients diagnosed at baseline with vascular dementia ($n = 79$), Alzheimer's disease ($n = 113$) or stroke without dementia ($n = 56$) and followed for up to 7 years with annual neuropsychological and other examinations. *Methods:* Study patients were diagnosed using established criteria for dementia and were administered cognitive screening, functional screening and neuropsychologic measures. Baseline dementia severity was rated using the Clinical Dementia Rating Scale. Random effects modeling was used to examine rates of decline. ANOVA and ANCOVA were used to examine the presence of decline and to compare the rates of decline in the 3 groups. *Results:* (1) Patients with vascular dementia showed significant cognitive and functional decline during follow-up. (2) Patients with vascular dementia declined at a slower rate than patients with Alzheimer's disease. (3) Patients diagnosed with stroke without dementia at baseline did not show cognitive or functional decline during follow-up. *Conclusions:* Patients with vascular dementia decline at a slower rate than patients with Alzheimer's disease. Patients who do not meet criteria for dementia soon after stroke may not be at high risk for developing dementia. Future studies are needed to follow vascular dementia patients with longitudinal, specialized MRI protocols, concurrent neuropsychological examinations, and neuropathologic examination to determine possible neuroimaging predictors of progressive cognitive and functional decline, and to assess the contribution of Alzheimer's pathology to decline in patients diagnosed with vascular dementia.

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M.J.E. VAN ZANDVOORT, E.H.F. DE HAAN, & L. J. KAPPELLE. A Minor Brainstem Stroke and the Effects on Cognitive Functioning.

Little research has been done on the neuropsychological sequelae of ischemic brainstem stroke. This is probably because these patients very rarely develop complaints regarding cognitive functioning. However, recent studies suggest that subcortical, including brainstem lesions, can negatively affect cognitive status. We studied 20 subacute patients with a single symptomatic minor brainstem stroke [days post stroke = 12 (8.5)] and 20 matched controls were included for a brief neuropsychological evaluation. The test battery was specifically designed and involved 10 tasks in the main cognitive domains: Boston Naming task, Digit Span, Corsi Block Span, Verbal Fluency, WAIS Similarities, Benton Judgement of Line Orientation, Rey-Osterrieth Complex figure, TEA-Lottery & Visual Elevator, Trail Making. Statistical analyses of the results demonstrated 4 tasks on which the patients significantly underperformed the controls: Boston Naming task ($p = .009$), Verbal Fluency ($p = .009$), WAIS-Similarities ($p = .017$), TEA visual elevator ($p < .001$). This pattern of spared and mild disturbed cognitive functions suggest that a minor brainstem stroke can cause subtle neuropsychological impairments. This is probably not a specific cognitive

deficit directly due to the lesion location but a more general effect. Possible explanations include the hypothesized role of the brainstem in arousal, and (selective) attention, and secondary metabolic effects that have influenced more distance structures.

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J. PARK, Y. KANG, J.H. CHIN, & D.L. NA. Differential Visuoconstructive Deficits in Alzheimer's Versus Vascular Dementia.

The present study was conducted to examine the differences of visuoconstructive functioning between Alzheimer's disease (AD) and Vascular dementia (VaD) according to the severity of dementia. The Rey-Osterrieth Complex Figure Test (RCFT) was administered to 98 AD, 63 VaD, and 102 healthy elderly (NC). The groups did not differ in age and education. There was no difference between DAT and VaD in the severity of dementia assessed by CDR and K-MMSE. Copy trial of the RCFT was scored based on the Taylor's classical 18-units scoring system and the Bernstein-Waber Developmental Scoring System (DSS). DAT and VaD did not differ on the total copy score and all the measures of DSS (organization, style, accuracy, and error), whereas these two groups showed significant deficits compared with NC. Each dementia group was divided into 3 subgroups based on CDR: *very mild* (0.5), *mild* (1.0), and *moderately* (2.0) demented groups. The progressive impairments of visuoconstructive functioning were found in AD, as the severity of dementia increased [$F(2,96) = 12.41, p < .001$]. More distortions or omissions of the *configurational structures and left-side part* (units 3, 4, 6, 10, 17, and 18) were found in mild than very mild AD, whereas more deficits in *internal details and right-side part* (units 8, 11, 12, 13, 15, and 16) were found in moderate than mild AD. However, a significant deterioration in visuoconstructive functioning in VaD was found only between mild and moderate VaD, but not between very mild and mild VaD. Moderately demented VaD showed more deficits in *configurational structures* (units 2, 3, 5, and 11) than mild VaD. These results were also confirmed by the analyses based on the DSS. This study suggests that there is a significant difference in the deterioration process of visuoconstructive functioning between AD and VaD.

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FTD AND AD

K. RASCOVSKY, D.P. SALMON, G. HO, D. GALASKO, L.A. HANSEN, & L.J. THAL. Mattis DRS Profiles Differ in Alzheimer's Disease and Frontotemporal Dementia.

The performance of autopsy confirmed FTD and AD patients on the Mattis Dementia Rating Scale (MDRS) was examined in order to determine if these conditions produce distinct cognitive profiles, and whether these profiles can aid in the clinical differentiation of these disorders. MDRS subscale profiles were compared for 14 FTD and 28 AD patients, all of them autopsy-confirmed, and matched for overall level of education and dementia. Repeated measures MANCOVA controlling for age and education revealed a highly significant Test \times Group interaction ($F = 4.431, p = .005$), reflecting distinct cognitive profiles for each diagnosis. While FTD patients performed worse on the Attention (81% vs. 84% of possible maximum scores), Initiation/Perseveration (44% vs. 54%) and Conceptualization (63% vs. 70%) subscales as compared to AD patients, they performed better in the Construction (70% vs. 56%) and Memory (60% vs. 42%) subscales of the MDRS. However, only the difference in performance on the Memory subscale was statistically significant ($F = 4.223, p = .047$). Stepwise Logistic Regression with age, Construction, Initiation and Memory subscales produced a model that significantly aided in the prediction of diagnosis, having an overall correct discrimination of 85.7%. A model excluding the most severely demented patients (DRS score < 70) and taking into account age, Initiation, Conceptualization and Memory subscales accurately discriminated all (100%) patients in both groups. These results indicate that MDRS profiles may be a useful adjunct in the clinical differ-

entiation between FTD and AD, especially among mild-to-moderately demented patients.

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P.A. BOYLE & P.F. MALLOY. Frontal Lobe Functioning and the Prediction of Functional Abilities in Patients With Dementia.

Frontal lobe dysfunction is common among patients with neurological disorders and is associated with disabling functional impairment. We investigated (1) relations between frontal lobe functioning and performance of instrumental activities of daily living (IADLs) in patients with early dementia, and (2) the contributions made by specific aspects of frontal functioning in the prediction of IADLs. Patient and caregiver-based data was obtained for 30 dementia patients. Patients participated in neuropsychological testing including several tests of executive functions (COWAT, DRS-IP, Trail Making Test) and underwent SPECT imaging. Caregivers were administered the Frontal Lobe Personality Scale (FLOPS), a questionnaire designed to assess behavioral changes following damage to the frontal lobes, and the Lawton-Brody Activities of Daily Living Questionnaire. It was hypothesized that SPECT estimates of frontal perfusion and FLOPS scores would emerge as the best predictors of IADLs. Contrary to our hypothesis, simple correlations revealed no relation between frontal perfusion and performance of ADLs or other measures of frontal functioning (e.g., neuropsychological, behavioral). Neuropsychological ($r = .41, p < .04$) and behavioral ($r = -.52, p < .005$) measures correlated significantly with IADLs, however. Stepwise multiple regressions revealed that only the FLOPS total and COWAT scores contributed a significant proportion of the variance in predicting IADLs ($r = .57, p < .002$). These findings indicate that behavioral and neuropsychological changes are associated with functional abilities in dementia patients. Given the lack of a relation between frontal perfusion and IADLs, specific behavioral and cognitive measures of frontal functioning may be more sensitive indicators of functional declines than are SPECT studies, particularly early in the course of illness.

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J. JURIK, J.F. DONNELLY, J.K. KRAMER, & B.L. MILLER. Cognitive Profiles of Frontotemporal and Alzheimer's Dementias on the MMSE.

Previous studies relying on comprehensive neuropsychological assessment have suggested that memory and visuospatial construction are disproportionately impaired in patients with Alzheimer's disease (AD), whereas executive abilities are more affected in patients with frontotemporal dementia (FTD). While AD patients have been extensively studied and profiled using the Mini-Mental State Exam (MMSE), previous studies using the MMSE with FTD patients have reported only global cognitive scores. In the present study, distinct cognitive profiles were obtained for patients with AD and FTD on the MMSE. Thirty-one patients diagnosed with probable AD, based on the NINCDS-ADRDA criteria, were compared to 16 patients diagnosed with FTD (all with bifrontal involvement), based on the Neary criteria and neuroimaging data. There were no differences between the groups in total MMSE scores. However, when a subset of items (three-item recall, orientation, WORLD backward, and pentagons) were used, a discriminant function analysis correctly classified 87% of the cases ($\chi^2 = 14.79, p < .005$). Ninety-four percent of the AD cases and 75% of the FTD cases were classified correctly. The three-item memory score, the sum of the orientation items, and the pentagons were found to be the best discriminants in the model. A significant Group \times Domain interaction, controlling for total score on the MMSE using MANCOVA, provided further support for the differential MMSE profiles found in the two dementia syndromes ($F = 3.22, p < .05$). The AD patients did worse on the memory, orientation, and visuospatial items, whereas the mean score for mental control (WORLD backward) was higher in the AD group than in the FTD patients. Although cross-validation is necessary, these results

demonstrate the diagnostic utility of the MMSE for differentiating between AD and FTD.

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J. GALLO, G. GLOSSER, K. BAKER, N. DUDA, J. DeVRIES, C. CLARK & M. GROSSMAN. Visual Processing in Frontotemporal Dementia and Alzheimer's Disease.

Frontotemporal dementia (FTD) and Alzheimer's disease (AD) differ substantially clinically and pathologically, but are more difficult to distinguish neuropsychologically. Based on differences in the neuroanatomical distribution of pathology in the 2 disorders, it might be expected that AD patients show greater impairment in intermediate level visual processes mediated by posterior temporal-parietal regions than FTD patients who have primary pathology in anterior brain regions. FTD patients ($N = 14$), AD patients ($N = 22$) and healthy controls ($N = 11$) were administered tests of low level visual processes (contrast sensitivity and shape discrimination), intermediate processes mediated by the magnocellular "where" system (spatial locations), and intermediate processes mediated by the parvocellular "what" system (matching unusual views of objects and unfamiliar faces). Neither patient group was impaired in low level visual processes compared to age matched controls. Similarly, there were no group differences in matching spatial locations. However, FTD and AD groups both differed significantly from normal controls on measures of intermediate level visual processes involving constancy for objects and faces. There were no differences between FTD and AD patients on any measures, nor were there differences between FTD patients with primary progressive aphasia ($N = 3$) and other FTD patients in overall level or pattern of impairment. These findings highlight similarities in visual processing disorders between FTD and AD patients, but do not indicate whether similarities are due to involvement of similar brain regions nor whether the same cognitive dysfunction underlies impaired visual processing in both types of dementia.

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G. GLOSSER, J. GALLO, & M. GROSSMAN. Memory Encoding and Retrieval in Frontotemporal Compared to Alzheimer Dementia.

Frontotemporal dementia (FTD) has been well characterized clinically, neuroradiographically and pathologically, but it has been harder to define unique neuropsychological markers of this disorder. Some studies have demonstrated more intact memory functioning in FTD compared to AD patients, but this result has depended on the method of memory testing. It has been proposed that since medial temporal lobe involvement is an early and almost universal feature of AD, but is less common in FTD, then FTD patients should retain greater capacities for encoding new information into long-term memory. Because of disrupted executive control processes, however, FTD patients may have difficulties generating strategies to retrieve data from memory. Consequently, it might be expected that while AD and FTD patients would be equally impaired in free recall measures of new learning, FTD patients would benefit more from cued memory assessment. Patients with probable FTD ($N = 20$) and AD ($N = 21$) completed verbal and visuospatial supraspan learning tests. FTD patients scored higher than AD patients on measures of free recall as well as cued recall and recognition memory. The relative difference between cued/recognition and free recall scores was similar in the two groups. Comparisons between FTD patients with primary progressive aphasia and other FTD patients revealed no significant differences on any memory measures. Results confirm that FTD patients perform reliably better than AD patients on tests of new learning, though they are impaired relative to age-matched controls. Data, however, do not support the idea that a selective retrieval disorder underlies FTD patients' poor memory.

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ALZHEIMER'S DISEASE

R. YUSPEH & R. VANDERPLOEG. Cognitive Functioning in Young-Old Versus Old-Old Persons With Alzheimer's Disease.

The present study examined the differential performance of young-old (aged 60–74, $n = 27$) and old-old (aged 75 and older; $n = 63$) individuals diagnosed with possible/probable Alzheimer's disease (AD) on a comprehensive battery of neuropsychological measures. Two normal control groups were employed as well with individuals placed into these groups according to the same age parameters (young-old, $n = 38$; old-old, $n = 45$). All normal control and AD groups were equivalent for age and education. Both AD groups were also equivalent on dementia severity using the MMSE, and scored significantly lower than the two normal control groups. A series of univariate ANOVAs indicated significant differences between the two normal control groups and the two AD groups (all p values $< .00001$) on all neuropsychological measures. Tukey's HSD *post hoc* analyses showed the 2 normal control groups were equivalent on all neuropsychological measures. Further, these analyses showed the only significant difference observed between the 2 AD groups was the young-old group performed significantly worse than the old-old group on a letter fluency task, indicating the possibility of some differences between these 2 groups with executive functioning. Otherwise, the AD groups were equivalent on all other neuropsychological measures. The present results are in contrast with previous research that indicated that young-old AD patients display significantly greater impairment on a variety of measures of executive functioning and learning and memory. Future research will be needed to further characterize differences, if any, that exist between these groups of AD patients. Correspondence: Robert Yuspeh, Department of Psychology, Rawl Building, East Carolina University, Greenville, NC 27858-4353.

B. SNITZ, I. DAUM, L. SORCINELLO, & G. SARTORI. Remote Memory in Advanced Alzheimer's Disease and Older Controls.

The present study investigated remote memory functioning in advanced dementia of Alzheimer type (DAT). Measures of autobiographical memory included the Autobiographical Memory Enquiry (AME), and two measures of autobiographical fluency. Memory for public knowledge was assessed using a recognition test for public events and identification of famous faces. Ten DAT patients were selected with MMSE scores of less than 15 (M MMSE score = 11.8, $SD = 1.6$). Healthy controls were individually matched to patients on sex, age and years of education (M age for each group = 8.31 years; $SD = 9.0$). DAT patients were impaired on both measures of remote public knowledge and exhibited better memory performance for earlier events compared to later events, as did controls. Performance on the AME was substantially impaired in the patient group but did not show the expected temporal gradient (i.e., *Ribot effect*). DAT patients were impaired on fluency for autobiographical events but only borderline impaired on fluency for autobiographically relevant names, consistent with a functional distinction between personal semantic and autobiographical incident memory. In both groups, AME performance was highly correlated with fluency for autobiographical events but not with fluency for names, indicating convergent validity for the autobiographical incident memory construct across different assessment methods (i.e., structured interview vs. timed verbal fluency). Overall, results indicate a minimal degree of preserved remote public knowledge and autobiographical memory, although without clear evidence of the Ribot effect, in DAT patients with significant dementia.

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K. LANGE, M. BONDI, L. EYLER ZORRILLA, P. GOLDIN, S. KINDERMANN, & G. BROWN. fMRI Study of APOE-ε4 Genotype and Picture Encoding in Older Adults.

Recent research has emphasized the need to identify individuals who are likely to develop Alzheimer's disease (AD), given the importance of early pharmacological intervention to inhibit the neurodegenerative disease process once such interventions are available. Using echoplanar MR imaging,

we examined the brain activation patterns of nondemented older adults with and without a genetic risk for AD (by virtue of the presence or absence of an APOE- ϵ 4 allele) during encoding of complex pictures. Seven APOE- ϵ 4-negative and 4 APOE- ϵ 4-positive nondemented participants of comparable age ($M = 75.5$) and education ($M = 15.4$) levels were asked to view a series of novel pictures and learn and remember them. Using a blocked design, BOLD signal intensity during the picture encoding task was compared to a control condition in which participants viewed a repeated picture. Cluster analysis was used to identify regions of activation. Similar to findings in younger adults, individuals in both APOE genotype groups showed activation in bilateral posterior occipital regions. When between-sample t tests revealed group differences in activation patterns, the APOE- ϵ 4-negative individuals tended to have greater activation during the encoding *versus* repeated picture task relative to APOE- ϵ 4-positive subjects. These differences were most pronounced in right frontal, right superior temporal, and left anterior temporal regions. These findings suggest that picture encoding in older adults without an APOE- ϵ 4 allele involves a different pattern of neuronal activation than that of APOE- ϵ 4-positive individuals.

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X. BERISTAIN, D.A. KAREKEN, D. MOSNIK, & F.W. UNVERZAGT. The Weigl-R: A Brief Measure of Conceptual Reasoning in Dementia.

The CERAD battery and other short assessments of dementia lack measures of conceptual reasoning and mental flexibility. The Weigl Color Form sorting test is a candidate, but it can be insensitive to mild disturbance. We increased the complexity of this test (Weigl-R) and studied its ability to detect cognitive decline in older adults. *Methods:* Participants were 21 controls (C; age 67.4 ± 9.9), 34 patients with mild cognitive impairment (MCI; age 68.9 ± 8.4) and 30 patients with dementia (D; age 69.8 ± 8.4 , 50% Alzheimer's disease, 18% Parkinson's disease, 10% vascular, 12% other). The sample's education was 14.4 ± 2.1 , and equivalent across groups. All took the CERAD and Weigl-R. The Weigl-R has 16 chips in different combinations of colors, shapes, symbols, and textures. On the first of 4 trials, participants sorted the chips in any manner they chose. On each of 3 subsequent trials, they were asked to find alternate ways to sort. Absent a spontaneously correct response after 45 s, prompts (partial demonstration, direct command) were given. The score was the sum of sort points (3 = no prompts; 2 = correct to demonstration; 1 = correct to command; 0 = unable) across each of 4 categories. One point was also given for each correct description of the sort (concept score). *Results:* MMSEs were 28.8 ± 1.4 , 26.7 ± 2.1 and 19.0 ± 5.6 for C, MCI and D, respectively. ANOVA showed significant differences between groups in sorting: *Post-hoc* tests indicated that MCI and D were lower than NC, and that D was lower than MCI. The concept score also differentiated groups. *Conclusions:* The Weigl-R is a brief, sensitive measure of conceptual reasoning suited to screening batteries.

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P. MASSMAN, R. DOODY, & R. DAVIS. The Baylor Cognitive and Behavioral Status Questionnaire: Psychometrics in AD.

When evaluating Alzheimer's disease (AD) patients, information elicited from caregivers regarding cognitive, psychiatric, and everyday functioning is crucial in both diagnosis and subsequent management. Such information could also prove useful in tracking disease progression, particularly in patients who cannot be evaluated in person due to physical or logistical limitations. We constructed the Baylor Cognitive and Behavioral Status Questionnaire (BCBSQ) to provide a standardized means of obtaining caregivers' ratings. This 76-item measure includes 4 Cognitive subscales (Speech and Language, Non-Dominant Hemisphere, Frontal/Executive, and Attention) and 5 Psychiatric subscales (Depression, Anxiety/Agitation, Delusions, Hallucinations, and Pseudobulbar Features). The BCBSQ is administered orally by a trained examiner in person or by telephone. The

caregiver responds "yes", "no", or "does not apply". We utilized data from the caregivers of 208 patients with a diagnosis of probable or possible AD. The mean percentage of items endorsed ranged from 22.5% for Hallucinations to 41.5% for Speech and Language. Internal consistency (coefficient alpha) of the 9 subscales ranged from .62 to .89, with a median value of .75. Coefficient alpha was .84 for all the Cognitive items combined and .88 for all the Psychiatric items. A principal components factor analysis yielded two factors, which could clearly be construed as Psychiatric and Cognitive. Regarding concurrent validity, the Cognitive total score correlated $-.58$ with MMSE, $.60$ with ADAS error score, and $.74$ with CDR stage. Correlations between BCBSQ scores and other individual neuropsychological measures (e.g., Boston Naming Test) also supported the measure's validity, as did canonical correlation analyses.

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R. DAVIS, P. MASSMAN, & R. DOODY. Neuropsychiatric Symptoms and Functional Status in Alzheimer's Disease: A Canonical Correlation Approach.

The Baylor Cognitive and Behavioral Status Questionnaire (BCBSQ) was recently developed to measure caregiver-rated cognitive and psychiatric symptoms among AD patients. The BCBSQ's 2 factors (cognitive and psychiatric) correlate with performance on a variety of neuropsychological tests, but their relationship to AD patients' functional capacity has not been explored previously. The present study addressed this issue in a sample of 192 probable AD patients (67 males, 125 females; M age = 73.5 years, M MMSE score = 19.6, and M years of education = 13.8). Patients' caregivers completed the BCBSQ as well as the Physical Self-Maintenance Scale (PSMS) and Instrumental Activities of Daily Living (IADL). We conducted a canonical correlation analysis on BCBSQ cognitive and psychiatric factor scores (representing the symptom domain) in relation to the PSMS and IADL (representing the functional capacity domain). These domains were significantly related to one another, Wilks' lambda = $.52$, $p < .01$. Two reliable pairs of canonical variates were extracted, accounting for 44% and 8% of the variance, respectively. The first pair of canonical variates had high loadings on the BCBSQ psychiatric factor (.99) as well as the PSMS (.99) and IADL (.86). The second pair of canonical variates had high loadings on the BCBSQ cognitive factor (.96) as well as IADL (.51). These results indicate that greater psychiatric symptomatology is related to impairment in both basic self-care and IADL, and that greater cognitive symptomatology is associated with additional impairment in IADL.

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L. LACRITZ, E. BIGIO, A. LIPTON, F. BONTE, D. COOPER, & M.C. CULLUM. Concordance of Neuropsychology, Neuropathology and SPECT in Lateralized AD.

A variety of diagnostic tools are utilized in the diagnosis of Alzheimer's disease (AD), including SPECT and neuropsychological assessment. The presence of lateralized findings is not uncommon on neuropsychological testing, and asymmetric hypoperfusion on SPECT has been reported in subgroups of patients with AD, supporting the notion of lateralized subgroups of AD. This study examined the correspondence between cognitive deficits, neuropathologic markers (where available), and SPECT findings in 14 patients with autopsy confirmed Alzheimer's disease who demonstrated lateralized SPECT findings during initial evaluation (4-10 years prior to death). Lateralized cognitive deficits were found in 12/14 cases, but corresponded to side of SPECT lateralization in only 6/12 (50%) instances. Frontal, temporal and parietal plaques and tangles infrequently lateralized. Six of the 14 patients had synaptophysin (a marker of synapse loss) data available, with 100% concordance with SPECT for levels in the frontal lobe, but only 50% agreement with parietal synaptophysin, and no agreement with temporal lobe levels. These findings highlight the importance of using different diagnostic tools in the assessment of AD, and the potential utility of synaptophysin as a marker of disease asymmetry. The

low concordance rate between SPECT and cognitive dysfunction raises questions about how best to identify lateralized subgroups of AD, and whether lateralized findings across diagnostic techniques are necessary to support the existence of distinct subgroups of AD.

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L. RAFALSON, S.P. DAVIES, Z. WALKER, & C. KATONA. Education Status and Verbal Fluency in Alzheimer's Disease.

The contribution of demographic factors to verbal fluency performance in AD patients is still unclear. The Controlled Oral Word Association Test (COWAT) is a commonly used neuropsychological test that has been shown to be sensitive to thalamic, frontal and temporal lesions, which are often indicated in Alzheimer's disease (AD). The present study examined the effects of education on COWAT performance in a sample of 45 women and 22 men suffering from AD. Participant age ranged from 61 to 99 years ($M = 75$, $SD = 8$) and years of education ranged from 2 to 21 ($M = 10$, $SD = 3$). Hierarchical multiple regression analysis was conducted to examine the contribution of education to letter fluency performance after controlling for age, gender, and dementia severity. The mean Clinical Dementia Rating (CDR) score in this sample indicated a mild level of dementia. The main finding was that education had a statistically significant effect on letter fluency performance in AD patients with mild dementia. The effect of education contributed significantly to the overall variability in letter fluency scores, accounting for 24.4% of variance, after controlling for age, gender and dementia severity. Individuals with 9 or fewer years of education (equivalent of elementary school) performed worse than those with 10 or more years of education in the sample as a whole and in the questionable and mild dementia subgroups. The present study provides additional evidence for the continuing role of education in cognitive test performance even in the context of the diagnosis of AD.

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J.L. WOODARD, K.D. SHANNON, M.E. DOBRASKI, S.T. GRAFTON, J.R. VOTAW, R.C. GREEN, R. HALKAR, & J.M. HOFFMAN. Longitudinal Working Memory Activation Patterns in Alzheimer's Disease and Aging.

Neuroimaging studies of memory and cognition have frequently noted increased regional activation patterns in Alzheimer's disease (AD) patients as compared to healthy controls. However, the long-term stability of these patterns is not known. We used positron emission tomography (PET) to study regional cerebral blood flow activation produced during overt rehearsal of 5-word and 10-word lists compared to a reading control task in 12 healthy elderly controls [all negative for the Apolipoprotein E4 allele (Apo-E4)] and 6 mildly affected probable AD patients (3 heterozygous for Apo-E4, 2 homozygous for Apo-E4, and 1 negative for Apo-E4), matched on age and education, over a 2-year period. Participants underwent two PET studies separated by approximately 2 years, together with yearly neuropsychological testing. At baseline, relative to the reading control task, both rehearsal conditions produced bilateral activation predominately in dorsolateral prefrontal cortex (DLPFC) for both controls and patients, although more diffuse frontal, cerebellar, and temporal activation was observed for patients. After 2 years, controls demonstrated no significant differences from their baseline study, while patients demonstrated a significant decline in the spatial extent of activation, particularly in frontal regions. We conclude that healthy older controls demonstrate a remarkably stable pattern of activation associated with a working memory task over 2 years, while AD patients show an increased spatial extent of activation at baseline, relative to controls, followed by a substantial decrease in extent of activation. This decline in activation in AD patients is presumably due to neuronal dropout and synapse loss.

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J.L. WOODARD, S.K. MILLER, K.D. SHANNON, & M.E. DOBRASKI. Rehearsal Characteristics Influencing Recall in Aging and Alzheimer's Disease.

Rehearsal is a commonly used strategy when learning a word list. Although this strategy is typically employed subvocally, overt rehearsal can shed light on underlying cognitive processes involved in learning a list of words. This study investigated the relative roles of rehearsal rate (RR) versus number of unique words rehearsed (UWR) on word recall in healthy elderly controls and mild Alzheimer's disease (AD) patients. Participants included 22 controls and 21 AD patients matched on age (control $M = 70.9$, $SD = 6.6$; AD $M = 68.5$, $SD = 6.9$) and education (control $M = 15.8$, $SD = 2.9$; AD $M = 16.1$, $SD = 2.7$). Individual words from 5 and 10 word lists (repeated in triplicate) were presented via computer at the rate of 4 s/word over 2 min. Participants rehearsed aloud the presented word along with previously presented words, and measures of RR and UWR were derived from tape recordings for each session. A free recall period followed 15 s of mental arithmetic. For the 10-word list, both RR and UWR were correlated significantly with list recall for the controls, whereas for AD patients, only UWR was associated with recall. A similar pattern was noted for the 5-word list, although a ceiling effect complicated the findings. Rehearsal rates were comparable between groups. These findings suggest that controls are able to profit from both rapid articulation of words and maintenance of multiple words in working memory, presumably enhancing both contextual and interitem associations. In contrast, AD patients benefit predominately from directed rehearsal of multiple unique words, thereby relying more on interitem associations.

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T. HOPPER, K. BAYLES, F. HARRIS, & A. HOLLAND. Minimum Data Set Ratings and Performance on Communication and Hearing Measures.

The Minimum Data Set (MDS) is the federally mandated assessment tool for the evaluation of residents in Medicare-certified nursing facilities. Best described as a rating scale, it comprises 74 items in 16 domains of functioning, including communication and hearing. The MDS is used in conjunction with Resident Assessment Protocols or RAPs to develop the individualized care plans required by law. Although mandated for use, no study has been made of the validity of MDS items related to communication and hearing, despite the high prevalence of communication deficits and hearing loss among elderly individuals. The purpose of this study was to determine the relation between MDS hearing and communication ratings and actual hearing and communicative function of residents with dementia, and to determine the number of those residents with MDS-identified deficits who received a referral for communication and/or hearing evaluations. Fifty-seven individuals with a medical diagnosis of dementia participated in the study. Hearing and linguistic communication were evaluated using standardized methods and results were compared to MDS ratings. Those residents rated as having normal or adequate communication and hearing on the MDS were not performing within the normal range on standardized communication and hearing tests. Of those with MDS-identified impairments, not one was referred for further evaluation. Implications for policy and care for nursing home residents with dementia are discussed.

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R. DAVIS, P. MASSMAN, & R. DOODY. Relationships Between Neuropsychological Functioning and Caregiver-Rated Symptoms in AD.

The presentation of AD is heterogeneous and includes cognitive as well as psychiatric symptoms such as hallucinations. Evidence is inconsistent as to whether psychiatric symptoms are associated with more severe cognitive deficits. Unreliability in patients' reports of their symptoms may contribute to these inconsistent findings. However, caregivers appear to be reliable informants of AD patients' functioning. The Baylor Cognitive and

Behavioral Status Questionnaire was recently developed to assess caregiver-rated cognitive and psychiatric symptoms in AD patients. How do the BCBSQ's factors relate to patients' neuropsychological functioning? We addressed this question using canonical correlation analyses between the BCBSQ factors (cognitive and psychiatric) and measures of language and visuospatial functioning among AD patients. Separate analyses evaluated BCBSQ factor scores in terms of language measures (Animal Naming, Boston Naming Test, FAS; $n = 144$) and visuospatial measures (Benton Facial Recognition Test, Letter Cancellation, Rey Figure copy; $n = 104$). BCBSQ factor scores related significantly to language measures along a single reliable dimension, Wilks' lambda = .81, $p < .01$. Lower cognitive (−.99) and psychiatric (−.51) symptoms were associated with better performance on animal naming (.82), the BNT (.80), and FAS (.94). BCBSQ factor scores also related significantly to visuospatial measures, but along two reliable dimensions, Wilks' lambda = .74, $p < .01$. On the first dimension, higher cognitive (.99) and psychiatric (.62) symptoms were associated with lower Rey copy (−.97), Facial Recognition (−.81), and letter cancellation (−.74) performance. On the second dimension, lower psychiatric symptoms (−.78) were associated with better letter cancellation performance (.64). Results indicate reliable associations between caregiver-rated symptoms (both cognitive and psychiatric) and neuropsychological functioning in AD patients.

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E. ARNAIZ, G. SMITH, R. J. IVNIK, O. ALMKVIST, R. C. PETERSEN, & B. WINBLAD. Diagnostic Reliability of Mild Cognitive Impairment Diagnosis.

Objective: To compare cognitive patterns for persons diagnosed with mild cognitive impairment (MCI) at 2 separate institutions: Mayo Clinic (MC), Rochester Minnesota, USA and Karolinska Institut (KI), Stockholm, Sweden. *Background:* MCI is a relatively new clinical term. It is important to assess the reliability of these diagnostic criteria. *Design/Methods:* Samples consisted of 172 MC Alzheimer's Disease Patients Registry participants and 133 KI-Huddinge Hospital Registrants with MCI. MCI criteria followed Petersen et al., 1999. Several common measures were employed; WAIS-R Information, Digit Span, Similarities, Block Design, and Digit Symbol, WMS-R Logical Memory, and Rey Auditory Verbal Learning Test (AVLT). Age and education adjusted Mayo's Older Americans Normative Studies (MOANS) scores were calculated, though it is recognized that such calculations are tenuous for the KI group. *Results:* KI MCIs were significantly more impaired than MC MCIs on AVLT Trial 1 ($t = 3.45$, $df = 249$; $p < .001$) and Block Design ($t = -2.9$, $df = 274$; $p < .001$). MC-MCI performed worse on AVLT Total Learning ($t = 3.48$, $df = 249$; $p < .01$). However impairment distributions were similar for learning and retention for both groups. Across groups only learning and retention scores fell more than 1.5 SDs below age means on average. *Conclusions:* There are statistical differences between MC and KI groups in attention and perceptual organization but there is a similar cognitive pattern underlying MCI profiles. Learning and retention are equally affected in the two MCI populations. The cognitive differences could be due to differences in language, culture, age, education, recruitment approach, test administration, etc. MCI diagnosis appears reasonably reliable across these settings but additional cognitive assessment standardization could enhance reliability.

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B. MAST, J. ALLAIRE, J. FITZGERALD, J. STEINBERG, & P. LICHTENBERG. Latent Variable Growth Curve Modeling of Verbal Learning in Alzheimer's Disease.

The present study applied latent variable growth curve modeling (LGM) to list learning and dementia. LGM is a structural equation modeling technique which simultaneously estimates latent variables representing overall levels of performance and change in performance over trials. This approach is advantageous in that (1) change over trials is estimated as a latent variable free from measurement error, and (2) latent variables representing change can be incorporated as analytic foci and can be used to

identify predictors and correlates of change over trials. Data from 116 patients seen at the Detroit satellite of the Michigan Alzheimer's Disease Research Center were incorporated in the present analyses. All patients were administered the Fuld Object Memory Evaluation and examined independently by a geriatrician and if appropriate given a diagnosis of probable Alzheimer's disease according to NINCDS-ADRDA criteria. A measurement model estimating an intercept and positive linear slope demonstrated excellent fit, suggesting this model adequately captured learning over trials. Next, cognitive status (demented vs. nondemented) was incorporated as an exogenous predictor of learning over trials. The presence of AD significantly predicted both the intercept (i.e., overall level of performance) and slope (i.e., the amount of learning over trials), with AD patients demonstrating lower performance and less learning over trials. Overall, dementia status explained 61% of the variance in level of performance and 31% of variance in learning over trials. LGM is a useful and flexible analytic tool which might extend list learning research by identifying predictors and correlates of learning over trials.

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D. BADENES, E. MUÑOZ, O. GELONCH, N. CARULLA, G. CHICO, & M. AGUILAR. Cognitive Functioning in Mild-Moderate Alzheimer Disease Patients Treated With Donepezil: A 6-Month Follow-Up.

The efficacy of cholinesterase inhibitors as a treatment for patients with mild-moderate Alzheimer's disease (AD), was shown in controlled trials. The primary efficacy measure in all studies has been the cognitive portion of the Alzheimer's Assessment Disease Scale (ADAS-Cog). The treatment has efficiency when there is a 4-point improvement in ADAS-Cog or if treated patients have 4 points less than nontreated patients, during 2 years. The treatment does not obstruct the progression of the illness. *Aim:* We studied the benefit, efficacy and profile of evolution of mild-moderate AD (NINDS-ADRA criteria) in all patients treated with Donepezil during 6 months in a Dementia Unit. *Methods:* Fifty-one patients studied at baseline and at 6-month follow-up. 74.5% women, age $M: 75.82$, $SD 5.7$; MMSE (10-14: 35.29%; 15-19: 39.21%; 20-25: 25.49%). Cognitive functions as measured by ADAS-Cog, verbal fluency, visual gnosis, Kohs, Coding. Comparison of measures on all subtests at baseline and at 6-month follow-up were analyzed using SPSS for Windows. *Results:* Significant differences were found in the subtests of verbal memory ($p < .005$, $M 8.26$, $SD 1.27$; and $M 7.64$, $SD 1.31$, respectively) and total scores in ADAS-Cog (confidence interval $-0.64-3.81$). 51.2% of patients showed improvement (same or less points) 34.2% got worse in less than 3 points and 14.6% got worse in more than 4 points. No significant differences were found in other subtests. *Conclusions:* Our study has shown results in accordance with previous trials carried out with donepezil.

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DEPRESSION AND DEMENTIA

J. GREEN, W. McDONALD, M. EVATT, B. SIROCKMAN, A. CLARK, J. BROWN, N. WAHLAY, & J. VITEK. How Frequent Are Neuropsychological Impairments in Nondemented, Nondepressed Advanced PD Patients?

Although statistically significant group differences between Parkinson's disease (PD) patients and controls have been documented, our study quantified the clinical significance of neuropsychological deficits in individual nondemented, nondepressed patients with advanced PD. *Method:* Patients included 61 nondemented (MDRS M age = 137), nondepressed (Ham-D $M = 2.1$) patients (M age = 59) with advanced, idiopathic PD (Hoehn-Yahr > Stage II). Test scores from the CVLT, WMS-R Digit Span, WCST, COWA, Category Fluency, JOLO, and BNT were categorized as unimpaired or impaired (< the 10th percentile in comparison to a largely, clinically-appropriate normative data set). *Results:* The percent of patients showing impairment on specific measures was: 1% on forward span, 8% on backward span, 30% on BNT, 31% on COWA, 23% on category flu-

ency, 67% on WCST number of categories, 21% on JOLO, 30% on CVLT Trial 1–5 learning, 11% on CVLT long delay recognition discrimination. For most measures, impaired patients were not distinguished by age, education, disease duration, age of disease onset, estimated premorbid IQ, or disease severity. The 19 patients (31%) who showed impairment on 3 or more measures from different tests had significantly lower MDRS scores ($p = .0001$) and tended to have more severe disease ($p = .05$) and a longer disease duration ($p = .06$). *Conclusion:* Neuropsychological impairments are common in advanced PD even without dementia, and the nature of these deficits suggests widespread dysfunction in basal ganglia–thalamocortical as well as other brain systems.

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S.D. SPERRY, M.E. STRAUSS, & A.M. LANDES. Relation of Apathy to Depression, Cognition, and Daily Function in Dementia.

Caregivers of 74 older adults with dementia completed a 22-item apathy questionnaire designed to assess changes in initiation, social engagement, and interest since onset of dementia. Caregivers also completed the Blessed Dementia Rating Scale, and the Behavioral Rating Scale for Dementia (BRSD). Cognitive functioning of the older adults with dementia was assessed using the CERAD neuropsychological battery. Patients with dementia were mildly to severely impaired (M MMSE = 19.8, range = 3–29). Internal consistency reliability coefficient for the apathy questionnaire was high (.91). Apathy scores were significantly correlated with functional capacity (Blessed Dementia Rating Scale) and disease severity (CDR) ($p < .001$). Apathy was also significantly related to cognitive functioning of the patient [CERAD verbal fluency ($p < .001$), naming ($p < .01$), MMSE ($p < .001$), and word list learning ($p < .05$)]. Depressive symptoms as assessed by the BRSD were not associated with functional capacity, disease severity, or any of the neuropsychological tests ($p > .05$). Apathy scores were modestly correlated with depressive symptoms on the BRSD ($r = .24$, $p < .05$). Controlling for depression did not materially affect the correlations between apathy and the above neuropsychological measures. These findings support the importance of assessing apathy in dementia as apathy appears to have stronger associations with cognition and functional capacity than do depressive symptoms.

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A. CHRONOPOULOS, R. McCUE, W.J. BURNS, & A. SELLERS. Memory Assessment Discriminates Alzheimer's Disease and Depression From Other Forms of Memory Dysfunction.

The detection of organic *versus* functional memory loss in elderly memory dysfunction is a crucial aspect of memory assessment. The purpose of the present study was to investigate the clinical utility of verbal subtests from the Wechsler Memory Scale–III [WMS–III; e.g., Verbal Paired Associate (VPA) and Logical Memory (LM)] in 4 elderly samples of mild memory dysfunction. Fourteen patients with probable Alzheimer's disease (AD), 18 patients with Parkinson's disease (PD), and 30 patients with subcortical vascular disease (VaD) were compared to each other and against 22 patients with geriatric depression (GD). The mean age of the sample was 76 years. Planned multiple comparison procedures on the mean scaled scores of VPA1 significantly discriminated AD from PD, AD from VaD, and AD from GD. There were no significant differences on VPA1 among the PD, VaD, and GD samples. Delayed mean scaled scores on VPA2 significantly discriminated AD from VaD, and AD from GD. VPA2 did not significantly discriminate between AD and PD. Group mean scaled scores on LM1 significantly discriminated GD from AD, GD from PD, and GD from VaD. Delayed mean scaled scores on LM2 significantly discriminated GD from VD, GD from AD, and GD from PD. No significant differences on LM1 or LM2 were detected among the AD, PD, or VaD groups. These findings show that impaired performance on VPA1 and VPA2 best discriminates mild AD from other forms of memory dysfunction whereas poor performance on LM1 and LM2 best discriminates dementia from depression. Results support separate mechanisms for the retrieval deficits associated with depression, and cortical and subcortical dementia. Mild AD is best

exemplified by poor learning strategies whereas GD, PD, and VaD are best exemplified by deficits in attention.

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ETOH, DRUGS, AND TOXIN-RELATED DISORDERS

J. RUGER, R. HOPKINS, L. WEAVER, S. JOHNSON, D. TATE, E. BIGLER, & D. BLATTER. MR-Based Temporal Horn Enlargement Following Carbon Monoxide Poisoning.

Introduction: Carbon monoxide (CO) can result in neuroanatomical changes and neuropsychological impairments. There are few reports regarding the effects of CO on total brain (TB) volume and ventricles using quantitative magnetic resonance imaging (QMRI) analysis. We hypothesized that CO would result in brain atrophy and ventricular enlargement. *Methods:* Prospectively, brain MRIs and neuropsychological tests of 65 patients were acquired within 24 hr (Day 1), 2 weeks, and 6 months following CO poisoning. TB and ventricular volumes were analyzed in the axial plane using ANALYZE. *Results:* TB volume was not significantly different between Day 1 and 6 months. A significant difference was found between the 2-week and 6-month measurements of the left temporal horn ($F = 4.846$, $p = .03$) and a trend for the right temporal horn ($F = 2.77$, $p = .09$). Thirty-four patients (52%) experienced loss of consciousness. For patients with LOC there was an inverse correlation between TB volume and time to complete the Trail Making Test ($r = -.564$, $p = .00$). For patients with LOC there were significant correlations for Trails B and the left horn ($r = .20$, $p = .03$) and right horn ($r = .195$, $p = .04$). *Conclusions:* Although the CO patients exhibited no change in total brain volume following CO exposure, there was enlargement of the temporal horns at 6 months, indicating adjacent temporal lobe atrophy. Among patients with LOC, smaller TB volumes and enlarged temporal horns were associated with impaired neuropsychological test performance. LOC may be a risk factor for temporal horn enlargement and cognitive impairments following CO poisoning.

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K.K. ZAKZANIS & A.A. BIRZE. Executive Dysfunction in Abstinent MDMA ("Ecstasy") Users.

Methylenedioxyamphetamine (MDMA, or "Ecstasy") is a growingly popular recreational drug of abuse that is known to damage brain serotonergic neurons in animals and possibly humans. Few functional consequences of MDMA-induced serotonin neurotoxicity have been identified, either in animals or humans. This study sought to determine whether individuals with a history of MDMA use showed evidence of executive dysfunction. Accordingly, two groups of young individuals (17–26) were compared: 13 abstinent MDMA users who had taken MDMA at least once and 24 controls who had never taken MDMA. Each MDMA user completed a questionnaire regarding the characteristics of their MDMA use and all participants completed a questionnaire regarding other recreational drug experience. The Behavioural Assessment of the Dysexecutive Syndrome (BADS) was used to measure executive function in all participants. Results indicate that MDMA use may be associated with mild deficits in executive function. Evidence of impairment was found on one component subtest of the BADS. Several significant product moment correlations were found suggesting that increases in MDMA consumption may relate to more pronounced impairment in executive function.

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K. K. ZAKZANIS & A. SILVERBERG. Implicit and Explicit Memory in Abstinent MDMA ("Ecstasy") Users.

Methylenedioxyamphetamine (MDMA, or "Ecstasy") is a popular recreational drug of abuse that is known to damage brain serotonergic neurons in animals and possibly humans. Few functional consequences of MDMA-induced serotonin neurotoxicity have been identified, either in

animals or humans. The present study used the Rivermead Behavioral Memory Test (RBMT) as a measure of explicit memory and a stem-completion task as a measure of implicit memory along with other cognitive measures to determine whether individuals with a history of extensive MDMA use showed evidence of both explicit and implicit memory impairment because brain serotonin has been implicated in mnemonic function. Accordingly, we compared 15 abstinent MDMA users and 17 normal controls who were well matched in terms of age, gender, education, and prorated intelligence (based on Vocabulary and Block Design subtests of the WASI). We also explored important correlations between characteristics of MDMA use (such as duration of use, number of times used, usual dose, frequency of use, and time since last dose) and neurocognitive performance. We found evidence of explicit memory impairment and intact implicit memory in the abstinent users compared to the normal controls. Moreover, several significant product moment correlations were found suggesting that increases in MDMA consumption may relate to more pronounced impairment in explicit memory. These results suggest that it should be possible, and it is indeed important, to determine the neurochemical substrates of cognitive processes. Such research will both advance our understanding of normal brain function and assist us in developing rational therapies for patients with cognitive disorders.

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K. MEDINA, J. SCHAFER, P.K. SHEAR, & P. DYER. Cognitive Functioning and Length of Abstinence in Polysubstance-Dependent Men.

Numerous studies have demonstrated cognitive deficits associated with polysubstance abuse and single drugs of abuse. To date, however, there are few large-scale studies that have examined the relationship between duration of abstinence and cognitive functioning in polysubstance dependent individuals. Several studies examining users of single substances have demonstrated considerable recovery of functioning within the first several months of abstinence with continued recovery for up to 5 years. In contrast, existing large-scale studies of polysubstance abusers have reported only minimal recovery of cognitive functioning with abstinence. The goal of this study is to test whether length of abstinence (1 day–14 months) is related to cognitive ability in a large sample of men recovering from polysubstance dependence ($N = 207$). Participants met DSM-IV criteria for dependence on at least two drugs. The cognitive battery included tests of visual and verbal memory, word knowledge, abstract reasoning, inhibition of overlearned responses, attention, sequencing, and psychomotor speed. A series of Poisson regressions was run to test whether length of abstinence is associated with neuropsychological performance while controlling for frequency of drug use, age, education, and income. As expected, increasing age was significantly related to neuropsychological performance decrements. There was no significant relationship between length of abstinence and neuropsychological ability; that is, within the limitations of this cross-sectional design, there is no evidence that cognitive functioning varies systematically over the first year of abstinence.

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R. GONZALEZ, R. HEATON, D. MOORE, J. RIPPETH, M. CHERNER, I. GRANT, & THE HNRC GROUP. Lifetime History of Methamphetamine Dependence Is Associated With Learning Deficits.

This pilot study examined neuropsychological (NP) performance across three groups differing on lifetime history of substance dependence: no history of dependence (*none*), $n = 12$; history of methamphetamine dependence only (*meth*), $n = 19$; history of methamphetamine and alcohol dependence (*both*), $n = 10$. Participants did not meet criteria for current substance dependence and/or abuse, and none had lifetime history of dependence and/or abuse for other substances (i.e., cocaine, opiates, sedatives, other stimulants). Groups were comparable on age and ethnicity. Demographic differences in education were controlled for statistically. Scores on NP tests were grouped into five ability areas: Learning, Memory/Retention (M/R), Speed of Information Processing/Working Memory (SIP/WM), Motor, and Verbal Fluency (VF). Individual MANOVAs were

conducted for each NP ability area using substance use history (*none*, *meth*, *both*) as the independent variable and results from all NP test measures within an ability area as dependent variables. Results from these analyses revealed a significant finding for Learning ($p = .04$). No significant findings were observed for other NP domains (M/R, $p = .74$; SIP/WM, $p = .17$; Motor, $p = .16$; VF, $p = .26$). Follow-up tests for each Learning measure revealed differences in Story Memory Learning Rate ($p = .003$, $R^2 = .26$, *meth* < *none*) and Figure Memory Learning Rate ($p = .02$, $R^2 = .19$; *meth* < *none*). These results suggest that lifetime history of methamphetamine dependence alone may result in greater learning deficits in comparison to individuals with no lifetime history of substance dependence. Individuals with lifetime history of dependence for both substances did not exhibit this pattern. Similar findings have been reported with cocaine and alcohol users.

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C. ALLEN & M. ROBARDS. Effects of Frequency of Exposure on the Performance of Railroad Workers on Tests of Attention and Memory Following Long-Term Use of Organic Solvents in the Workplace.

Performances on tests of attention and memory were analyzed in 36 male, railroad workers referred for neuropsychological testing secondary to long-term exposure to organic solvents. The sample was divided into groups according to self-ratings of the average frequency of use of solvents per week over their career. The high frequency (HF) group ($n = 23$) consisted of workers reporting use of solvents five days per week. The low frequency (LF) group ($n = 13$) reported use of solvents less than five days per week. Group means were virtually identical for age, years of education and years of exposure. It was predicted that workers in the HF group would display significantly lower scores on tests of attention (letter and block span, Brief Test of Attention, and Ruff 2&7 Selective Attention Test) and memory (Memory Assessment Scales, Verbal and Visual Memory scale; and letter and block span with 20-s delay) than workers in the LF group. Multiple, independent t tests were used to analyze group differences. A Bonferroni correction was made to adjust the alpha level for multiple comparisons. Our hypothesis was partially confirmed. Significantly lower scores were documented in the HF *versus* LF group for letter span and the MAS, Visual Memory Scale. These results suggest that relative deviations in attention and memory in railroad workers, following long-term use of solvents in the workplace, may be associated with frequency of use when age, years of education and years of exposure are controlled.

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B.C. SCHWEINSBURG, O.M. ALHASSOON, M.J. TAYLOR, J.S. VIDEEN, G.G. BROWN, T.L. PATTERSON, & I. GRANT. [¹H] Spectroscopy Reveals Selective Vulnerability of Frontal White Matter in Abstinent Alcoholics.

Neuropsychological and magnetic resonance imaging investigations have suggested that the human frontal lobes seem particularly sensitive to the neurotoxic effects of alcohol. Quantitative volumetry has revealed that white matter changes may account for the brain "shrinkage" associated with alcohol consumption, however, the nature of this change is not well-understood. Single-voxel [¹H] magnetic resonance spectroscopy (MRS) was used to characterize the metabolic change associated with chronic alcoholism in frontal (FWM) and posterior (PWM) brain white matter regions, and to determine the relationship between brain metabolism and neuropsychological functioning. We hypothesized that the FWM would be differentially impacted by alcohol consumption compared to a PWM region, and these alterations would be associated with neuropsychological dysfunction. Twenty-seven recently detoxified alcoholics [RDA: M age: 39.8 (7.2); M education = 13.4 (1.7); M length of abstinence = 33.2 (7.1)] and 14 controls [CON: M age: 37.6 (8.2); M education = 14.0 (1.6)] were examined using MRS (PRESS, TE = 35 ms, TR = 3000 ms). Concentrations of N-acetylaspartate (NAA), choline, creatine, and *myo*-Inositol were calculated. Repeated measures ANOVA revealed a Group \times Region interaction for concentration of NAA [$F(1,39) = 5.90$, $p = .02$]. Follow-up

analyses showed RDA had significantly lower NAA in the FWM, [$t(39) = 4.07, p = .0002$], while RDA and CON had similar concentrations of NAA in the PWM. No between-group changes were found for the other metabolites, and no relationship between brain metabolism and neuropsychological functioning was found. The results indicated that the frontal lobes are particularly susceptible to axonal injury after long-term alcohol consumption. This is consistent with rodent models of alcoholism and may be due to altered blood flow and/or glutamate/NMDA mediated injury.

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C. BOAKE, W.M. HIGH, JR., A.M. SANDER, J.S. KREUTZER, S.N. MACCIOCCHI, A.Y. STRINGER, F.M. HAMMOND, M. ROSENTHAL, & J.A. BOGNER. Effect of Blood Alcohol Level on Neuropsychological Outcome From Brain Injury.

Objective: To resolve contradictory reports in the literature regarding adverse effects of acute blood alcohol level (BAL) on neuropsychological outcome from traumatic brain injury (TBI). **Patient sample:** 459 adults with nonpenetrating TBI who were inpatients at one of 6 rehabilitation centers in the TBI Model Systems project, whose BAL had been measured at hospital arrival, and who emerged from posttraumatic amnesia (PTA) and underwent neuropsychological testing before rehabilitation discharge. **Outcome Measures:** 15 neuropsychological tests were administered after resolution of post-traumatic amnesia and at 1 year post injury. **Analysis:** BAL was classified as (1) negative vs. positive and (2) intoxicated (BAL > 100 mg/dl) vs. nonintoxicated. The effect of BAL on neuropsychological performance was analyzed by linear models adjusting for age, education, and PTA duration. **Results:** 51% had positive BAL and 32% were intoxicated. Alcohol involvement adversely affected the Glasgow Coma Scale score but not PTA duration. Those with alcohol involvement were less likely to complete testing during rehabilitation. There was no adverse effect of BAL on neuropsychological performance during rehabilitation. The sample size provided 80% power to detect a standardized mean difference of at least .33. Results of testing at 1 year post injury also showed no adverse effect of BAL although the sample size was decreased by attrition. **Conclusions:** In TBI rehabilitation inpatients, any adverse effects of BAL on early neuropsychological outcome are smaller than detectable from the present sample size. Therefore, adverse effects of alcohol involvement on functional outcome from TBI may be mediated by factors other than neuropsychological deficits.

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M. ROSSELLI, A. ARDILA, S. MURRAY, C. WALSH, K. KING, & S. GUALDONI. Neuropsychological Differences of Cocaine Abusers With and Without Alcohol Dependence.

Recent research has suggested that cocaine and alcohol abusers may be less cognitively impaired than demographically compared cocaine abusers. The aim of the present study was to replicate these findings. The performance on a neuropsychology battery of 29 cocaine users (M age: 35.3 ± 6.11 ; M education 11.67 ± 1.95), 22 codependent alcohol and cocaine users (M age: 33.5 ± 6.6 ; M education 11.16 ± 2.0) and 18 matched control participants was analyzed. The neuropsychological battery included memory (CVLT; ROCF), constructional (ROCF, BVRT), visuomotor (Trails A & B), attention (WAIS-R Digits), verbal fluency (FAS) and executive functioning (WCST; WAIS-R Arithmetic) tests. Multivariate analyses of variance were performed to compare the three groups. *Post-hoc* tests were used to probe significant univariate effects. Results showed that both drug users performed significantly poorer than the controls did in some memory, constructional, visuomotor, and executive function measurements. Participants, who abused cocaine only, did not differ significantly in any of the neuropsychological measurements from the cocaine group that also used alcohol. The findings of this study failed to corroborate the protective effect of alcohol in chronic cocaine users. Possible explanations for these findings are analyzed.

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M. HORNER, K. BECHTOLD, W. WINDHAM, & R. HARVEY. Cognitive Functioning in Patients With Concurrent Cocaine and Alcohol Dependence.

Many previous neuropsychological studies of cocaine dependence have examined individuals without other substance use disorders, even though many cocaine-dependent patients also abuse alcohol. The present study examined the cognitive sequelae of cocaine dependence among patients who were also alcohol dependent. Participants were 47 male outpatients enrolled in intensive substance abuse treatment who volunteered for comprehensive neuropsychological evaluation as part of an ongoing study (M age = 47.8, $SD = 7.6$; M education = 12.2 years, $SD = 2.6$; M length of abstinence from substances = 35.8 days, $SD = 48.7$). Patients with concurrent cocaine and alcohol dependence, with no other substance use disorder except nicotine dependence (Group CA; $N = 11$), were compared to patients dependent on alcohol alone, with no other substance use disorder except nicotine dependence (Group A; $N = 28$). For comparison, a group of patients with uncomplicated cocaine dependence was also included (Group C; $N = 8$). Preliminary data indicate that Group CA demonstrated trends toward poorer performance than Group A on the Wisconsin Card Sorting Test (percent perseverative errors) and WMS-R Digits Backward. Group CA also demonstrated trends toward poorer performance than Group C on Wisconsin Card Sorting Test (percent perseverative errors), Trails B (number of errors), and Shipley Institute of Living Scale Conceptual Quotient. These pilot data suggest that, among alcoholic patients, concurrent cocaine dependence was associated with attentional and executive dysfunction; among cocaine-dependent patients, concurrent alcoholism was associated with executive dysfunction.

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J.N. BROWNDYKE, J. BEAUVAIS, S.P. WOODS, P.C.H. GOTTSCHALK, & T. KOSTEN. Cerebral Hypoperfusion and Neurocognitive Impairment in Chronic Cocaine Abusers.

Throughout the neurotoxicology literature, cerebral hypoperfusion and neuropsychological impairment have been identified as common sequelae of chronic cocaine abuse. Nevertheless, the relationship between cognitive performance and hypoperfusion in this population has yet to be fully determined. In the current study, comparisons were made between SPECT neuroimaging results and neuropsychological assessment data for a group of chronic cocaine abusers and normal controls. A statistical parametric mapping (SPM) technique was employed and results demonstrated significant global hypoperfusion in SPECT neuroimaging data for cocaine abusers relative to controls. In addition to neuroimaging deficiencies, neuropsychological impairments were identified in cocaine abusers on factors of complex attention, verbal memory/fluency, graphomotor/executive functioning, and manual dexterity. For chronic cocaine abusers, however, direct comparisons between various global indices of cerebral perfusion severity and neuropsychological performance were nonsignificant. The current investigation suggests a general disparity between neuropsychological indicants of cerebral perfusion and measures of objective functional ability in this population. The clinical and theoretical implications of this discrepancy are discussed.

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CROSS-CULTURAL ISSUES AND TEST DEVELOPMENT

F.W. UNVERZAGT, K.S. HALL, P.O. AYOU, J.B. BALLIDAWA, E.O. OMOLLO, B.S. MUSICK, K.A. LANE, S. GAO, S.L. HUI, & H.C. HENDRIE. Clinical Utility of the CERAD Neuropsychological Battery in Elderly Kenyans.

Background: The prevalence of Alzheimer disease (AD) is lower in West Africans than in African Americans. Study of other African populations

will help to isolate the genetic and environmental factors that influence AD. We report data from a pilot study on the effectiveness of a cognitive test battery in detecting dementia in elderly East Africans. *Method:* 120 persons age 65 and older residing in the rural district of Vihiga, Kenya were tested with a Kiswahili adaptation of the CERAD neuropsychological battery (K-CERAD). Each participant was seen subsequently by a physician who took a history and conducted physical, neurological, and mental status examinations. Diagnosis of dementia was according to DSM-III-R without reference to K-CERAD scores. *Results:* 109 subjects were diagnosed as normal and 11 as demented. Demented patients were older and had less education than normals (both $ps < .05$) and scored significantly below normals on each test in the K-CERAD: Mini-Mental State Examination (MMSE) mean scores 11.6 vs. 23.8, respectively ($p < .01$); Animal Fluency 7.9 vs. 9.5 ($p = .05$); Boston Naming (maximum score = 24) 13.7 vs. 19.7 ($p < .05$); Stick Design (max = 12) 4.5 vs. 8.8 ($p < .01$); Word List Learning (max = 30) 8.4 vs. 13.7 ($p < .01$); Word List Delayed Recall 2.5 vs. 4.1 ($p < .01$); IU Tokens Test (max = 24) 7.9 vs. 16.8 ($p < .01$). Differences remain after ANCOVA controlling for age and education, on MMSE, Word List Learning, and IU Tokens Test (all $ps < .01$). *Conclusions:* The K-CERAD has utility in the differential diagnosis of normal aging and dementia among community-resident elders in Vihiga District, Western Province, Kenya.

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S. POMPÉIA, M.C. MIRANDA, & O.F.A. BUENO. Picture Naming by Adults: A Comparison of Norms From 5 Different Cultures.

We compared norms for a 26-item picture set obtained from published studies with North American, Japanese, Spanish, French and Brazilian university students samples. The same methodology was followed in the different studies. The variables used were familiarity with the concept, visual complexity of the drawings and name agreement measures as (1) the percentage of participants who attributed the most common named to each picture (modal name); (2) H index, which considers the number of all alternative names given to each picture; (3) percentage of "don't know name" (DKN) and "don't know object" (DKO) responses to naming. Scores were compared using Spearman correlations. Significant but modest ($r < .588$) correlations of percentage of name agreement between all cultures were obtained. Correlations for the H index were equally modest ($r < .481$) and significant except between the North American and other populations, suggesting that this picture set best reflects the culture of USA citizens. Correlations for DKN and DKO between cultures were in general also significant and low. Correlations for familiarity and complexity between all cultures were high and significant ($r = .547$ to $.907$ for familiarity; $r = .715$ to $.940$ for complexity). Low correlations between cultures for name agreement and high correlations for familiarity and complexity corroborate previous findings. No pattern of contrasts was observed between cultures for the different parameters investigated, indicating that familiarity, complexity and naming reflect different attributes of graphic stimuli that must be considered in cognitive studies employing pictures.

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M.C. MIRANDA, S. POMPÉIA, & O.F.A. BUENO. Picture Naming by Young Children: A Comparison of Norms From Different Cultures.

We compared norms for a 400-item picture set obtained from North American and Brazilian children in 2 different studies following the same methodology. Participants were 32 (16 boys) 5 to 7 year old Brazilian children native speakers of Portuguese, and 30 (16 boys) North Americans of the same age native English speakers. The variables used were familiarity with the concept, drawing visual complexity and name agreement (H index and %). Scores of both groups were compared using Spearman correlations and t tests for independent samples. Positive correlations were observed for all measures between cultures. They were particularly high for name agreement, visual complexity and number of "don't know name" (DKN) and "don't know object" (DKO) responses to naming. Naming measures

were equivalent for both groups. However, North American children rated pictures as less familiar and more complex and used shorter names than Brazilians, who rated more pictures as DKN and DKO. Both groups attributed names that did not correspond to the intended names to the same 61 pictures; 24 of these were exactly the same misnomers in both cultures (e.g., the cherry was considered an apple). The Brazilian children failed to name 73 pictures that the American ones named correctly. The North American children failed to name 24 pictures named correctly by the Brazilians. Results indicate important developmental and cultural characteristics that should be taken in account for selection of pictures to be used in cognitive studies.

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P. TOURADJI, J. MANLY, D. JACOBS, & Y. STERN. Acculturation, Literacy, and Working Memory Among African American Elders.

Previous studies have shown African American elders to obtain lower scores on various neuropsychological tests than White elders, even after controlling for demographic variables such as years of education. Nondemented African American elders with more traditional African American practices and beliefs obtain lower scores on both verbal and nonverbal tests. Reading level, a reflection of literacy, also accounts for differences in test scores between education-matched White and Black elders. The current study examined the effect of acculturation and quality of education on performance on a commonly used measure of working memory. Participants were 64 English-speaking elders, age 65 and older, randomly selected from an epidemiological study in northern Manhattan, who self-identified as non-Hispanic and Black. Participants were independently diagnosed by a physician as nondemented. WAIS-III Letter-Number Sequencing (LNS), WRAT-III Reading Recognition, and the African American Acculturation Scale were administered. Reading level was not a significant predictor of LNS performance after accounting for demographics (i.e., years of education, gender, and age). More traditional (less acculturated) African American participants obtained significantly lower scores on LNS after accounting for demographics and reading level. Results suggest that on this measure of working memory, cultural experience is a more salient predictor of performance than literacy. Future studies should examine whether acculturation also influences nonverbal measures of working memory. Also, future studies should examine whether a more extensive measure of educational experience would predict LNS performance among African American elders. Correspondence: *Jennifer Manly, G.H. Sergievsky Center, Columbia University, 630 West 168th St., P & S Box 16, New York, NY 10032.*

J. MANLY, D. JACOBS, P. TOURADJI, S. SMALL, & Y. STERN. Educational Setting and Cognitive Test Performance Among African American Elders.

African American elders have diverse educational experiences that affect performance on neuropsychological measures used to detect dementia. The current study examined the independent relationship between variables representing quality of education (reading level, school location and setting) and neuropsychological test performance. Participants were 207 African Americans age 65 and older that were randomly selected from an epidemiological study of aging and dementia in Northern Manhattan. Participants were independently rated as nondemented and free of neurological/psychiatric disease based on a physician's examination. A comprehensive neuropsychological battery and the WRAT-3 Reading Recognition subtest were administered. A detailed assessment of educational experience gathered data on location (North vs. South), setting (rural vs. urban) and racial breakdown (integrated vs. segregated) of elementary schooling. Multiple regression analyses revealed that after adjusting for age, years of education, and gender, school setting variables accounted for a significant and independent amount of variance on measures of language (naming, letter and category fluency) and figure matching ($p < .01$ for all). WRAT-III reading level accounted for a significant amount of variance over and above demographic and school variables on measures of word list learning, verbal abstraction, language (naming and letter fluency), and construction (drawing and figure matching). Results suggest that important

educational differences exist within African Americans that are not captured by years of education alone. African Americans educated in Northern, urban, integrated settings obtained higher scores on certain cognitive measures than those educated in Southern, rural, segregated settings, and these effects are not completely explained by reading level.

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A. VASKINN & K. SUNDET. Estimated Premorbid IQ: A Norwegian Version of the NART.

Measures of intelligence and word reading are highly correlated in normal individuals. Whereas IQ-measures often decrease following brain damage, reading is regarded a 'hold-function' more resistant to cognitive impairment. The National Adult Reading Test (NART) has been constructed to estimate premorbid IQ for English speaking persons. In countries where correct pronunciation to a lesser degree necessitates access to the semantic knowledge base but follow the phonological route, the method has been assumed less suited. In this study we report results from adopting NART into Norwegian. In Part 1 we investigate the psychometric properties of 73 nonorthophone words administered to 41 participants and scored by 4 raters. Based on measures of interrater reliability, degree of difficulty, and internal consistency, 50 words were chosen to comprise a preliminary Norwegian research version of the NART. In Part 2 we investigate the correspondence between NART and WAIS-R in 3 groups. Group 1 comprised clinical controls with no signs of cognitive dysfunction ($N = 30$), Group 2 patients with evidence of brain impairment ($N = 10$), and Group 3 those with schizophrenia ($N = 12$). Formulas for estimating verbal, performance and fullscale IQ from the NART score were derived by regression analyses within Group 1. When comparing WAIS-R scores with NART-based estimates, significant impairments were found for Groups 2 and 3. The results correspond to findings reported internationally. We conclude that the NART is a promising method for estimating premorbid IQ level also for Norwegian speaking individuals.

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M.K. CHOI, A. CHAN, L. LAM, & H. CHIU. Clinical Utilization of a Cantonese Version of the Dementia Rating Scale.

The present study aimed to study the clinical validity and applicability of the Cantonese version of the Dementia Rating Scale (CDRS) for the Chinese elderly in Hong Kong. The scale was found to have good reliability with internal consistency ranging from .7 to .9. Its significant correlation with the Chinese version of Mini-Mental Status Examination (total: $r = .848$, $p < .01$; subscales: r ranged from .594 to .859, $p < .01$) evidenced satisfactory construct validity. The discriminant validity of CDRS in differentiating Alzheimer's disease (AD) patients and normal control (NC) elderly was supported by the receiver operating characteristics analysis. All the scores provided significant information (area under curves significantly greater than 0.5) in distinguishing AD patients from NC elderly. Several cut-off points of the CDRS subscales and total scores were presented as references for application in situations with different clinical or research goals. The scores were adjusted with the age and educational level of the participants by the slopes of the regression lines in order to improve the discriminatory power and to control the effects of the two variables while interpreting the CDRS performances. The Initiation/Perseveration and Memory subscales were suggested to be an abbreviated version of the CDRS for quick screening with adequate classification rate (91.9% overall correct classification rate). Preliminary data also indicated an association between the impairment of the CDRS subscales performance and the severity of the dementia.

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J. MCGINLEY, K. BENOFF, & D. MASUR. Race and the Prevalence of Left-Handedness in Persons Entering Drug Treatment.

Estimates of the prevalence of left-handers in the general population have ranged from 6% to 16%, with a generally accepted average of 10%. Left

handedness has been correlated with an increased development of a variety of disorders (e.g., learning disabilities, immune disorders). In addition, an increased rate of left-handedness (18% to 39%) has been reported in persons who abuse substances. However, over 97% of the participants in those studies were White and less than 3% were minorities. In this study, a sample of 154 participants was selected from a residential drug treatment program between November 1999 and February 2000. Demographics included gender (39% female), race (59% Black, 32% Hispanic, and 9% White), age ($M = 36$ years), and drug of choice (46% crack, 30% heroin, 10% non-crack cocaine, 8% marijuana, 5% alcohol, 1% other). Handedness was noted with a single self-report item that has produced significant agreement with Oldfield's standard battery. Overall results showed 82.5% were right-handed, 13% left-handed, and 4.5% ambidextrous. Left-handed by race showed 10% of Blacks, 13% of Hispanics, and 36% of Whites, a significant finding by means of Pearson chi-square [$\chi^2(2) = 6.62$, $p < .05$]. The ambidextrous group was excluded for statistical purposes. On the basis of this study, it may well be that the overabundance of left-handers in previous studies of substance abuse may reflect an oversampling of White participants, relative to other racial groups, rather than a specific marker for the tendency to use substances.

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L. MORROW, L. STEIN, D. DALEY, F. CAMPBELL, D. SANDSTROM, & E. YENERALL. Neuropsychological Functioning in a Welfare-to-Work Sample.

Previous studies of Welfare to Work (WtW) have delineated elevated rates of substance abuse and psychiatric symptomatology. To what extent this affects neuropsychological functioning has not previously been studied formally. We assessed neuropsychological functioning in 30 WtW participants (98% female; 82% African American; 17% White; M age = 30.1, $SD = 6.23$; M education = 11.3; $SD = 1.1$). Participants completed subtests from the WMS-III, the WASI, Trail Making Test, WCST, and MCMI. Results demonstrated that when compared to published age based norms, 50% of the WtW group performed below the 25th %ile on verbal abstract reasoning, and 46% performed below the 25th %ile on working memory. On those tests with norms for age, gender, and education, a large number of WtW participants performed below the 16th %ile on Trails A (23%), Trails B (40%), and WCST perseverations (26%). WtW participants scored higher on the Schizoid ($p = .004$), Schizotypal ($p = .01$), Alcohol Dependence ($p = .03$), and Thought Disorders ($p = .03$) subscales of the MCMI compared to an aged matched control group. Moreover, 22% of the WtW individuals scored at or above the clinical cutoff for alcohol dependency. However, no significant correlations between the Alcohol Dependence subscale and neuropsychological tests were found. While the Thought Disorders subscale was significantly associated with letter number sequencing ($r = -.48$; $p = .03$), the Schizotypal subscale was related to Logical Memory II ($r = -.49$; $p = .01$) and Trails B ($r = .37$; $p = .05$). The implications for our findings raise important issues with respect to job training and placement in WtW programs. In addition, there is a paucity of demographically (age, gender, educational, and ethnicity based) based norms for this population which may hinder accurate neuropsychological and psychiatric interpretation in this under served population.

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M.S. KIM & J.S. KWON. The Cognitive and Cerebral Functions of Patients With Conduct Disorder.

The cognitive and cerebral functions of patients with conduct disorder were investigated with event-related potentials (ERP) and the neuropsychological test battery (STIM). The STIM includes such subtests as attention tests, spatial memory test and Wisconsin Card Sorting Test (WCST). The Korean version of WAIS (K-WAIS) was also administered to control the level of intelligence. ERP was measured at 32 electrode sites using oddball paradigm in which the low-frequency tone (1000 Hz) was served as a standard stimulus and the high-frequency tone as a target stimulus. The number

of subjects participated in the study were 36 with 18 for conduct group and 18 for control group. The results of STIM showed that conduct group showed significant lower hit-rate than control group in WCST [$F = 10.9325$, $p < .01$] but not in other tests. The amplitude and latency of P300 of ERP were analyzed separately with 3-way ANOVA, mixed design, repeated measures. The result of amplitude showed that there were main effects of group and electrode ($p < .01$). Both groups showed the largest amplitude at Pz and the smallest at Fz. But conduct group showed smaller amplitude at all electrode sites (particularly the amplitude elicited at Fz had negative potentials). For P300 latency, conduct group showed longer latency than control group at Fz. In conclusion, the lower hit rate of WCST, and the small amplitude (particularly the negative potentials) and the longer P300 latency at Fz indicate that patients with conduct disorder have impairments in problem-solving and utilizing feedback possibly due to the frontal dysfunction.

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MULTIPLE SCLEROSIS

L. DE SONNEVILLE, J. BORINGA, I. REULING, R. LAZERON, H. ADER, & C. POLMAN. Information Processing Characteristics in Subtypes of Multiple Sclerosis.

The purpose of this study was to evaluate information processing characteristics in patients with multiple sclerosis (MS). We selected 45 patients and 58 matched healthy controls. Using computerized tests we investigated focused, divided and sustained attention, and attempted to pinpoint deficits in attentional control to peripheral (encoding, response organization) and central (memory search, decision) processing stages. The results substantiate the hypothesis that cognitive slowing in MS is *general*, i.e., irrespective of type of cognitive process, with MS patients being 50% slower than controls. MS patients may suffer from focused, divided and sustained attention deficits. Central processing stages seem to be particularly compromised. Processing speed appears to be affected most in primary and secondary progressive MS *versus* relapsing-remitting MS. It is stressed that attentional tests and processing speed proved to be very sensitive and thus especially useful in detecting cognitive decline in MS patients. In contrast to most previous results, cognitive speed appeared to be robustly correlated with severity of MS as measured by the Expanded Disability Status Scale and with disease duration. Patients did not differ in accuracy of processing from controls, suggesting the importance of using time strategies in planning everyday life and job activities to compensate for, or alleviate MS-related speed handicaps.

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P. ARNETT, J. RANDOLPH, & P. FRESKE. Longitudinal Examination of Mood, Evaluative, and Vegetative Depressive Symptoms in MS. Point prevalence estimates of depression in multiple sclerosis (MS) patients are high, reaching 50% in some studies; however, little is known about the longitudinal course of depression in MS. In the present study, we examined 54 clinically definite MS patients at two time points three years apart on the Chicago Multiscale Depression Inventory. This measure of depression was designed for use in MS and other medical patient groups and has mood, evaluative, and vegetative subscales. Significant correlations from Time 1 to Time 2 were found for the mood ($r = .41$, $p < .005$), evaluative ($r = .71$, $p < .001$) and vegetative ($r = .71$, $p < .001$) subscales. Our results suggest that evaluative and vegetative symptoms of depression in MS are extraordinarily persistent over significant periods of time. Although mood symptoms also showed some stability over time, they displayed more variability than vegetative and evaluative symptoms. These findings underscore the importance of treating depressive symptoms in MS.

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P. ARNETT, J.J. RANDOLPH, & P. FRESKE. Longitudinal Examination of Depression and Speeded Attentional Functioning in MS.

Recent research has demonstrated that mood, but not vegetative, symptoms of depression are associated with impaired speeded attentional functioning in multiple sclerosis (MS) patients. Another cluster of depression symptoms, those involving negative self-evaluation, have been theorized to interfere with cognitive performance because they are thought to use up available task-relevant cognitive capacity; however, the relationship between these evaluative symptoms of depression and cognitive performance has not been assessed empirically in MS. In the current study, we examined 54 clinically definite MS patients at 2 time points 3 years apart on 3 speeded attentional tests (Visual Elevator subtest from the Test of Everyday Attention, Symbol Digit Modalities Test, and 3-Second PASAT) and a measure of depression with mood and evaluative subscales (Chicago Multiscale Depression Inventory). The evaluative subscale was significantly ($p < .05$) correlated with all 3 speeded attentional indices at Time 1 (r range = $-.36$ to $.46$) and Time 2 (r range = $-.39$ to $.47$). The mood subscale was significantly correlated with all 3 indices at Time 1 (r range = $-.33$ to $.40$) but none at Time 2. All correlations remained significant after age and education were partialled out first in regression equations. Our results suggest that evaluative symptoms of depression are most consistently associated with speeded attentional dysfunction in MS. If evaluative symptoms of depression cause cognitive difficulties in MS, altering these negative beliefs about the self may result in improved cognitive functioning and, consequently, improved quality of life for these patients.

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J.M. LAFOSSE, J.R. CORBOY, M.A. LEEHEY, F. McCULLEY, D. BOUHALL, C.L. CAREY, D.B. ENGLAND, & C.M. FILLEY. Neuropsychological Distinction Between Subcortical White and Gray Matter Dementia.

Although the distinction between cortical and subcortical dementia is useful from both a neuroanatomical and neuropsychological perspective, it does not adequately account for the fact that some subcortical pathologies affect primarily gray matter structures while others affect primarily white matter. Since gray matter and white matter are fundamentally different types of neural tissue, damage to one or the other would be expected to produce different neurobehavioral consequences. To test specific hypotheses about expected neuropsychological differences between dementia syndromes that primarily affect either subcortical white or gray matter, 14 patients with relapsing-remitting multiple sclerosis (MS), 6 patients with genetically confirmed Huntington's disease (HD), and 11 normal controls (NC) to date have been administered a battery of neuropsychological tests. The MS patients had either never been on immunomodulatory medications or taken them for less than 1 year, and all 3 groups were matched on years of education. Results of a repeated-measures ANOVA indicate that the HD patients performed significantly worse, relative to the MS patients, on a rotary-pursuit skill learning task. Moreover, the MS group performed comparably to the NC group. No significant differences were found between the two patient groups on mirror tracing. In addition, the MS group scored significantly higher than the HD group on the PASAT, Symbol Digit Modalities Test, and Self-Ordered Pointing Test. These findings on measures of procedural memory, sustained attention, and working memory are discussed in terms of a neuroanatomically based model for distinguishing between subcortical white and gray matter dementia.

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D.B. ENGLAND, J.M. LAFOSSE, J.R. CORBOY, C.M. FILLEY, D. BOUHALL, E. McCULLEY, & C.L. CAREY. The Impact of Neuropsychological and Psychiatric Symptoms in MS on Caregiving Spouses. Neuropsychological and psychiatric impairments in individuals with MS have been empirically documented. However, their impact on spousal caregivers has not been well researched. This ongoing study examined the impact of neuropsychological and psychiatric symptoms on spousal strain.

Fourteen married relapsing-remitting MS patients who had never been on immunomodulatory medications or taken them for less than one year were administered a neuropsychological test battery including the CVLT, PASAT, COWAT, and SDMT. Spouses were administered the Neuropsychiatric Interview (NPI) regarding the patient's psychiatric symptoms, as well as the Caregiver Strain Index (CSI) and other measures of coping. Regression analyses demonstrated that the NPI accounted for 66% of the variance in the CSI scores. Long-delay free recall of the CVLT increased the variance explained to 69%. The remaining neuropsychological variables did not explain any additional variance. A *post-hoc* analysis of the 10 psychiatric domains assessed by the NPI found that anxiety, depression, and sleep disturbance contributed the most to the total NPI score. These results suggest that in spite of the neuropsychological deficits present in MS patients, psychiatric symptoms account for a greater proportion of strain in their spouses. These findings will be discussed in terms of their implications for more effectively meeting the varied needs of MS patients and their spouses.

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L. JULIAN & P. ARNETT. Connections Between Anxiety, Depression and Cognitive Dysfunction in Multiple Sclerosis Patients.

Cognitive dysfunction, anxiety, and depression are prevalent in multiple sclerosis (MS) patients. Recent studies have suggested that depression may be an important contributor to cognitive dysfunction in MS. Although anxiety is also known to compromise cognitive functioning, the relationship between anxiety and cognitive functioning has not been examined in MS. Furthermore, the possible independent contributions of anxiety and depression to cognitive dysfunction in MS have not been investigated. This study was designed to explore these issues in a sample of 73 MS patients. Anxiety was measured by the STAI-State anxiety scale and depression by the Multiscale Depression Inventory Mood subscale. One neuropsychological test composite assessed speeded attentional/executive functioning and was comprised of the Visual Elevator subtest of the Test of Everyday Attention, the Paced Auditory Serial Attention Test, the Symbol Digit Modalities Test, and a reading span task. The second neuropsychological composite involved planning/executive skill and was comprised of two indices from the Tower of London (TOL) test. Increased anxiety was significantly associated with decreased speeded attentional/executive skill ($r = -.39, p < .001$) and executive/planning ability ($r = .33, p < .005$ —higher scores on the TOL composite reflect poorer performance). Hierarchical regression analyses revealed that depression accounted for 8.1% ($p < .01$) of the variance and anxiety an additional 13.8% ($p < .02$) in the speeded attentional/executive composite. On the planning/executive component, depression accounted for 12.1% ($p < .006$) of the variance, whereas anxiety did not significantly predict the planning/executive component above and beyond depression. These findings have implications for MS regarding theories of cognitive impairment, clinical assessment, and psychotherapeutic intervention.

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L. SWOROWSKI, D. DENNEY, & S. LYNCH. Initial Planning Time in Patients With 3 Different Subtypes of MS.

The demyelination process involved in MS results in multifocal lesions, and the distribution of these lesions appears to differ across subtypes of MS. Compared to patients with relapsing-remitting or secondary progressive MS, those with the primary progressive form of this disease tend to have more spinal lesions relative to cerebral lesions. Differences in lesion pattern may be related to differences in cognitive deficits among patients with MS. This study was designed to examine possible cognitive deficits among patients with PPMS, SPMS, RRMS, and patients with rheumatoid arthritis (RA) who served as medical controls. We studied attention, memory, and spatial planning in 20 PPMS, 23 SPMS, 20 RRMS, and 20 RA patients. Groups were well matched on estimated premorbid IQ, education, gender, medications with potential cognitive side effects, and depres-

sion. Groups differed on age, fatigue, length of diagnosis, and physical disability, and these variables were statistically controlled. We found that groups differed on initial planning time (*time taken to plan the first move on each problem*) on the Tower of London text ($p < .016$), but did not differ on planning accuracy ($p = .50$) nor on the attention or memory tests in our battery. Patients with SPMS took significantly more time to plan TOL solutions than RA participants ($p = .007$). The RRMS group also had slower planning times compared to the RA group, and this difference approached significance ($p = .012$) after adjusting for multiple comparisons. These data suggest that cognitive slowing may be related to type of MS and possibly to lesion location.

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L.B. KRUPP, L.E. ELKINS, L.B. STROBER, W. SCHERL, & C. CIANCIULLI. Explicit and Implicit Verbal Memory in Multiple Sclerosis: Implications for Treatment.

Memory is the most common area of cognitive impairment in multiple sclerosis (MS). Memory deficits are typically attributed to lesion location and global reduction in information processing, and options for intervention have been limited. However, recent evidence has suggested that MS may also include specific decreases in cholinergic activity not explained by structural findings. Cholinergic function has been associated with effortful or conscious learning mediated by the hippocampus, and can be dissociated from automatic or implicit learning. We hypothesized that MS participants would have impairment on an explicit *versus* implicit verbal learning task. Thirteen participants with mild MS (EDSS scores from 0–6) and 17 healthy control participants completed the Selective Reminding Test (SRT, 6-item version) and a word stem completion task as part of a larger testing battery. (Participants were matched according to age, years of education and reading level measured by the WRAT–3.) As predicted, the MS participants compared to the controls were impaired on the SRT ($M = 40.9 \pm 7.4$ and $M = 52.3 \pm 8.6; p = .001$), but not word stem completion (total correct completions, $M = 5.2 \pm 2.6$ and $M = 5.0 \pm 2.2; p = .79$). These findings support that MS-related memory deficits may also be due to cholinergic depletion, with currently available acetylcholinesterase inhibitors representing a promising treatment option.

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J.J. RANDOLPH, P.A. ARNETT, & P. FRESKE. Metamemory in Multiple Sclerosis: Relationship to Depression, Depressive Attitudes, and Executive Functioning.

Metamemory, or one's self-reported memory ability, has been researched extensively; however, few studies have examined it in multiple sclerosis (MS). Although depression and executive functioning impairment have been associated with metamemory reports in previous research, no study has examined various contributors to metamemory collectively in an MS patient sample, and no previous study has examined the role of depressive beliefs or attitudes on metamemory with any neurological patient group. The present study was designed to test the possibility that depression, depressive attitudes, and executive functioning impairment all impact metamemory reports in MS. Forty-eight MS patients completed the Memory Functioning Questionnaire and were administered measures assessing depression, depressive attitudes, and executive functioning. We tested a model of metamemory in MS using structural equation modeling; this analysis revealed that greater executive dysfunction and depression were associated with increased self-reported memory complaints, but only via the mediating influence of depressive attitudes. For this tested model, three fit indices (chi-square, comparative fit index, and incremental fit index) revealed good model fit, with all variable paths being significant ($p < .05$). Although our results suggest some objective basis for metamemory complaints in MS (i.e., executive dysfunction), they also suggest that these complaints may be exacerbated by the potentially reversible influences of depression and depressive attitudes. In general, these findings suggest that

treatment of depression and depressive attitudes in MS may result in MS patients having more accurate perceptions of their actual memory abilities which, in turn, may lead to improvements in their quality of life.

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L.S. WALKER, L. DELLA MALVA, M. FREEDMAN, A. TELLIER, & B. COLLINS. Neuroradiological Correlates of Neuropsychological Functioning in Early Phase Relapsing–Remitting Multiple Sclerosis. The correlation between the pathological changes of multiple sclerosis and the subcortical dementia profile was investigated. The relationship of demyelination (as detected by T2-weighted and gadolinium-enhanced T1-weighted MRI imaging), to cognitive deterioration (as detected by neuropsychological assessment), was examined. Twelve individuals with early-stage relapsing-remitting MS underwent serial imaging and neuropsychological assessment at both baseline and 6-month follow-up. Results

revealed mild deterioration in functioning with respect to all four aspects of the subcortical dementia profile (i.e., attention and information processing speed, memory, executive functioning, and affective disturbance). Pathology was found to correlate with cognitive functioning. Specifically, total lesion load was positively correlated with the degree of cognitive impairment in the areas of attention and executive functioning at baseline and follow-up, and in memory at baseline. Total lesion load was not significantly related to affective disturbance. No significant changes took place over time with respect to pathology, attention, memory, or affect. However, executive functioning improved to a mild degree. The significant relationship between pathology and cognitive dysfunction are discussed in the context of the subcortical dementia profile. The notion of clinically-silent lesions in multiple sclerosis is brought into question. It is recommended that neuropsychological assessment become a standard outcome measurement technique in future clinical trials for MS.

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FRIDAY AFTERNOON, FEBRUARY 16, 2001

Paper Session 6/1:30–3:15 p.m.

LANGUAGE

B. CROSSON, H. BENEFIELD, A. CATO, J. SADEK, K. GOPI-NATH, D. SOLTYSIK, R. BAUER, E. AUERBACH, D. GÖKÇAY, & R. BRIGGS. Subcortical Activity During Word and Syllable Generation: An fMRI Study.

Twenty-one right-handed native English speakers (12 M, 9 F; age 18–38 yrs) performed 4 language generation tasks during fMRI: (1) generation of nonsense syllables, (2) generation of words rhyming with a cue word, (3) generation of words from a category, matched to the generation rate of nonsense syllables, and (4) generation of words from a category, matched to the generation rate for rhyming words. Each task was compared to a resting control state. As previously reported, medial frontal activity during syllable generation was confined to the left hemisphere and was located primarily in SMA. Medial frontal activity for the word generation tasks was located in both hemispheres (left > right), and was located primarily in pre-SMA. Current analyses focus on activity in the basal ganglia and thalamus. For generation of nonsense syllables, basal ganglia activity was located in the left putamen, with no thalamic activity. For generation of rhyming words, activity was located in the left caudate nucleus, the right putamen, the right caudate nucleus, and the left ventral anterior thalamus. For generation of category members, activity was located in the left caudate nucleus, the right caudate nucleus, the right putamen, and the left ventral anterior thalamus. Thus, concerning laterality, there is good correspondence between basal ganglia and medial frontal activity. For syllable generation, left medial frontal and basal ganglia structures that were activated are known to be primarily motoric in nature. For word generation (rhyme or category), activated left medial frontal and subcortical structures are known to subservise cognition.

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B. BELL, B.P. HERMANN, M. SEIDENBERG, K. DAVIES, A. WOOD-ARD, D. CARISKI, J. ROSENBEK, & M. BISHOP. Early Onset Left TLE and Intrahemispheric Reorganization of Language.

Decline in confrontation naming ability occurs in a minority of temporal lobe epilepsy (TLE) patients following left (dominant hemisphere) anterior temporal lobectomy (ATL). Patients with late onset of seizures are most vulnerable to such decline. In addition, object names typically learned later in life are the words most likely to be lost after ATL. This study in-

vestigated why early onset left TLE patients with left hemisphere language dominance, as determined by Wada test, are at lower risk for postoperative dysnomia. Boston Naming Test (BNT) performance was examined pre- and post-ATL as a function of age of onset group (<12 years old, >12 years old) and age of acquisition category (<7, 7–11, >11 years old). Early onset left TLE patients ($n = 31$) showed significantly less postoperative decline in naming ability compared to late onset patients ($n = 34$), even though the 2 groups performed almost identically in each of the 3 BNT age of acquisition categories preoperatively. Thus, the more stable pre- to postoperative BNT performance exhibited by early onset patients cannot be attributed to impaired preoperative learning of the words shown to be most vulnerable to postoperative decline (i.e., late age of acquisition words). Their pre- to postoperative stability in object naming suggests that early onset left TLE patients experience intrahemispheric reorganization of language function early in life and this reorganization provides protective benefit to confrontation naming ability after standard ATL.

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A.B. MOORE, C. LOFTIS, B. CROSSON, D. GÖKÇAY, C.M. LEON-ARD, & A.L. FOUNDAS. Localization of Functional Activity in Pars Triangularis.

Broca's area, typically defined as pars triangularis (BA 45) and pars opercularis (BA 44), has long been implicated in neural mechanisms of language production. Variability in the anatomical boundaries of these areas has led to challenges in reliable localization of functional activity. Furthermore, the role of pars triangularis (Ptr) versus pars opercularis (POP) has not been detailed. Thus, the purpose of this study was to address these challenges to functional localization and to begin to examine the role of Ptr in a task of language production. We have previously presented guidelines whereby Ptr may be reliably delineated from surrounding structures. Using these rules, Ptr and the diagonal sulcus (DS), traditionally considered part of POP, were traced in consecutive sagittal sections with a user-interface localization tool, LOFA (localization of functional MRI activity). Using LOFA, the Ptr and DS (when present) were traced and thickened to encompass sulcal boundaries. Two operators traced a subset of the images with an inter-rater reliability of .99. Continuous clusters of activity, defined by time-series correlations of .50 or greater, and a total volume of 25 μ l or greater, were identified within defined sulcal boundaries. Comparisons of sulcal activation in Ptr were made between participants with and without a DS. Results indicate that presence of a DS is associated with greater activation in Ptr. This finding not only highlights the complexities of the anatomy and function of Broca's Area, but also suggests that dy-

namic imaging studies of language production in Broca's Area must consider the DS as this structure appears to be related to activity in PTR.

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M. TETTAMANTI, A. MORO, D. WENIGER, L. MENONCELLO, H. ALKADHI, G. CRELIER, P. SCIFO, S.F. CAPPÀ, D. PERANI, S. KOLLIAS, & F. FAZIO. Neural Correlates of Learning New Grammatical Rules: A fMRI Study.

Learning the grammar of a 2nd language may require either a language-specific competence or unspecific strategies to extract regularities from sensorial input. These two positions receive particular relevance in adulthood, since plasticity may be lost beyond a critical period. Aim of this study was to investigate the neurophysiological correlates of encoding and retrieving new syntactic rules. *Methods:* The encoding of new syntactic rules was examined by three silent reading conditions: *baseline* (sentences following L1-grammar), *linguistic* (sentences with new rules of a linguistic nature), *non-linguistic* (sentences with new rules of a nonlinguistic nature). The retrieval of the rules encoded was then examined under three detection conditions: *baseline* (violations of L1-grammar), *linguistic* (violations of the linguistic rules), *nonlinguistic* (violations of the nonlinguistic rules). 1.5 T fMRI scans were acquired according to standardized protocols, behavioral data collected by button press. *Participants:* 5 right-handed healthy volunteers. Data were analyzed with SPM99. *Results:* Common activations for both types of new rules included the anterior cingulate gyrus (BA32) during encoding and retrieval and right-hemispheric areas (BA44,46,40) during encoding only. Left-hemispheric frontal and parietal regions were instead activated only during encoding and retrieving new linguistic rules: Broca's area (BA44), BA46 and BA40. Bilateral activations of prefrontal regions (BA9,10), anterior middle temporal (BA21) and medial cingulate gyrus (BA24) were observed in retrieving non-linguistic rules only. *Conclusions:* The study shows a dissociation in the brain regions involved when encoding and retrieving new linguistic vs. nonlinguistic rules. The fact that Broca's area was only found during the linguistic task demonstrates its modulating impact in learning grammatical features. Correspondence: Marco Tettamanti, Istituto Scientifico San Raffaele, Reparto di Medicina Nucleare, Via Olgettina 60, I-20132 Milan, Italy.

P. BEESON, S. RAPCSAK, A. RAMAGE, J. CHARGUALAF, & T. TROUARD. The Neural Substrates for Writing: A Functional Neuroimaging Study.

Functional magnetic resonance imaging (fMRI) was used to examine regional brain activity during writing tasks. Eight neurologically normal, right-handed subjects were studied using several contrasting tasks including (1) generative writing of words *versus* drawing circles, (2) generative writing of words by semantic category *versus* silent generative naming, and (3) writing words to dictation *versus* writing nonwords to dictation. Activation was examined for writing with the dominant right hand, as well as the nondominant left hand. When writing words was contrasted with circle drawing so that coactivation for nonlinguistic motor control was removed, left hemisphere activation was greater than right in all subjects regardless of the hand used for writing. Given that this protocol appeared to reveal linguistic as well as motor aspects of writing, regional activation was examined using task contrasts intended to isolate brain activation associated with semantic, orthographic, phonological, and motor components of the writing system. Lexical-semantic processes (i.e., retrieval of orthographic representations in response to semantic codes) appeared to be associated with activation in left extrastriate regions including inferior/middle temporal and inferior parietal lobes. Phonological mediation necessary for spelling nonwords compared to real words resulted in perisylvian activation in inferior frontal and superior temporal lobes. Activation associated with graphomotor planning and implementation was in regions surrounding the intraparietal sulcus, supplementary motor area, premotor, and motor areas. In summary, these data show relatively good concurrence with presumed neural substrates for writing that have been postulated on the basis of lesion data.

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Paper Session 7/1:30–3:15 p.m.

EMOTION

C. CIMINO & T. BORGATTI. Priming and Recall of Affective Information.

Neuropsychological investigations of the influence of emotional salience on the perception and recall of verbal information are few and those reported have provided somewhat inconsistent findings. The present study investigated these variables utilizing an affective priming task in which valence and arousal characteristics of target items were systematically manipulated using empirically derived norms. The possible confounding effects of semantic priming were also minimized by control of the associative relationship among prime-target pairs. Sixty-two individuals participated in a 2×4 within-subjects factorial design in which 4 prime-target pair conditions (i.e., neutral-positive, positive-positive, neutral-negative, negative-negative) were presented to the LVF or RVF. Results revealed a significant cross-over interaction in which neutral-positive and positive-positive prime-target pairs were identified more quickly in the RVF (LH) and neutral-negative, negative-negative pairs were identified more quickly in the LVF (RH). Analysis of free recall and recognition performance revealed no significant interaction of valence with visual field. Interestingly, however, when incongruent (incorrect) target responses were removed from analysis, a highly significant interaction of Valence and VF emerged with significantly more positive words recognized in RVF (LH) and significantly more negative words recognized in the LVF (RH). Furthermore, an analysis of error types also revealed that significantly more positive target words were judged to be negative in the RH and more negative words were judged to be positive in the LH. These findings provide strong support for predictions from the valence model and extend this work into the domains of priming and memory for affective information.

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W.D.S. KILLGORE, G. KANAYAMA, & D.A. YURGELUN-TODD. Sex Differences in Functional Activation of the Amygdala During the Perception of Happy Faces.

Functional neuroimaging studies have demonstrated increased activity within the amygdala during the perception of negatively valenced affective stimuli such as fearful faces, with most studies finding greater activation within the left amygdala. In contrast, few studies have examined amygdala activation in response to happy faces, and there has been inconsistency in the laterality of findings across studies. Given prior neuropsychological evidence suggesting that there are sex differences in the cerebral lateralization of higher cognitive functions as well as for emotional responsiveness, we hypothesized that the inconsistency of lateralized amygdala activation across studies may be accounted for by sex differences in the organization of neural systems specialized for emotional processing. We used functional magnetic resonance imaging (fMRI) to test for sex differences in amygdala activation in response to visually presented happy faces. Eight healthy participants (4 males; 4 females) underwent blood-oxygen-level-dependent (BOLD) fMRI while viewing monochromatic photographs of happy faces. When normalized signal intensity changes were analyzed, males showed greater right than left amygdala activation in response to the happy faces, whereas females showed a nonsignificant trend in the opposite direction. Our data suggest that previous findings of greater lateralization of higher cortical functions in males may also extend to subcortical limbic structures involved in affective processing. There appear to be fundamental differences between males and females in the manner in which affect is processed within the limbic system.

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D. BOWERS, R. GILMORE, D. GÖKÇAY, S. ROPER, M. ROGISH, & S. KORTENKAMP. Laterality Effects in Verbal–Emotion Modulation of Startle After Temporal Lobectomy.

Rationale: In humans, startle eyeblinks are larger during negative emotional states such as fear and anxiety. This enhancement presumably reflects the amygdala's dual role in detecting danger and modulating subcortical startle circuitry. We previously reported that right, but not left, temporal resection involving the amygdala disrupted aversion-enhanced startle during picture viewing. In the present study, we wished to learn whether this disruption was modality specific or whether a similar defect would occur when verbal-contextual stimuli were used to induce motivational states. **Methods:** Twelve controls and 22 patients with unilateral anterior temporal lobectomy (ATL) listened via headphones to standard sets of emotional sentences spoken in neutral prosody. Emotion was conveyed solely by semantic content (e.g., As you swim, the sharks begin to circle). Following each sentence, white noise bursts (95 db) were binaurally presented to elicit startle eyeblinks. Sentence ratings of valence and arousal were obtained. The 2 ATL groups (12 right, 10 left) were left language dominant and matched for seizure onset, and duration. **Results:** Controls and the left ATL group had greater startle reactivity after listening to sentences that conveyed fear vs other emotions. The right ATL group did not show aversion-enhanced startle. This mismodulation was not due to mood, medication, or failure to understand emotional meaning of the sentences. **Conclusions:** We propose that the right anterior temporal region plays a unique and non-modality-specific role in translating results of cognitive appraisal of sensory–emotional stimuli, either verbal or visual, into somatomotor changes that are associated with an aversive motivational state. **Correspondence:** Dawn Bowers, Department of Clinical & Health Psychology and University of Florida Brain Institute, P.O. Box 100165, Gainesville, FL 32610.

C. McDONALD, S. KORTENKAMP, & D. BOWERS. The Role of the Retrosplenial Region in Emotion Processing: An Ablation Approach.

Background: The retrosplenial region is a paralimbic area, beneath the splenium, that receives input from the hippocampus and projects to the anterior thalamus and frontal lobes via the cingulum. Recent functional neuroimaging studies (PET, fMRI) have suggested that the retrosplenial area may play an important role in evaluating emotional stimuli. Although discrete lesions of the retrosplenial region induce profound amnesia, no human data currently exist concerning the impact of retrosplenial damage on emotional processing. **Methods:** In this study, we examined a 48-year-old left-handed college educated man (VIQ = 148) who became amnesic following removal of an AVM in the left retrosplenial region. Experimental measures of emotion processing included (1) psychophysiological reactivity (SCR, startle response) to aversive, neutral, and pleasant pictures; (2) appraisal of nonverbal (prosody, facial expressions) and verbal emotional stimuli (words, sentences); and (3) recall of autobiographical emotional memories. Responses were compared to age-matched controls ($N = 12$). **Results:** Physiologic reactivity to emotional stimuli did not differ from controls as reflected by: normal aversion-potentiated startle responses and increased arousal (SCR) to emotional stimuli. Similarly, appraisal and communication of prosody and facial expressions were WNL, as was understanding of emotional sentences and words. Recall of emotional autobiographical memories appeared intact. **Conclusion:** The retrosplenial region does not appear to be an essential part of neural networks that subserve emotional processing; nor does it appear essential in the interaction between emotion and memory. Interpretative discrepancies between “lesion” and functional neuroimaging approaches will be discussed. **Correspondence:** Carrie McDonald, Box 100165, Health Science Center, University of Florida, Gainesville, FL 32610-0165.

A. KASZNAK, L. NIELSEN, S. RAPCSAK, & B. DAVID. Emotion Experience and Physiology Following Frontal Versus Temporal Lobe Damage.

Skin conductance response (SCR), facial (bilateral zygomatic and corrugator) surface electromyography (EMG), and subjective ratings of experienced emotional valence and arousal were recorded during the viewing

of emotionally salient scores (International Affect Picture Series slides) in 12 patients with focal frontal lobe damage, 7 patients with focal temporal lobe damage, and 47 age- and education-matched healthy controls. Both patient groups did not significantly differ (group by slide type ANOVAs) from controls in their subjective valence and arousal experience ratings, or in their facial EMG response (greater bilateral zygomatic EMG change when viewing pleasant scenes, and greater bilateral corrugator EMG change when viewing unpleasant scenes). However, both patient groups showed smaller ($p = .05$) raw SCRs overall, and there was a significant ($p = .05$) group by slide type interaction for standardized SCRs during slide viewing. In comparison to the normal response of controls (larger SCRs when viewing unpleasant or pleasant, compared to neutral slides), frontal damage patients showed a lack of SCR differentiation across the three slide types. Examination of lesion location among the frontal damage group suggests that it is primarily ventromedial damage that accounts for this effect. Temporal damage patients showed a selective decrease (compared to controls) of SCRs to the unpleasant scenes. Results are consistent with the interpretation that focal frontal (particularly ventromedial) damage can disrupt autonomic emotional response while leaving facial expression and self-reported experience intact. In contrast, focal temporal damage appears capable of selectively disrupting autonomic response to unpleasant stimuli while leaving autonomic response to pleasant stimuli and facial expression intact.

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Poster Session 6/1:30–3:15 p.m.

CHILD COGNITION

A. YAMAMOTO. Prediction of CVLT–C Total Recall Performance From Other Neuropsychological Measures.

Total recall (List A free recall for Trials 1–5) is the most commonly used learning index of the California Verbal Learning Test–Children's Version (CVLT–C). The purpose of this study was to investigate which neuropsychological measures uniquely predict CVLT–C total recall performance in 151 children (aged 9–16) with known or suspected central processing difficulties. Five independent variables were selected from different neuropsychological domains: intelligence (Wechsler Intelligence Scale for Children–III, Verbal IQ), language (verbal fluency), attention and psychomotor speed (Trail Making Test, Part A; Trails A), tactile–spatial memory (Tactual Performance Test, memory for block shape; TPT–M), and mathematical calculation (Wechsler Individual Achievement Test, Numerical Operations subtest). Each of these variables were significantly correlated with CVLT–C total recall ($r = .26$ to $.41$; $p < .001$). A standard multiple regression was used to predict CVLT–C total recall from the 5 independent variables. Age effects were controlled by entering age into the regression equation in the first block, before the other variables were entered. Only TPT–M ($sr^2 = .06$), Trails A ($sr^2 = .04$), and verbal fluency ($sr^2 = .02$) contributed unique variance that significantly predicted CVLT–C total recall. Together, all of the predictor variables accounted for approximately 33% of CVLT–C total recall variability. Overall, these results suggest that verbal fluency (i.e., production of words to command), attention/speed of processing, and memory all play distinct but important roles in CVLT–C total recall performance.

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S. MAJERUS & M. VAN DER LINDEN. The Development of Long-Term Memory Influences on Verbal Short-Term Memory.

This study investigated the influence of semantic, lexical and phonotactic knowledge on the development of verbal short-term memory (STM). Ninety healthy participants from 5 age groups (6, 8, 10, 13–16, and 20–22 years) realized immediate serial recall (ISR) tasks for (1) high and low imageability word lists matched for frequency and syllable length, (2) high and low frequency word lists matched for syllable length and imageability,

(3) unisyllabic CVC word and nonword lists, matched for phonotactic frequency, and (4) a unisyllabic CVC nonword list with significantly lower phonotactic frequencies. Forty-six participants received Lists 1 and 2, and 44 received Lists 3 and 4. All lists were of increasing length (1–7 items). For nonwords, rate of articulation was measured. ISR was better for high *versus* low frequency lists [$F(1,41) = 122.41, p < .0001$], for high *versus* low imageability lists [$F(1,41) = 12.22, p < .01$], for words *versus* nonwords [$F(1,39) = 261.97, p < .0001$], and for nonwords with high *versus* low phonotactic frequencies [$F(1,39) = 51.28, p < .0001$]; only items recalled in correct serial position were scored. The effect of age was significant for each list type. Most interestingly, planned comparisons showed that the effect of list type remained significant in each age group, except for the imageability lists where only 1 contrast was significant. An ANCOVA showed that the effect of phonotactic frequency was still significant after control of rate of articulation. Thus, long-term knowledge seems to support STM equally during early and later development, possibly through reintegration processes that could represent a basic property of STM. Correspondence: *Steve Majerus, Neuropsychology Unit, University of Liège, Boulevard du Rectorat, 3 (B33), Liège 4000, Belgium.*

K. ESPY, M. McDIARMID, & M. GLISKY. A Continuous Recognition Memory Test for Preschool Children.

Continuous recognition memory tests have been useful to elucidate memory impairment in a number of adult and childhood clinical populations. Because many clinical conditions manifest prior to school age and there is a paucity of memory measures available for use with young children, a continuous recognition memory test was developed specifically for use in children under 6 years (CRM-Pre). The CRM-Pre included both verbal (animals) and nonverbal (spacemen) stimuli to be sensitive to potential lateralization differences. In addition, the test stimuli repeated at fixed intervals to assess qualitative performance differences. The CRM-Pre was administered to 49 preschool children ($n = 17$ 3-year-old; $n = 15$ 4-year-old; $n = 17$ 5-year-old). Performance differed across age groups [$F(4,90) = 7.00, p < .0001$]. The number of correct stimuli increased with age group [$F(2,46) = 13.26, p < .0001$], whereas the number of false alarms decreased with age group [$F(2,46) = 3.61, p < .05$]. The largest performance differences were between 3- and 4-year-old children. Younger children correctly identified fewer nonverbal stimuli [$F(2,46) = 3.61, p < .05$]. All children marginally identified fewer correct stimuli at longer retention intervals, regardless of age. These results indicate that the CRM-Pre is sensitive to both developmental and individual differences. The CRM-Pre may be useful to detect different patterns of memory impairment in clinical populations under the age of 6 years.

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K. ESPY & P. KAUFMANN. Clinical and Developmental Views of Executive Functions in Young Children.

Many clinical neuropsychologists consider tower-type tasks to be prototypic tests of frontal lobe function, requiring planning, judgment, problem-solving, and integration of multiple sources of information. Developmental cognitive neuroscientists, alternatively, have emphasized working memory and inhibition as key frontal lobe functions, whereas poor set shifting, a behavioral marker of frontal lobe disturbance, is a byproduct of these two executive subcomponents. The purpose of this study was to determine the relation among these executive function processes. Executive function tasks assessing working memory (A-not-B, Delayed Alternation), inhibition (Self-Control, Shape School Inhibit condition), set shifting (Color Reversal, Spatial Reversal) and planning (Tower of Hanoi) were administered to 68 preschool children (30 to 66 months of age). Working memory accounted for significant variability in Tower of Hanoi performance [$R^2 = 17\%$; $F(2,57) = 5.72, p < .01$]. When added to the model, inhibition also accounted for significant variability in TOH performance [$R^2\Delta = 23\%$; $F(2,54) = 9.14, p < .001$], however, set shifting did not ($R^2\Delta = 1\%$). In contrast to results from studies with adults, molar executive function processes, such as planning and problem solving independently were related

to both primary working memory and inhibition skills in preschool children. Set shifting, however, was not important in determining such molar skills in this age range. These findings are consistent with theoretical models of executive function that include limited or competitive working memory and inhibition resources. Set shifting may be a unique skill in normally developing preschool children that is not required to solve such molar tasks. These differences may be related to anatomical differences in prefrontal organization.

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P. CIRINO, T. FLYNN, M. MAHONE, M. VERDA, K. HAGELTHORN, J. HIEMENZ, D. SWANN, & K. ANSTENDIG. What IQ Does (or Doesn't) Tell Us About Verbal Learning and Memory in Children.

IQ and memory share a moderate correlation, generally stronger for total recall than learning/process variables. Presumptions about learning and recall may not be valid when based on knowledge of IQ alone, even when comparing groups formed on the basis of sizeable FSIQ difference. We examined the relationship between IQ and learning/memory in a mixed, urban, clinical sample ($N = 92$; M age = 11.0) using the WISC-III and CVLT-C. On the basis of FSIQ *avg* (FSIQ $\geq 90, M = 104.7$) and *low* (FSIQ $< 90, M = 75.6$) IQ groups were formed and compared along CVLT-C indices among other measures. Attention Span (ListATr1) was comparable between groups; however, differences in terms of Learning Efficiency (ListATr5) were identified and most evident at the extremes ($\pm 1.5 SD$). Relative to the *avg* group, the *low* group had more poor performances (30% *vs.* 9%) and fewer superior performances (4% *vs.* 24%), but a comparable portion scoring in the broad average range (66% *vs.* 67%). Similar results were found for other learning/recall measures (Free and Delayed Cued Recall, Total Recall, Learning Slope) with the exception of Inaccurate Recall (FalsePos errors) which was impaired in a minority of subjects mostly from the *low* group. Results highlight the multifactorial nature of learning and memory and importance of direct assessment even among children at lower levels of functioning. Recognizing the potential for average learning efficiency and recall in a child with a low IQ may highlight instructional opportunities and approaches for families and educators.

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A. GARCIA, D. FEIN, & A. CILLESSEN. The Relation Between Source Memory and Other Executive Functions in Children.

Source memory involves recollection of the source from which a specific item or fact was acquired. Source memory has been thought to require strategic retrieval processes and reasoning, functions which are similar to the executive processes mediated by the frontal lobes. The goal of the present study was to examine the relationship between source memory and frontal lobe functioning in a sample of 111 normally developing children aged 5 to 12 years. The participants were administered a newly developed measure of source recognition and the NEPSY Tower subtest which is thought to be sensitive to executive functions such as planning and problem solving. Source memory recognition correlated significantly with raw scores on the Tower subtest ($r = .35, p < .001$). When controlling for age, this relationship disappeared as a result of the high correlations of age with both measures. There was, however, a significant relationship between source memory and Full Scale IQ as measured by the WPPSI-R or WISC-III ($r = .20, p < .04$) when controlling for age. Specifically, the raw score of the vocabulary subtest correlated significantly with source memory ($r = .29, p < .003$). These findings support a relationship between source memory and other executive functions, but not independent of age. They do, however, demonstrate that source memory is related to intelligence independent of age, suggesting that source memory is valid as a cognitive measure. These findings also indicate that there is no simple underlying factor that underlies multiple executive tasks, including measures of planning and source memory.

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N. WILDE & K.A. KERNS. Time-Based and Event-Based Prospective Memory in Children.

This study sought to investigate the development of both time- and event-based prospective memory (PM) in children, as well as the relationship of prospective memory tasks to other well studied aspects of memory ability. Performance on computerized time-based and event-based PM tasks was investigated in 66 children between the ages of 6 and 12. Significant age effects were demonstrated using regression analyses for both the time-based and the event-based task. As has been proposed in the literature, a difference in performance was found, with the time-based PM task being more difficult than the event-based task in this study. Additionally, support was found for the relationship of the time-based PM task to measures of working memory. Conversely, event-based PM performance was related to performance on a cued-recall retrospective memory task but not to measures of working memory, while an implicit memory task did not appear to be related to any of the other memory measures. This pattern of performance suggests a distinction between these two types of PM and their relationship with other memory systems. Problems due to order effects with the selected tasks are discussed, and suggestions for future studies are proposed.

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G. GIOIA & P. ISQUITH. Age and Gender Differences in the Development of Executive Function.

Although developmental trends have been reported for specific executive functions, to date there have been no comprehensive examinations of age and gender differences across a broad range of executive function sub-domains. Age and gender variations in development of executive functions were explored via parent and teacher reports of children's everyday executive functioning on the Behavior Rating Inventory of Executive Function (BRIEF). There was a significant interaction between Age \times Gender for the Behavior Regulation scales of the parent ratings [$F(24,4424) = 2.3, p < .001$] and Inhibit scale of the teacher ratings [$F(3,712) = 2.6, p < .05$]. Boys demonstrated a dramatic decrease in reported problems on these scales with increasing age, while girls remained at a consistently low level of difficulty from 5 to 18 years. Amongst Metacognition scales, there was a main effect for gender for the parent [$F(1,1532) = 15.9, p < .001$] and teacher ratings [$F(1,752) = 13.3, p < .001$], with boys demonstrating consistently greater difficulties than girls with initiation, working memory, organization and planning, and self-monitoring. Distribution of BRIEF scale scores for boys and girls across the age spectrum also revealed greater reported overall difficulties within the 8-to-10-year-old group for the Parent Form and in the 7-to-8-year-old age group for the Teacher Form. This pattern suggests a normative period of increased developmental difficulty with executive function. These findings highlight the differential developmental trajectories for boys' and girls' executive functions.

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J.F. DONNELLY, E. CARTE, J.H. KRAMER, B. ZUPAN, & S. HINSHAW. Executive Functioning in Girls With Subtypes of ADHD.

Recent findings have suggested that executive functioning deficits, long reported among children with ADHD, may be more prevalent among the Combined Subtype (ADHD-C) than among the Inattentive Subtype (ADHD-IN). Prior research has also focused on male subjects. The current study examines differences in executive functioning between 84 girls with ADHD (54 Combined, 30 Inattentive) and 55 normal age-matched controls. Executive functioning was assessed with the California Card Sorting (CCS) and California Trail Making Tests. The WISC-III (FSIQ) was included as a covariate in all analyses to control for group differences in IQ. The Trail Making data was analyzed with a multiple regression. Even after forcing in FSIQ and the component tasks (number sequencing and letter sequencing), Group accounted for a significant proportion of the variance in completion time on Number-Letter switching. The ADHD-C group took longer than Controls to complete the N-L shifting task and was also

more likely than controls to make sequencing errors. On the Card Sorting task, the ADHD-C group had significantly fewer correct sorts, fewer explanation points, and more perseverative sorts than did controls. These findings indicate that subjects with ADHD-C, but not ADHD-IN, have greater deficits in executive functioning than Controls, but that discrimination between ADHD subtypes requires further study.

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J. SCHATZ & J. RICHARDS. An ERP Study of Developmental Changes in the Stroop Color-Word Interference Effect.

The Stroop color interference task has been an important paradigm for neuropsychology and cognitive psychology. Prior lesion and neuroimaging studies have suggested the importance of the anterior cingulate cortex for mediating the attention demands of this task, and that left temporal-parietal cortex is important for processing word meaning. We evaluated the timing of cortical involvement in the Stroop interference paradigm in 8-, 10-, and 12-year-old children ($N = 6$ for each group) relative to young adults ($N = 10$) using high-density event-related potentials (ERPs). Brain electrical activity was measured using a 128-channel geodesic sensor net while participants completed a color naming task in which the participant named the color of a printed word presented on a video monitor. Words to create facilitation (e.g., "blue" in the color blue), interference (e.g., "red" in the color blue), and neutral (e.g., "dog" in the color blue) conditions were presented. Distinct electrophysiological differences were seen in all four age groups between the facilitation and interference trials consisting of a frontal negative potential (between 400–500 ms in young adults) and a posterior positive potential (between 600–700 ms in young adults). Differences in the temporal relationship between activation of the frontal and posterior regions were present across the four age groups. The difference with age in the timing of activation in these regions likely reflects a combination of more automatic processing of words and better selective attention in older participants.

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R. DORMAN, H.S. LEVIN, & J. SONG. Tower of London-Extended Version: Planning in Pediatric Closed Head Injury.

The Tower of London (TOL) is a neuropsychological test used to assess problem-solving and planning skills. Clinically, the measure has demonstrated sensitivity in discriminating between performance among individuals with varying severity of closed head injury (CHI). However, ceiling effects have been demonstrated with pre-adolescent and adolescent CHI samples. An extended version of the Tower of London (TOL-E) was devised to minimize these ceiling effects. Significant complexity and age effects suggest that the Tower of London-Extended Version (TOL-E) contributes a significant level of complexity relative to the original TOL across all age groups. This finding has implications for the measure's ability to detect the development of planning and problem-solving in normal children, as well as differentiate between impaired and nonimpaired samples. To further examine the ability of the TOL-E to differentiate among clinical samples, the TOL-E was administered to children who suffered mild, moderate, and severe head injuries. Differences with respect to Initial Planning Time (IPT), Number Solved on Trial 1 (ST1), Number Solved in 3 Trials (ST3), and Total Solution Time (TST) are discussed.

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K. MUELLER-SCHRADER, R. LAJINESS-O'NEILL, B. MOIR, & W. COHEN. NEPSY Scores Differentiate Autistic Children: Support for a Dysexecutive Model.

The NEPSY has recently emerged as a comprehensive developmental neuropsychology battery for children from 3 through 12 years of age. The purpose of the present study was to determine whether the NEPSY Attention/Executive (AT/EX) and/or NEPSY Language (LAN) domain scores differed significantly among diagnostic groups which were as follows: children with—ADHD (AD); LD/NVLD (LD); ADHD and LD (ADLD); PDD

NOS (PDD); Asperger's (AS); Autism (AU). Participants were 90 children (male = 70; M age = 7.31, SD = 3.29) referred to an outpatient neuropsychology division within the past 24 months. Results demonstrated a significant effect for both the AT/EX and LAN Domain Scores (F = 4.999, p = .001 and F = 3.686, p = .007 respectively). *Post-hoc* Scheffé comparisons demonstrated that AU children obtained significantly lower scores on the AT/EX domain when compared with every other group except ADL children. Of additional importance was our finding that AU participants did not differ significantly from any group (with the exception of AS) with regard to IQ estimate, hence differences in intellectual functioning do not appear to account for the variability in AT/EX scores. Moreover, significantly lowered scores on the AT/EX domain for AU relative to other diagnostic groups supports the dysexecutive theory of autism. With respect to language functioning, the only significant difference noted was between the AU and AS participants. It is interesting to note that AU and AS subjects differed on every measure investigated suggesting support for discrete diagnostic categorization for these 2 groups. Additional implications will be discussed.

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P. ISQUITH, G. GIOIA, & P. RETZLAFF. BRIEF Modeling of Children's Executive Function.

Current theories of executive function posit a unidimensional *versus* multi-component or fractionated model with specific components (e.g., inhibition) playing an underlying enabling role for all other components. We examined these hypothesized models of executive function via hybrid structural equation modeling. Parent and teacher ratings of children's everyday executive behaviors on the Behavior Rating Inventory of Executive Function (BRIEF) were examined along with ratings of general behavior on the Child Behavior Checklist and Teacher Report Form (CBCL/TRF). Sequentially analyzed models revealed that the internalizing scales of the CBCL/TRF (e.g., Somatic Complaints) were a poor fit. Unitary, hierarchical and independence models represented the data poorly and were rejected. Instead, a 2-factor, or fractionated, structure best modeled the data. This model posits a Behavior Regulation factor underlying the observed BRIEF Inhibit, Emotional Control, and Shift scales, and the CBCL/TRF Aggression scale. This factor then causally enables a Metacognitive factor, which in turn drives the observed BRIEF Working Memory, Initiate, Plan & Organize, and Monitor scales along with the CBCL/TRF Attention scale. The 2-factor model left low residuals with fit indices of .90 (Parent) and .88 (Teacher) and relatively large R^2 values for all scale paths. The chi-square tests remained significant but were smaller than other tested models. The findings support a multicomponent, fractionated view of executive function with a Behavioral Regulation factor enabling a Metacognitive factor.

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P. J. ESLINGER & K. BIDDLE. Adolescent Development After Early Prefrontal Cortex Damage: 8-Year Follow-Up.

The adolescent development and pattern of recovery are described in a 15-year-old male who sustained extensive right dorsolateral prefrontal cortex damage at 7 years of age from rupture and surgical treatment of a deep arteriovenous malformation. Follow-up evaluations at 4 years and most recently 8 years after illness have shown clear improvement in all areas initially assessed, with resolution of left hemispatial neglect and other visuospatial impairments in spatial working memory, design fluency and spatial planning/organization, as well as in ideational fluency. At the 8-year follow-up interval, an acquired attention deficit disorder remains evident. Worsening performance was observed on tests of general intelligence, verbal learning and memory, processing speed, some aspects of discourse, and in academic achievement. This was due in large part to fewer planful responses and variable attention-concentration. Measures of emotional face and voice recognition showed only minor difficulties, principally in accurate identification of disgusted voice intonations. Social and psychological maturation has continued to improve, with no evidence of a primary or

pervasive social impairment, though the child is confused at times by complexities and nuances of social interaction. The developmental profile of findings suggests remarkable recovery of early visuospatial and social impairments. However, lingering and somewhat worsening performance deficits are occurring due to attentional difficulties and impulsive responding, 8 years after early right dorsolateral prefrontal cortex damage. Recent trial of stimulant medication has been encouraging. Overall developmental pattern contrasts markedly with early mesial-orbital frontal damage, and suggests a more manageable outcome though with need for continuing intervention.

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O.F.A. BUENO, M.C. MIRANDA, C. SCHEUER, & A. MOLINA. Free Recall of Words and Pictures in Preschool Children.

The aim of this investigation was to study serial position curves using the free recall paradigm in preschool children. Primacy and recency in free recall of 2 types of stimulus (words and pictures) were studied, as well as the manipulation of semantic relationship between items. Fifty-eight children (29 boys) aged 4 to 6 years were tested. A set of 8 lists of 9 items (words or pictures of the same concepts) were used. In half the lists the items were unrelated and in the other lists the 3 stimuli in the central positions belonged to the same semantic category. Overall, pictures were more recalled than words and no differences in serial recall were observed according to the type of stimulus. The lists with semantically related words were more recalled by the 6-year-olds than by the other ages. Difference related to sex were also observed at the age of 4; girls recalled more words in lists with related stimuli than boys. The analysis taking into account all lists showed no primacy effect at any age. However, all ages showed primacy effects in the first lists of both types of stimulus, suggesting that primacy decreases with fatigue. Recency was apparent at all ages when all lists were considered in the analysis, although the 4-year-olds presented less pronounced recency when compared to the older age groups.

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S. TJSSEM & J. HALL. The Relation Between Dichotic Listening and Callosum Morphology in Children.

Dichotic listening is an often used measure of cerebral laterality. In this noninvasive clinical paradigm, auditory stimuli in the form of 6 syllables are presented simultaneously to the right and left ears. Normative results would be indicated by a better ability to reproduce stimuli presented to the right ear. Important in this theory are findings from research with split brain patients. In this model the corpus callosum (CC) serves as a pathway of conduction for auditory information from the left ear to the right cerebral hemisphere then via the CC to the language centers of the left hemisphere. It is indicated that these auditory pathways cross the CC in the posterior sections suggesting that those individuals with decreased left ear scores reflect morphometric anomalies in these areas. Participants for this investigation consisted of 90 children ages 8 to 12, 50 of whom were diagnosed with attention deficit hyperactivity disorder (ADHD) and 40 diagnosed with a language based learning disability. The dichotic listening test was completed utilizing a digitized tape with natural speech and employing 3 conditions; *nonforced attention* (NFA), *forced right* (FR), and *forced left* (FL). MRIs were digitized and analyzed with NIH Image 1.61 by dividing the CC into 5 sections. Area measures were then obtained for each region. Findings from this study indicate that differences in measured CC posterior areas were positively correlated with hemispheric specialization.

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R. BOADA, R. TUNICK, E. WILLCUTT, N. CHHABILDAS, J. OGLINE, B. PENNINGTON, R. OLSON, & J. DEFRIES. A Twin Study of the Etiology of High Reading Ability.

The present study examined the etiology of high reading ability (above 1 SD from the mean) in a nonreferred sample of 350 twin pairs. The MZ

proband-wise concordance rate for high reading ability was significantly higher than the DZ proband-wise concordance rate, indicating genetic influence on this trait. Further behavioral genetic analyses were conducted utilizing the DeFries-Fulker method for ascertaining the heritability of behavioral traits in extreme groups. Results corroborated that high reading ability is partly due to genetic influence ($h_g^2 = .55$). Additionally, when probands were selected for high reading ability, there was a higher MZ than DZ proband-wise cross-concordance rate for measures of phonological awareness, verbal short-term memory and orthographic coding. Bivariate multiple regression analyses demonstrated that high phonological awareness, orthographic coding and short-term verbal memory skills all share significant common genetic influence with high reading ability (bivariate $h_g^2 = .59, .56$, and $.46$). These results suggest that reading ability is on a continuous distribution, with high reading ability being as heritable as reading deficits. It also supports the hypothesis that the same cognitive processes that are associated with dyslexia are important for the development of high reading ability.

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S. PIGOTT, P.M. PELLETIER, & E.R. VRIEZEN. Phonemic Versus Semantic Fluency Following Traumatic Brain Injury in Children.

Performance on tests of verbal fluency that require retrieval by semantic category (semantic fluency) or by initial letter (phonemic fluency) has been dissociated with patient populations in the neuropsychological literature. For example, patients with Alzheimer's disease are typically impaired on both phonemic and semantic fluency but have relatively greater deficits on semantic fluency. Additionally, children with traumatic brain injury (TBI) have been found to perform poorly on tests of phonemic fluency. The purpose of the current investigation was to examine if, following TBI, children would show a dissociation in their performance on semantic and phonemic fluency tasks and whether any deficits persist over time. Forty-one children aged 6 to 12 years who had sustained a moderate to severe TBI were tested on phonemic fluency (FAS) and semantic fluency (Animals and Foods). The children were further subdivided as to chronicity of injury: acute (<1 year post injury; $n = 13$) and chronic (>1 year post injury; $n = 28$). The groups did not differ with respect to mean age or WISC-III Verbal IQ. In the acute group, phonemic fluency was below average whereas semantic fluency fell within normal limits. In the chronic group, the measures of semantic and phonemic fluency fell within normal limits. Taken together, these findings suggest that in the initial period following a TBI, children with moderate to severe TBI are impaired on phonemic but not semantic fluency, but that the deficit in phonemic fluency appears to recover over time.

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A. SKALICKY, M. KIBBY, & G. HYND. Developmental Dyslexia: Family Presentation and Relation to Gyrus Morphology.

Six cases of developmental dyslexia are presented as assessed in children ages 8–12. Three cases present evidence of diagnosable reading disability in at least 1 biological parent, while all the parents of the other 3 dyslexic children were assessed as normal readers. All children and parents were evaluated for neuropsychological performance and posterior perisylvian region gyrus morphology, the latter using magnetic resonance imaging (MRI). Group means for IQ, reading ability and phonological processing were commensurate between children from the “familial” and “non-familial” cases (WASI FSIQ = 105 vs. 103; GORT-3 Passage = 68 vs. 75; CTOPP Elision = 83 vs. 80). Affected parents from the “familial” and unaffected parents from the “non-familial” group produced similar IQ scores, however the affected parents performed worse on measures of reading achievement and phonological processing (WASI FSIQ = 107 vs. 113; WRMT Word Identification = 90 vs. 106; CTOPP Elision = 76 vs. 105). MRI scans of the Sylvian fissure and surrounding structures were classified as either typical (Type I) or atypical (Type II or III) according to guide-

lines by Steinmetz and colleagues. Two of 3 “familial” cases revealed atypicality of the left perisylvian region for children and affected parents, while a child displayed the lone instance of (bi-lateral) atypicality for all children in the “non-familial” group.

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M. WOODIN, E. MOSS, C. SOLOT, P. WANG, D. McDONALD-McGINN, B. EMANUEL, & E. ZACKAI. Verbal Is Not Necessarily Language: An Analysis of NLD and Language in VCFS.

Velocardiofacial syndrome (VCFS) results from submicroscopic deletions on chromosome 22q11.2. Infants and young children with VCFS display significant speech-and-language delays. However, by school age, these primary speech-and-language delays appear eclipsed by even greater nonverbal or visuospatial and perceptual-motor deficits relative to “verbal” strengths (e.g., verbal IQ and rote verbal memory). They also exhibit other assets and deficits consistent with current descriptions of a nonverbal learning disability (NLD). Previous research has examined cognitive and language functions within a preschool sample of children with VCFS. Similar data has not been reported regarding the functioning of school-aged children. We analyzed the cognitive and language performance of 35 individuals with VCFS (ages 6–17; 18 F/17 M). Results of nonparametric Wilcoxon signed ranks tests indicated significantly lower Receptive ($z = -3.894$, $p < .001$), Expressive ($z = -4.941$, $p < .001$), and Total ($z = -4.881$, $p < .001$) Language composites on the CELF-R relative to Wechsler VIQ scores. Preliminary exploratory principal components analysis yielded a 2-factor solution. The first factor (eigenvalue = 5.423) accounted for 54% of the variance and reflected measures of crystallized or schooled verbal knowledge. The second factor (eigenvalue = 1.320) accounted for 13% of the variance and included measures involving automatic language processing and verbal working memory. This data indicates that individuals with 22q11.2 deletions demonstrate NLD characteristics, but it is inaccurate to portray their presentation or “disability” as limited to “nonverbal” functions. Results are discussed in terms of their relevance to the neurocognitive phenotype of this clinical group, further explanation of the NLD profile, and appropriate identification procedures and interventions to be used with these children.

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M.M. FOX, L.K. PAUL, K. J. SCHILMOELLER, S.R. GARRELS, A.A. TURK, E.V. FLORENDO, & W.S. BROWN. Paralinguistic Processing in Children With Callosal Agenesis.

While individuals with agenesis of the corpus callosum (ACC) can, in some cases, perform normally on standardized intelligence tests, recent studies have begun to suggest that ACC may result in deficits in other domains of fluid and social intelligence. Paul and Brown revealed impaired processing of nonliteral language, proverbs, and affective prosody in a group of normally intelligent ACC adults. However, cognitive and social developmental patterns have not yet been examined in children with ACC. Since normal children have incomplete myelination of the corpus callosum, it was hypothesized that paralinguistic deficits in ACC children may be less apparent relative to their peers. The Familiar and Novel Language Comprehension Test (FANL-C), Prosody Test, and Cartoon Humor Test were used to assess nonliteral language and affective prosody in 10 acallosal children with normal intelligence (IQ > 80) and 8 age and IQ matched controls. Acallosal children exhibited significantly poorer performance on the Humor Test ($p < .05$) and a trend toward significantly lower performance on the Prosody test ($p = .074$). A 2-way ANOVA showed a main effect for the literal versus nonliteral subtest on the FANL-C and a main effect for group. Although there was not a significant interaction between Group \times Subject, *post-hoc* *t* tests revealed that acallosal performance was significantly worse than controls on the nonliteral ($p < .05$), but not the literal items. These results indicate that acallosal children exhibit weak-

nesses in paralinguistic tasks, but that these deficits are less marked in ACC children than in adults.

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A. ASBJØRNSEN, C. BOLIEK, & J.E. OBRZUT. Language Laterality Estimates and Reading Disability.

The presented study focused on the application of different procedures for estimating laterality for language based on dichotic listening performance. Dichotic listening has shown to be a valid measure of language lateralization. Usually, lateralization is estimated from the proportion of right ear over left ear accuracy during an unbiased test procedure. However, as suggested by Bryden Munhall and Allard, a more accurate estimate can be obtained by using a directed attention procedure. In this study, a sample of 16 reading-disabled children were compared to 20 age, gender, and hand preference matched controls on dichotic listening performance in both an unbiased free recall task and in a directed attention task with consonant-vowel syllables as dichotic stimuli. The lambda coefficient was calculated for both the free recall and the directed attention ear scores. Both procedures yielded significant group differences with a lower laterality score for the reading disabled compared to the controls ($F = 23.93$), but there was no main effect of procedure or a group by procedure interaction. A correlation analysis between the two laterality indices yielded a significant correlation for the whole sample ($r = .40$), but not for the reading disabled group ($r = .010$). The results suggested that further validation studies must be done to ensure a valid procedure for assessment of laterality in reading impaired individuals.

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M. PONCELET & M. VAN DER LINDEN. Reading Development of Nonwords, Regular, and Irregular Words.

This longitudinal study was designed to explore the acquisition of reading procedures. Reading performances for nonwords (sublexical procedure), regular words (sublexical or lexical procedure) and irregular words (lexical procedure) were compared in 29 children when they were 6, 7, and 8 years old (i.e., respectively at the end of the 1st, 2nd, and 3rd grade). The test battery consisted of 30 pronounceable nonwords, 30 regular words and 30 irregular words. Regular and irregular words were paired for frequency, imageability, and number of letters and syllables. Words and nonwords were paired for number of letters. At ages 6, 7, and 8, scores for irregular words were significantly lower than scores for regular words and nonwords. Furthermore, at age 6, scores for nonwords and regular words were similar but at ages 7 and 8, scores for nonwords were significantly lower than scores for regular words. Performances for each of the 3 item types progressed significantly from age to age but at different rates. Progress in regular words reading was significantly greater from age 6 to 7 than from age 7 to 8. On the contrary, progress in irregular words reading was significantly greater from age 7 to 8 than from age 6 to 7. Finally, progress in nonwords reading was constant. These results show that the developmental dynamics of the 3 types of items are different and can be interpreted with reference to a model of reading acquisition as a sequential but cumulative development of 2 different reading mechanisms.

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S. CYRULNIK & J. HALPERIN. Reading Speed in Normal Adults: Automatic Versus Controlled Processing.

This study examined differences in reading strategies between fast and slow nonimpaired readers. It was hypothesized that fast readers use an automatized process when reading, whereas slow readers use a more controlled and effortful cognitive process. Because automatic processing is less susceptible to interference, it was predicted that fast readers would be less affected by distraction as compared to slow readers. Based on self-report, 27 college students were divided into 2 groups: 7 who reported themselves

to be slow, word-by-word readers; and 20 who reported themselves to be fast readers. This latter group described themselves as tending to skim or scan text while reading. Reading was assessed in all participants using the GORT-III and WRAT-III. They were subsequently timed while reading passages without distraction and in the presence of music and speech distractors. The 2 reading groups did not differ on either of the standardized reading tests. However, music distraction caused a greater decrement in reading speed in the slow readers as compared to the fast readers. Voice distraction did not differentially affect the groups. These data indicate that, although fast and slow readers are capable of attaining similar levels of performance, as measured by standardized reading tests, they utilize different cognitive processes when reading. Specifically, slow readers appear to use a more controlled cognitive process.

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Y.C. HO & A.S. CHAN. The Effects of Music Training on Memory of Children.

One of our recent studies showed that young adults who had at least 6 years of training with a musical instrument before the age of 12 demonstrated better verbal, but not visual, memory than those who had no such training. The present experiment further studied the effects of music training on children between the age of 6 to 15. Ninety students were recruited; 45 had 1 to 5 years of music training (MT), and the rest had no music training (NMT). The 2 groups were matched in terms of age, education level, IQ, and family's social economic characteristics. Their verbal and visual memories were assessed with the Hong Kong List Learning Test and Brief Visuospatial Memory Test-Revised, respectively. Consistent with the previous study, MT group performed significantly better in the verbal, but not the visual, memory test than NMT group ($p < .01$). Correlational analysis showed that the longer the duration of music training, the better the participants' verbal memory performance ($r = .50, p < .01$), controlling the effects of age, education, and verbal IQ. No evidence of the effect of beginning age of music training on mediating the memory was revealed. These results are consistent with the notion that music training may enhance the development of left planum temporale, and therefore improve the verbal memory that is mediated by this cortical area.

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K. SCHWARTZ & W. FROMING. Attention and Social Behavior in 8-10-Year-Old Children.

Three attention measures (Continuous Performance Task, Visual Color Trails, Wisconsin Card Sort) were given to 120 boys and girls ages 8-10 (40 of each age). Analyses revealed no changes as a function of age nor were there any significant correlations between any of the measures. There were also no gender differences. The participants were also exposed to one of three experimental conditions involving prosocial behavior. Children were given the opportunity to donate ice cream tokens to 2 friends under specific conditions. The first condition provided the child with an explicit behavioral standard ("most children give 8 tokens"). The second condition provided an abstract standard ("kind children help and mean children don't"). The third condition provided no guidance to the child. Chi-square analysis revealed that children in the explicit standard condition were more likely to donate 8 tokens than in the other conditions (i.e., they employed the standard provided). Two groups of children were formed: those who gave 8 and those who did not. The scores of 2 groups on the attentional measures were then compared. The two groups were significantly different on the CPT for errors of omission ($p < .01$). The other attention tasks did not predict behavioral outcomes in this (explicit standard) condition. None of the attention tasks predicted performance in the other conditions. The results underscore the specificity of the various attention measures and the role certain forms of attention play in prosocial behavior.

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B. HAREL, S. BULLARD, A. CILLESSEN, J. OMDOLL, & D. FEIN. It Takes 9 Days to Iron a Shirt: The Development of Cognitive Estimation Skills in School-Age Children.

Normative data from a sample of 394 school-aged children (K–12) are presented for the Biber Cognitive Estimation Test, a 20-item test with 5 estimation questions in each of 4 categories: time/duration, quantity, weight, and distance. The range of normal answers is provided across age groups for each domain and for the total score. A general developmental trend was observed on each of the domains tested, but the domains develop at different rates. Adult levels of response were achieved for all domains by about age 13, perhaps corresponding to maturation of formal operations. Age and fund of knowledge were found to correlate with overall test performance. No gender effects were found. Since estimating skills require inhibition of impulsive responding and are necessary in many everyday skills, it is anticipated that this test may provide a useful measure of judgment and executive skills in school-age children.

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P. MORAGA, M. GAROLERA, M. CABEZAS, & J.M. VENDRELL. Relating Executive Functions and Intelligence in Children.

The aim of the study was to assess the relationship between executive functions and intelligence in children. The study group consisted of 60 Chilean children, 32 boys and 28 girls, aged between 6 and 12 years. All presented normal development and academic achievement and attended Santiago schools located in low socio-economic areas. Tests applied were WCST, Verbal Fluency (phonological and semantic), Raven (colored or standard) and TONI-2. The analysis of variance (ANOVA, 2-way) showed sex and age effect in Fluency, TONI-2, Raven and in some of the WCST scores ($p < .05$). A soft correlation was found between the executive tests: perseverative errors in the WCST correlated with phonological fluency ($r = -.256, p < .05$) and with semantic transport fluency ($r = -.262, p < .05$). A moderate correlation between intelligence and executive tests was found. Raven's correlations were: with perseverative errors ($r = -.423, p < .01$), with categories completed ($r = .361, p < .01$) and with phonological fluency ($r = .293, p < .05$). TONI-2 correlations were: with perseverative errors ($r = -.404, p < .01$), with categories completed ($r = .398, p < .01$) and with phonological fluency ($r = .276, p < .05$). A Principal Component Analysis using Varimax Rotation showed a 3-factor solution accounting for 81.3% of the variance: an intellectual and flexibility factor (45.7%), a concept formation factor (21.2%) and an attentional factor (14.4%). Conclusions: Although the executive functions do not seem to play a decisive role in intellectual capacity, our findings reveal that flexibility has a stronger relationship with intelligence than concept formation. Further studies should clarify the possible role of age in these findings.

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M. VANN & K. KRULL. Factor Analysis of the Differential Ability Scales for a Clinical Population.

The psychoeducational literature has shown that the Differential Ability Scales (DAS) ability measures or subtests load onto more factors with increasing age because of development and differentiation of abilities. The pattern of factor loading may differ as well across clinical and non-clinical populations. To examine this sensitivity, standardized subtest scores on the DAS Core assessment were factor analyzed for 91 6-to-13-year-old children with clinical diagnoses. These children were identified with one (or more) of various cognitive, emotional, behavioral or learning disorders. Using a hierarchical model, an exploratory principal factor analysis with varimax rotation was done for the Core subtests (6 total). Two factors emerged from clinical subtest scores: 1 approximating the Verbal cluster and the other consistent with the Nonverbal Composite cluster. This result was fairly deviant from the 3-factor Core structure (Verbal, Nonverbal and Spatial) that Keith attributed to normals aged between 6 and 17 years. Further, Nonverbal and Spatial clusters correlated with each other slightly more than either did individually with the Verbal cluster in this clinical group. According to these findings, the DAS may reveal a

different cognitive profile for children classified with clinical diagnoses than for normals.

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J. CASEY & P. YAWNY. The Relationship Between Selected WIAT Subtests and the WISC-III.

The introduction of the WIAT provides an alternative to the WRAT as a measure of basic academic skills achievement. Because it was co-normed with the WISC-III, it has the advantage of enabling a statistical means by which to calculate ability-achievement discrepancies. However, unlike the WRAT, the research literature related to the WIAT is limited. The purpose of the present study was to examine the relationship between the Basic Reading (BR), Mathematics Reasoning (MR), Spelling (Sp), and Numerical Operations (NO) subtests of the WIAT and the subtests of the WISC-III in a heterogeneous sample of children with learning and behavioral problems. One hundred and sixty-nine children were selected from a pool of 216 seen for neuropsychological assessment consecutively between 1994 and 1997. The sample consisted primarily of children with various forms of learning disabilities. Children with a Full Scale IQ of less than 70 were excluded. Factor analyses were conducted using the principal components, principal axis, and maximum likelihood extraction methods with varimax rotation. With principal component and principal axis methods, all four WIAT subtests loaded with the Arithmetic and Digit Span subtests of the WISC-III (FDD Index). Of the four WIAT subtests, MR had the lowest loading on this factor. With the maximum likelihood method, BR, Sp, and NO loaded with Digit Span, whereas MR loaded with Information, Similarities, Arithmetic, Vocabulary, and Comprehension. The findings suggest that the MR subtest is multidimensional in nature, places greater demands on higher-order processing, and is not an alternative to the WRAT Arithmetic subtest.

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R. GRAY, R. LIVINGSTON, R. HAAK, & R. MARSHALL. Developmental Trends on Neuropsychological Measures in a 9-to-15-Year-Old Sample.

This study examines developmental trends on neuropsychological tests for a referred school sample between the ages of 9–15 ($N = 516$). Neuropsychological data are reported for the following measures; Finger Tapping; Grip Strength; Trail Making Test Parts A & B; Category Test; Tactual Performance Test; Seashore Rhythm Test; Speech Sounds Perception Test; Sensory-Perceptual Examination; and the Aphasia Screening Test. Means and standard deviations as well as graphic displays of developmental trends are provided at yearly intervals. Analyses suggest that psychomotor strength and sensory-perceptual skills demonstrated the greatest percentage gains from baseline across the age range. The smallest percentage gain was observed on the Seashore Rhythm Test. While the trends suggest a fairly linear progression on some tests, other tests appear to demonstrate a ceiling effect in this age range characterized by less improvement in the upper portion of the age range. These results are discussed in terms of neuropsychological developmental theory and the cognitive demands associated with specific tests.

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P. YAWNY, J. CASEY, & B. KING. WISC-III Factor Structure in a Neuropsychological Sample.

The purpose of the present study was to determine if the 4-factor structure of the WISC-III could be replicated in a heterogeneous sample of children referred for neuropsychological assessment who presented with both learning and behavioral concerns. Given that difficulties with attention, processing speed, and facility with symbols are linked with learning disorders, one might expect that PS and FDD factors would be more robust in this population than previously demonstrated in normative samples. One hundred and eighty-two children were selected from a pool of 216 who were

seen for neuropsychological assessment consecutively between 1994 and 1997 at a children's mental health centre. Children with a Full Scale IQ of less than 70 were excluded. The sample consisted primarily of children with various forms of learning disabilities. Using WISC-III scaled scores, exploratory factor analyses requesting 2, 3, 4, and 5 factors were requested for the principal components, principal axis, and maximum likelihood extraction methods. Kaiser-Guttman criteria were used with each of the three extraction methods. For each of these methods, the 4-factor solution was consistently found to be the best fit. However, the three extraction methods did not replicate exactly. Both the principal axis and maximum likelihood methods had Arithmetic loading most highly on Verbal Comprehension rather than FDD, which was represented by Digit Span alone. The findings from this sample of children with heterogeneous learning disabilities were consistent with normative studies, together indicating that the FDD factor is the least robust factor followed by PS.

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H.M. LEDESMA, M. MORRIS, R. SEVCIK, & R.D. MORRIS. Relation of Bilingual Children's Language Preference and English Language Skills.

This study examined the relation of bilingual children's language preference and their English language proficiency in several language-related domains. English language measures of semantics (WISC-III Vocabulary), fluency (Category Naming), automaticity of word retrieval (Object Rapid Naming), phonological processing (CTOPP Elision and Blending), and verbal learning (WRAML Verbal Learning) were administered to 81 bilingual (Filipino-English) children (M age = 6 years, 2 months; SD = 3.5 months). Parents were asked to complete a questionnaire regarding their children's language exposure and use across multiple contexts. A factor analysis of the questionnaire items yielded three principal factors, suggesting differences in language preference across settings: Social (i.e., language used in informal conversation and social situations); Formal (i.e., language used in schools and other social structures); and Media (i.e., language preferred in watching television/movies or listening to radio/CDs). Hierarchical regression analyses were performed to assess the predictive utility of these 3 factors for each of the language measures. Controlling for age and socioeconomic status, the 3 factors significantly predicted vocabulary and automaticity of word retrieval, while prediction of verbal fluency approached significance. However, the three factors evidenced different patterns of relation with each of these language variables. In contrast, language preference was not predictive of phonological processing and verbal learning skills. Findings are discussed with respect to: (1) the need to assess language proficiency in multiple environmental contexts, and (2) the influence of language environment on the development of specific components of linguistic skills.

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MATERNAL FACTORS IN FETAL OUTCOME

P. CONNOR & R. MAHURIN. A Preliminary Study of Working Memory in Fetal Alcohol Damage Using fMRI.

Memory disturbances are common in subjects with Fetal Alcohol Spectrum Disorders (FASD). However, no studies have yet attempted to demonstrate a corresponding brain dysfunction using functional neuroimaging techniques. A participant with fetal alcohol effects (FAE) and a control participant were administered a 2-back working memory paradigm during fMRI acquisition, requiring the respondent to respond whenever a stimulus being visually presented is identical to the letter presented previously (e.g., A-D-A). The control task was a simple stimulus discrimination task (e.g., X). The tasks were alternated 5 times in blocks of 30-seconds each. An EPI BOLD imaging protocol (TR = 3000, TE = 50, 90° flip angle) collected 21 axial slices 5 mm thick with a 64 × 64 matrix. Images were analyzed using MEDx software subtracting control task from activation

task. The resulting time series was registered to corresponding anatomical images, and subjected to unpaired t tests with a Bonferroni corrected significance threshold set at .01. Results of the fMRI analysis show that the control participant had prominent activation of the left dorsolateral prefrontal cortex (DLPFC, voxel z scores up to 4.3, p = .00002), a region associated with the activation of the working memory system. In contrast, the subject with FAE, displayed very little evidence of prominent activation of the left DLPFC. Performance on the memory task was significantly worse for the participant with FAE, suggesting a dysfunctional pattern of cognition and brain activation in patients with FASD, a result never before reported.

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S. HUGHES, C. JORDAN, & E. SHAPIRO. Defining Maternal Variables in an At-Risk Urban Population.

Mothers play an important role in buffering effects of poverty and associated environmental conditions in at-risk children. Identification of maternal factors contributing to developmental success is important in predicting outcomes and developing interventions designed to serve the urban poor. This study presents results from a factor analysis of maternal variables used in a prospective, longitudinal study of the effects of lead overburden on neuropsychological development in an ethnically diverse, low-income, urban community. Eighty participants drawn from the DREAMS (Developmental Research on Early Attention and Memory Skills) Project were used for this analysis. Mean age of the maternal sample was 28 years (SD = 6.48 years); participants were of African American (30%), White (24%), Native American (19%), Latino (6%), and multiracial (20%) descent. Factor analysis was performed using varimax rotation on variables of maternal age, intelligence (raw score on Ravens Progressive Matrices), quality of home environment (total score on the HOME rating scale), maternal distress (total score on the Brief Symptom Inventory) and risk for child abuse (Abuse score from the Child Abuse Potential Scale). Two factors were identified: Factor I (52% of total variance), representing Competence, consisted of age (loading = .74), Raven score (loading = .67), and HOME score (loading = .76). Factor II (23% of total variance) representing Distress, consisted of the BSI score (loading = .92) and Abuse score (loading = .76). Identification of underlying maternal variables will facilitate analysis of their effects on the neuropsychological development of attention, memory and behavioral regulation in their offspring.

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M. ISRAELIAN & E. EMORY. Fetal Movement and Habituation, Obstetrics Complications and Postnatal Outcome.

Fetal movement and habituation in response to a repeatedly presented vibroacoustic stimulus was studied in 58 fetuses who were between 34 and 38 weeks gestational age. Fetuses were stimulated with the Toitu Fetal Stimulator (TR-30, Wayne PA). Movement and heart rate were recorded with the Toitu MT-430 fetal actocardiograph. Prenatal and perinatal history, gestational age at birth, birthweight, length, and APGAR scores were obtained through medical chart review. That data was then used to score subjects on the Obstetric Complication Scale. Habituation was defined as 5 consecutive stimulation trials in which the fetus did not exhibit a movement response (p = .02). Twenty-four of the fetuses met criteria for habituation, whereas 34 of the fetuses did not. Results confirmed that the fetal movement response to repeated vibroacoustic stimulation is sensitive to pre- and perinatal factors and predictive of obstetric complications. Habituation of the movement response was associated with more optimal maternal health, [$\chi^2(1, N = 58) = 4.67, p = .03$], higher socioeconomic status [$t(56) = 2.72, p = .01$], greater birthweight [$t(56) = 2.21, p = .03$], fewer obstetric complications [$t(56) = -2.06, p = .04$] and fewer prenatal risk factors [$t(56) = -4.15, p < .001$]. Hierarchical multiple regression analyses indicated that specific characteristics of the movement response such

as reaction time, magnitude of the movement response, and overall levels of motor activity accounted for a significant proportion of the variance on the Obstetrics Complication Scale and Apgar scores at birth.

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P. McDONOUGH-RYAN, M.D. RIS, P.K. SHEAR, M. DELBELLO, & S. STRAKOWSKI. NLD in Children of Parents With Bipolar Disorder.

Objective: Learning difficulties in arithmetic and a pattern of VIQ > PIQ has been reported among children of parents with bipolar disorder (BPD). These findings have led investigators to hypothesize that children who are genetically at risk for BPD exhibit a nonverbal learning disability (NLD), but this hypothesis has never been tested. *Method:* At-risk children (ages 8–12) of BPD parents (AR group; $N = 21$) were compared to a demographically matched group of children with healthy parents (HC group; $N = 20$) for evidence of cognitive features associated with NLD. The WISC–III, WRAT3, and the Grooved Pegboard Test were administered. NLD criteria included (1) relatively good verbal capacity (VIQ > 79); (2) difficulty with arithmetic relative to reading and spelling (WRAT3 reading + spelling/2 > arithmetic by 10 points); (3) visual–perceptual–organizational deficits (VIQ > PIQ by 10 points); and (4) psychomotor deficits (Grooved Pegboard > 1 SD below mean). *Results:* The frequency of children attaining each criteria were as follows: Criterion 1: AR 21/21; HC 19/20; Criterion 2: AR 1/21; HC 2/20; Criterion 3: AR 13/21; HC 7/20; Criterion 4: AR 10/21; HC 4/20. Only 1 child in the AR group and no children in HC met all 4 criteria ($p = .893$). *Conclusions:* These findings do not support a NLD hypothesis. Although some children exhibited individual features of NLD, the rate limiting variable appeared to be a failure to demonstrate a weakness in arithmetic, relative to reading and spelling. The VIQ > PIQ profile among these children may reflect executive function impairment rather than a discrepancy between verbal and nonverbal abilities or lateralized abnormalities.

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C. SIAMBANI, G. KOREN, & J. ROVET. Prenatal Exposure to Organic Solvents and Child Neurodevelopment.

Although many pregnant women are exposed to organic solvents in workplace settings, the impact of this exposure on the developing child is not known. To address this issue, we conducted a comprehensive evaluation in 33 children, 3 to 7 years of age, born to prospectively identified women who were occupationally exposed to organic solvents during pregnancy. The exposed group was compared with 28 referent children matched on age, gender, ethnicity, and socioeconomic status. Groups were compared on neuropsychological tasks, including subtests of the NEPSY, a preschool continuous performance task (CPT), and on tasks of color vision and visual acuity. Neuropsychological tests were collapsed within domains to derive composite scores. An exposure index was estimated using questionnaire data obtained at time of initial contact. ANCOVA revealed that the exposed group performed more poorly than did controls on expressive language ($p < .02$) and graphomotor ability ($p < .05$). Attention, receptive language, visuospatial and fine-motor abilities did not significantly differ between the groups. Multiple regression analyses indicated that increasing exposure level predicted poorer performance on language and graphomotor abilities. On the CPT, the exposed group committed more false alarms ($p < .02$) than controls but did not differ on omission errors, response latency or signal detection. Observed visual deficits included problems in red ($p < .05$) and blue–yellow ($p < .01$) color discrimination as well as poorer visual acuity ($p < .05$) in the solvent-exposed children. Overall, these findings suggest that chronic, low-level maternal occupational exposure to organic solvents during pregnancy is associated with selective neuropsychological and visual deficits in the offspring.

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CHILD MOTOR AND SENSORY DISORDERS

M. LISS, C. SAULNIER, & D. FEIN. Sensory Disturbances in Children with Autism.

Although not part of the diagnostic criteria, unusual responsiveness to sensory stimuli is a commonly associated symptom of autism. The Sensory Survey (based on items from Dunn's Sensory Profile) was developed to more fully investigate this phenomenon. It is a 103-item scale that measures oversensitivity, undersensitivity, and sensory seeking self-stimulatory behavior in each sensory domain, including movement. The Sensory Survey was administered to 223 parents of children with autism and other pervasive developmental disorders. Parents were also administered the Vineland Adaptive Behavior Scales, and the Kinsbourne Overfocusing Scale. The Sensory Survey has high reliability; Cronbach's alpha for the entire scale is .94. Reliabilities for the oversensitivity, undersensitivity, and seeking subdomains were .90, .86, and .87, respectively. Multivariate Analysis of Variance (MANOVA) indicated that children diagnosed with Autistic Disorder based on the DSM–IV Checklist were significantly more impaired than those diagnosed with PDD–NOS [$F(36,402) = 1.6, p < .05$]. Univariate analyses indicated that children with Autistic Disorder were more impaired than children with PDD–NOS on all sensory subdomains except movement oversensitivity and taste/smell. Correlation analyses found that general sensory oversensitivity is associated with lower Vineland Socialization scores, and sensory undersensitivity and seeking behaviors are associated with lower scores on all adaptive behavior domains. Overfocused attention is especially associated with greater oversensitivity ($r = -.590$) as predicted by Kinsbourne. Results indicate that sensory disturbances are related to adaptive impairment and symptom severity and are reliably measurable by the Sensory Survey.

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J. HIEMENZ, M. MAHONE, J. PILLION, F. DORREGO, & L. FAMA. Development of Eye and Hand Preference and Visual Motor Behaviors in Preschoolers.

Although sensorimotor tasks for preschoolers often contain right/left components, little research has addressed sensorimotor performance in the context of developing hand and eye preference in this population. The NEPSY contains tasks that assess right and left-hand maneuvers (Imitating Hand Positions, Fingertip Tapping), and attention to left/right hemisphere (Visual Attention); however, separate norms are not provided by side. Because development of hand/eye preference may be emerging in preschoolers, performance on tasks requiring visual attention, memory, and visual-motor integration may be dependent on developmental variations in hand/eye preference. We examined the relationship among eye/hand preference and performance on selected neuropsychological measures in 100 normal preschool children. Tasks included NEPSY Visual Attention (VA) and Imitating Hand Positions (IHP), Multiple Boxes Test (MBT), and PPVT–III. There were no significant group differences for eye or hand preference, or discordance on any of the neuropsychological measures; the rate of left-handedness, left eye preference and eye/hand discordance was constant across the age range. Eye/hand preference had no effect on right versus left PPVT–III errors; however, left hand preference on VA was associated with fewer omissions bilaterally. Left-handers also demonstrated a trend toward stronger performance bilaterally on IHP. On MBT, right-handers began their search on the left 55% of the time, while left-handers were much more likely to begin the search on the right (75%) of the array. Results support the idea that left hand preference may lead to a different search pattern on visual–motor tasks in preschoolers, but that eye/hand discordance is relatively benign.

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A.R. KEUNING, S.D. MARIAN, S.C. KILLIAN, T. NARRAMOR, & W.S. BROWN. Performance of Left-Handed Children on the Bimanual Coordination Test.

The Bimanual Coordination Test (BCT) requires moving a cursor through angled pathways—right hand controlling vertical; left hand, horizontal.

BCT can differentiate visuomotor coordination and interhemispheric (interhand) coordination. Age is significantly correlated with BCT performance, with young children more similar to acausalos. Asymmetric angles (hands move at different speeds) contribute unique age-related variance, revealing callosal development. Thus far, developmental studies have been conducted entirely on right-handers. It was hypothesized that directional error (negative error scores reflecting excessive left-hand movement; positive scores, excessive right hand movement) on asymmetric angles might be different in left-handers. BCT performance of 8 normal left-handed children was compared to 8 right-handers matched for age and academic achievement. Directional error was analyzed using separate Group \times Task ANOVAs of symmetric (45° vs. 135°) versus asymmetric (67.5° , 112.5° , 22.5° , 157.5°), and right-hand (67.5° , 112.5°) versus left-hand (22.5° , 157.5°) angles. Main effects of task were noted for left-hand versus right-hand angles ($p < .0001$) and for symmetric versus asymmetric angles ($p < .0001$). Group main effects were found in both tests ($p = .034$ and $p = .041$, respectively). Left-handers produced more positive error scores. A significant interaction between Handedness \times Right versus Left-Handed Angles was also detected ($p < .031$), with left-handers committing more positive errors (excessive right hand movement) on left-handed angles. Thus, compared to right-handers, left-handed children exhibited excessive right-hand movement on tasks demanding greater left-hand movement. This may reflect greater difficulty inhibiting associated movements of the right hand when the left hand must dominate performance.

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S.D. MARION, D.H. BADARUDDIN, S.C. KILLIAN, T. NARRAMOR, & W.S. BROWN. Development of Hand Bias in Bimanual Coordination in Normal Children.

Bimanual coordination in normal children increases with age. Tasks demanding bimanually coordinated asymmetric hand movement correlate most significantly with age, reflecting developmental myelination of the corpus callosum. In the current study the *directionality* of the errors in bimanual trials was considered in greater detail. The computerized version of the Bimanual Coordination Test (cBCT) was used to measure the tendency for younger ($M = 100 \pm 13$ months, $N = 38$) and older children ($M = 144 \pm 18$ months, $N = 35$) to show greater hand bias (directionality in error). Right-hand bias was indicated by errors with positive sign, and left-hand bias, by negative sign. Asymmetric angles produced significantly more error in the positive/vertical direction than symmetric angles ($F = 5.5$, $p < .05$), indicating an overcompensation with the right/dominant hand. However, within asymmetric performance, more vertical test angles produced more negative errors and horizontal angles produced more positive errors ($F = 206.73$, $p < .000$). Finally, an interaction effect was found such that right hand bias error diminishes with age, while left hand error remains the same (Age \times Angle interaction, $F = 3.30$, $p < .05$). These data suggest that development of callosal function and handedness in normal children results in a diminished tendency to over utilize the right hand, particularly when faster left-hand responding is required.

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S. MOSTOFSKY, E. RUSSELL, O. KOFMAN, J. CARR, & M. DENCKLA. Deficits in Motor Response Inhibition and Motor Persistence in ADHD.

Deficits in response inhibition and associated difficulties with motor persistence have been hypothesized to be important mechanisms contributing to symptoms of excessive hyperactivity, impulsivity and difficulty staying on task ("inattention") observed in attention deficit hyperactivity disorder (ADHD). To examine this hypothesis, the performance of a group of 17 children with ADHD and without comorbid diagnoses (ages 9.6 ± 1.3 years) was compared to that of 15 normal controls, matched for age (ages 9.5 ± 1.2 years), Full-Scale IQ, and gender, on tests of motor response inhibition

(conflicting motor response test and contralateral motor response test) and motor persistence (Statue Test from the NEPSY and test of lateral gaze persistence). A multivariate analysis of variance (MANOVA) with diagnosis as a factor and tests of motor response inhibition and motor persistence as dependent variables was significant ($p < .0001$). *Post-hoc* analyses revealed that children with ADHD made significantly more errors on the conflicting motor response test ($p = .0001$) and the contralateral motor response test ($p = .02$). Children with ADHD also had significantly more difficulty with motor persistence during the Statue Test ($p < .0001$) and during lateral eye gaze ($p = .02$). The results from this study strongly support the presence of deficits in motor response inhibition and motor persistence in ADHD and suggest that these deficits may be important fundamental features of the disorder.

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S. MARTINEZ, B. GIORDANI, H. POLATAJKO, K. RYAN, & L. ERNST. Motor Task Learning in Children With Developmental Coordination Disorder.

Accidents are a leading cause of injury/death in children under 12 years of age, and abnormal clumsiness is an associated factor of childhood accidents. According to DSM-IV, developmental coordination disorder (DCD) is characterized by fine and/or gross motor coordination impairments in the absence of a neurological, intellectual, or psychiatric disorder and occurs in 6–15% of children. For this study, 42 children ($M = 10$ years) were given a brief neuropsychological test battery, including the Movement Assessment Battery for Children, a standardized motor assessment. Children's overall motor performance fell into three groups: DCD ($n = 12$), borderline DCD ($n = 16$), and normal controls (NC, $n = 14$). Children also performed a novel stepping accuracy task modeled after the Trail Making Test. Performance across six repeated trials of the stepping task were analyzed for the 3 groups using a repeated measures ANOVA. Significant main effects were found for Walking Trial ($p < .0001$) and a trend for Group ($p < .08$). Bonferroni comparisons indicated improvement for all groups across walking trials. Additionally, the DCD group showed marginally worse performance when compared to the NC group. The Group \times Trial interaction, however, was not significant, suggesting that the 3 groups learned the task in a similar manner. Improvements in walking task performance appeared independent of group differences on neuropsychological measures. Findings are consistent with Missiuna's report that DCD children start off at a lower performance level on an upper extremity motor task, and maintain this lowered level of performance even though their rate of learning is comparable to the NC children.

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EPILEPSY

O. PEDRAZA, G. SELKE, R. GILMORE, J. DEMERY, M. ECKERT, & D. BOWERS. Contributions of Hippocampal and Amygdala Asymmetries to Verbal Memory in TLE.

Background: Combined lesions of the hippocampus and amygdala result in more severe memory disturbance than lesions of either alone, presumably due to disruption of two distinct neural systems underlying episodic memory (Papez, Yakolev). Although previous studies of temporal lobe epilepsy (TLE) have demonstrated strong relationships between hippocampal parameters (volume, asymmetry, neuron density in CA subfields) and episodic memory, few have examined the additional contributions of the amygdala to memory. *Methods:* Forty-eight patients with nonlesional focal TLE (21 left, 27 right) were evaluated for severity of episodic verbal memory deficits (CVLT, LM-II) and distribution of hippocampal and amygdala atrophy, measured from volumetric MRI. Hippocampal amygdala volumes were expressed as an asymmetry score $[(R - L)/(R + L)/2]$. All participants were left language dominant based on Wada, had EEG documented seizure foci, and were seizure surgery candidates. *Results:* Results

of hierarchical regression analyses revealed that hippocampal asymmetries contributed significant variance to the prediction of delayed recall of word lists among patients with left TLE. Prediction of verbal memory among left TLE patients was not improved by amygdala (or temporal lobe) volume asymmetries. As expected, no relationship was observed between verbal memory scores and anatomic asymmetries of the mesial temporal lobe (hippocampus, amygdala) among right TLE patients. *Conclusions:* Our findings suggest that verbal memory, especially delayed recall of word lists, is predicted by hippocampal, but not amygdala asymmetries, in patients with left TLE. These results provide additional information for the role of the hippocampus in verbal memory recall.

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E. ECKLUND-JOHNSON, R.M. BAUER, P. CONNELL, R. GILMORE, & S.N. ROPER. Quality of Life Outcome and Cognitive Variables in Surgical Epilepsy.

The current study examined the relationship between cognitive functioning in the domains of language, verbal memory, and nonverbal memory and quality-of-life outcome in a sample of patients who had undergone anterior temporal lobectomy (ATL) for relief of intractable epilepsy. Participants included 23 postsurgery patients who underwent pre- and postsurgical neuropsychological evaluations and who completed a quality-of-life measure, the QOLIE. Composite scores for each of the cognitive domains were created by standardizing raw scores from several measures from each and combining them. Simple difference scores were also created by subtracting presurgical from postsurgical scores on these variables. Stepwise regression analysis revealed that (1) postsurgical verbal memory scores and (2) pre-post change in language functioning were the best predictors of overall QOLIE scores. The postsurgical verbal memory composite was also the best predictor of individual cognitive domain scores on the QOLIE. These findings may reflect the importance of these variables in functions of everyday life. The finding that the language change score but not the postsurgical language score was a significant predictor of quality-of-life might suggest that the difference between baseline and postsurgical performance is more important than the absolute impairment within this domain. Alternatively, it may be that, since the vast majority of the participants had substantial or complete seizure relief, much of the variance in QOLIE scores was accounted for by difficulties in memory and language.

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S.M. TESTA, M. ESHLEMAN, & B.K. SCHEFFT. Diagnostic Utility of WAIS-R Deviation Quotients in Epilepsy Surgery Candidates.

We investigated the pattern of performance on the WAIS-R Deviation Quotients (verbal-conceptual, perceptual-constructional, and attention-concentration; VCDQ, PCDQ and ACDQ, respectively) in a group of 96 patients being evaluated for epilepsy surgery. The sample was divided into 3 groups (16 frontal, FL; 40 left temporal, LT; and 40 right temporal, RT) based on concordance between neuroimaging studies, Video/EEG monitoring, and when necessary, electrocorticography. A 3 (group) \times 3 (DQ) repeated measures ANOVA yielded a significant Group \times DQ interaction [$F(4,182) = 3.18, p < .02$]. Simple main effect tests and planned comparisons were used to examine the interaction effect. No differences in DQ performance were revealed in the right temporal group. Within the FL group the significant difference was between VCDQ and PCDQ [$F(1,15) = 5.94, p < .03$] with better performance on VCDQ ($M = 94.69, SD = 14.99$) than PCDQ ($M = 90.75, SD = 11.31$). In the LT group the pattern of performance was opposite that of the FL group with a significant difference between VCDQ and PCDQ [$F(1,39) = 10.95, p < .003$; VCDQ: $M = 89.08, SD = 14.62$; PCDQ: $M = 96.43, SD = 13.74$]. The results indicate the diagnostic usefulness of the WAIS-R DQ's in the evaluation of epilepsy surgery candidates, highlighting the key role of VCDQ weaknesses in left temporal patients, and PCDQ weaknesses in frontal lobe patients. Future

research could focus on the utility of the WAIS-III index scores for similar purposes.

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N. WILDE, E. STRAUSS, G. CHELUNE, D. LORING, M. HUNTER, & D. HULTSCH. WMS-III Performance in Patients Before and After Temporal Lobectomy.

Pre- and postoperative performance on the WMS-III was investigated among 41 left (LTL) and 38 right (RTL) temporal lobectomy patients. As expected, both groups demonstrated mean memory performance lower than the population mean before surgery, with the LTL group showing more impairment than the RTL group. A predicted postoperative auditory memory decline was demonstrated in the LTL group, but patients with RTL did not exhibit an expected postoperative decline on visual memory measures. Postoperative improvement was demonstrated on some auditory memory measures in the RTL group. Exploratory factor analyses (using PCA with oblique rotation) of the preoperative WMS-III 11 primary subtest scores revealed separate auditory and working memory dimensions. The Faces and the Family Pictures subtests did not form a coherent factor. Similar results were found in the LTL group postoperatively. However, after surgery the RTL factor structure was altered and included a dimension composed of the Logical Memory and the Family Pictures subtests. Separate immediate and delayed memory constructs did not emerge in any of the preoperative or postoperative analyses. The relationship between preoperative cognitive variables and postoperative memory performance was also examined to determine the variables that could assist in predicting postsurgery memory performance. Preoperative WAIS-III verbal comprehension and processing speed variables were associated with postoperative WMS-III memory performance.

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V. JAGAROO & J. WU. Micropsia, Macropsia and Temporolimbic Expression in the Writings of Jonathan Swift.

The writings of Jonathan Swift, the foremost prose satirist in the English language, has long been of interest in behavioral neurology. Classic Geschwind-Bear-Fedio indices of temporolimbic behavioral alterations can be interpreted in Swift's writings, particularly *Gulliver's Travels*, Swift's best known work. Exacting moral criteria, copious descriptive and hypergraphic qualities, and strong religious motives are temporolimbic hallmarks which coalesce in Swift. Neurobehavioral speculation about Swift simply associates these features with epileptic auras and seizures—manifesting hallucinatory distortions of size, shape and topographic schema, abound in the voyages to Lilliput and Brobdingnag. This study analyzed technical details in Swiftian writing, paying special attention to *Gulliver's Travels*. Quantitative scales assessed proportions, magnitudes of amplification and diminution, and copious descriptions. Numerous inconsistencies were found in the details of relative proportion. Finger-arm-leg ratios of Brobdingnag natives, for example, fluctuate and are inconsistent with mere magnification of human proportions. Such findings discount the role of primary visual mechanisms in Swift's size distortions. They also discount the notion of these size distortions as literal transpositions of hallucinatory micropsia or macropsia. Swift's hypergraphic details were found to be too well synchronized with the story's organized framework to be mere results of absence states. It is proposed that Swift's micropsia, micropsia and hypergraphia were indeed generated by temporolimbic and possibly central vestibular systems. However, they were also under the conscious control of highly developed frontoparietal spatial-analytic systems. Swift's brilliant artistic satire was textured but not structured by temporolimbic alterations. The relevance of such analysis to forensic neuropsychology is discussed.

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D. FLECK, P.K. SHEAR, & S. STRAKOWSKI. A Reevaluation of CPT Performance in Temporal Lobe Epilepsy.

Studies of Continuous Performance Test (CPT) ability have consistently demonstrated that patients with temporal lobe epilepsy (TLE) exhibit normal discrimination accuracy. In contrast, a recent report has suggested non-specific absolute reaction time (RT) deficits in TLE patients. Therefore, in the present study we have examined both accuracy and RT measures across the vigilance period. Seventeen patients with medically intractable epilepsy of temporal lobe origin and 17 healthy volunteers participated. The Conners CPT assessed sustained attention over a 14-min vigil, during which time letters appeared on a computer screen for 250 ms. Participants were required to depress the space bar as quickly and accurately as possible for any letter except 'X', which appeared on 10% of trials. There were no significant accuracy effects. For RT variability, the main effect of group and the Time \times Group interaction approached significance ($p < .06$), but RT produced the only significant main effect of group, qualified by a significant Time \times Group interaction. *Post-hoc* comparisons revealed within group RT differences for patients at the end of the vigil. These findings are consistent with a previous report of nonspecific RT deficits in TLE despite normal accuracy scores, and extend that study by demonstrating a RT increment over time. Unlike accuracy measures, RT increased sharply at the end of the vigil for patients, possibly implicating a late-acting impairment of arousal.

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M. SEIDENBERG, B.P. HERMANN, B. BELL, C. DOW, A. WOODARD, P. RUTECKI, R. SHETH, & G. WENDT. Quantitative MRI Volumetrics and Naming Performance in Temporal Lobe Epilepsy.

Patients with complex partial seizures of temporal lobe origin (CPTL) often exhibit impaired naming ability, but little is known about naming performance across different lexical categories. We compared 59 CPTL patients and 41 healthy controls across three visual naming tasks; object naming, verb naming, and naming famous faces. Quantitative MRI segmented volumes (white and gray) were obtained for both hemispheres (frontal, temporal, parietal, occipital regions). The CPTL group performed significantly worse than controls on all naming tasks. Patients also exhibited significantly reduced MRI gray and white matter volumes across all brain regions (except for occipital lobe). Correlational analyses revealed significant relationships between object naming and naming of famous faces with left but not right temporal lobe white matter volume. Decreased left temporal lobe white matter volume was associated with poorer object naming ($r = .48$) and famous face naming performance ($r = .41$), while the relationship with verb naming was weaker ($r = .25$). Left and right hemisphere white matter volumes in nontemporal regions were unrelated to naming performance across all tasks (all $ps > .05$). In addition, nonsignificant relationships were evident between naming and gray matter volumes in both hemispheres (all $ps > .05$). Cognitive processing models of visual naming tasks include several operations; picture recognition, semantic identification, and lexical-phonological retrieval and these are presumably mediated by different neural regions. These data suggest that white matter integrity in the left temporal lobe is critical for the operation of this distributed network for object and famous face naming.

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D.E. CRAGAR, J. CIBULA, T. FAKHOURY, D.T.R. BERRY, C. DEARTH, C. MIARA, & F. SCHMITT. Diagnosis of Nonepileptic Seizures: Use of the MMPI-2 and Motivational Test.

The diagnosis of nonepileptic seizures (NES) can be a difficult task requiring the use of expensive resources such as 24-hr EEG video monitoring. Binder et al. reported that the MMPI and the PDRT, a malingering test, aided in the discrimination of NES patients from those with epileptic seizures (ES). The present study expanded on Binder et al.'s work by using the MMPI-2 and 4 motivational tests (PDRT, DMT, LMT, & TOMM) as well as more traditional indicators to distinguish between patients with NES ($n = 19$), ES ($n = 39$), and ES + NES ($n = 17$). The most powerful

predictors of group membership were age at onset of seizures, history of psychiatric treatment, and current number of antiepileptic medications. However, several MMPI-2 scales and one of the motivational measures added a significant increment in predictive power beyond that contributed by these 3 variables.

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C. SCHRAMKE, J. VALERIANO, & K. KELLY. Predicting Pseudo-seizures Using Routine EEG, the MMPI, and Years of Seizures: A Replication.

All patients were admitted for 24-hr video EEG monitoring (vEEG) and completed the MMPI-2. Patients were referred for vEEG because pseudo-seizures (PS) were suspected ($n = 24$) or as part of a presurgical evaluation for epilepsy ($n = 18$). Of patients evaluated for PS, 8% were diagnosed with seizures (SZ), 71% were diagnosed with PS, and 21% were suspected of having PS and not given a definitive diagnosis of SZ. Using *t* tests or chi-square as appropriate, patients with probable PS were compared to patients with definitive SZ diagnoses. The PS ($n = 20$) and SZ ($n = 22$) groups were not different in years of education ($M = 11.9$ vs. 13.0), age ($M = 33.5$ vs. 40.0 years), gender (57 vs. 43% female), or the percentage applying for disability (64 vs. 36%). The PS and SZ groups were significantly different in the number of years of spells ($M = 4.9$ vs. 22.4, $p < .01$), number of elevations above 65 on the MMPI ($M = 5$ vs. 3, $p < .01$), and percentage with a *t*-score above 65 on the HY scale (68 vs. 32%, $p = .01$). Applying the logistic regression equation described in Storzbach et al. which included results of routine EEG, MMPI-2 Hy, and years of spells, yielded an overall classification accuracy of 76%, sensitivity of 85%, specificity of 68%. These findings are similar to results described in the literature and suggest that the MMPI, routine EEG, and years of spells can help identify PS patients.

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C.S. KUBU, L. CARSWELL, M. HARNADEK, & N. GALVAN. The Diagnostic Utility of the Boston and Benton Naming Tests in Epilepsy.

The Boston Naming Test and the Benton Naming Test (MAE) are two of the most frequently used measures of confrontation naming in the evaluation of surgical epilepsy patients and are presumed to be sensitive to left temporal dysfunction. Despite their wide use, relatively few studies have examined the validity of these measures in an epilepsy population. The current study applied a likelihood ratio approach to study this question. Study participants were drawn from a large series of patients referred to a surgical epilepsy center. All patients were judged to be left hemisphere dominant for language and underwent a temporal lobectomy (right = 28, left = 25). Patients were placed into either an impaired (scores \leq ~10–12th percentile) or an intact group based on performance on the confrontation naming tests. Likelihood ratios (range .76–1.3) indicated that neither test improved significantly upon the pre-test probability (~50%) of identifying patients who ultimately underwent a left temporal lobectomy. In sum, these data suggest that the BNT and MAE, using standard normative data to define level of impairment, do not substantially add to diagnostic accuracy in identifying patients with left temporal lobe epilepsy. Better clinical utility might be obtained using different levels of impairment on the tests or alternatively using another confrontation naming test more sensitive and specific to the range of word finding difficulties found in patients with epilepsy.

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D. JACKSON, J. NITSCHKE, B. HERMANN, M. SEIDENBERG, B. BELL, C. DOW, C. BURGHE, A. HANNA, & R. DAVIDSON. Resting EEG Asymmetry Differences in Temporal Lobe Epilepsy and Healthy Controls.

Patients with temporal lobe epilepsy are known to be at increased risk for interictal depression. In healthy controls, frontal and anterior temporal EEG

asymmetries are predictive of depressive symptoms. In this study, 128-channel EEG was used to map resting frontal and anterior temporal EEG asymmetries for 57 TLE patients and 17 controls during 8 1-min baselines. Asymmetry scores were computed by subtracting left from right EEG activity for homologous scalp sites (e.g., F7L = F8 - F7 power density; positive scores thus indicate increased relative right-sided power density). Self-report measures of depression were collected, and clinical interviews were conducted (SCID) to determine the presence or absence of past or current psychiatric disorder. In healthy controls, significant ($p < .05$) inverse correlations were found between Symptom Checklist-90-R Depression (SCLDEP) scores and anterior temporal delta ($r = -.54$), theta ($r = -.55$), and alpha ($r = -.53$) asymmetry. In contrast, TLE patients without a lifetime history of depression showed an opposite relation between SCLDEP scores and brain asymmetry. For these patients, significant positive correlations were found between SCLDEP scores and frontal pole ($r = .51$), and lateral frontal ($r = .54$) alpha asymmetry. These findings suggest that in TLE patients, relative right-sided frontal brain activation (i.e., more relative left-sided slow-wave activity) may act as a protective factor against depression. This is in contrast to findings from this and other studies of normal control subjects, in which relative left-sided activation is typically associated with decreased risk for depression.

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R. DOSS & S. FARNHAM. MMPI-2 Versus PAI in Detecting Depression in an Inpatient Neurologic Sample.

This study compared sensitivity of the Minnesota Multiphasic Personality Inventory-2nd edition (MMPI-2) and Personality Assessment Inventory (PAI) to detect depression in a sample of patients undergoing comprehensive inpatient evaluation for seizure disorder. Patients were classified as having depression (*Dep*; $n = 14$) or not (*NoDep*; $n = 19$) either by history or diagnosis on the unit. Counterbalanced administration of both personality measures occurred during the same admission. The 2 groups were comparable with respect to age, gender, education, cognitive ability (WAIS-III/WMS-III), and presence of antiepileptic medication. However, the *NoDep* group had a significantly younger age of seizure onset ($M = 18.58$ vs. 32.57) and the *Dep* group was significantly more likely to be prescribed antidepressant medication (91% vs. 0%). A T-score ≥ 65 on the MMPI-2 D scale or the PAI DEP scale was used to denote presence of depression. Chi-square analyses demonstrated a significant association [$\chi^2(1) = 13.30, p < .001$], between group membership and clinically significant elevation on the PAI DEP scale but not the MMPI-2 D scale. Odds-ratio analysis of these data revealed the *Dep* group was 32 times more likely than the *NoDep* group to obtain a clinically significant PAI DEP score. Overall, our findings suggest that the PAI is a more sensitive measure to detect depression in a sample of seizure patients undergoing inpatient evaluation. These results coupled with a number of psychometric and practical advantages suggest that the PAI may be a more useful personality measure for neurologic populations.

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T. DIKEL, E.B. FENNELL, & R. GILMORE. Prevalence and Incidence of Trauma and PTSD in Epilepsy Surgery Candidates.

This study compared rates of trauma and posttraumatic stress disorder (PTSD) among potential surgery candidates with intractable epilepsy. It was hypothesized that histories of trauma and PTSD would be more prevalent in non-epileptic seizure than in epilepsy patients. *Methods*: Consecutive admissions to the inpatient epilepsy monitoring unit EMU ($n = 9$) and consecutive follow-up appointments to neurology clinic ($n = 26$) were interviewed using the self-report Life Events Checklist from the Clinician Administered PTSD Scale and the clinician administered SCID PTSD module. Epilepsy or nonepileptic seizure (NES) status was determined by correlation of electroencephalographic data with videotaped typical paroxysmal behaviors. *Results*: 31.8% of epilepsy and 76.9% of NES patients met criteria for PTSD. Rates for assaultive trauma (childhood sexual

or physical abuse or adult sexual or physical assault) were 63.6% for epilepsy, and 100% for NES, patients. Rates of childhood sexual abuse were 40.9% for epilepsy, and 61.5% for NES patients. Chi-square analyses indicated statistically higher rates of PTSD with NES, and no statistical difference in rates of childhood sexual abuse or lifetime assaultive trauma between groups. *Conclusions*: Although the hypothesis that NES patients experience higher levels of PTSD than epilepsy patients was supported, both groups showed extremely high levels of assaultive trauma exposure. The extent of trauma and PTSD in epilepsy patients was unexpected. Because of the potential impact on assessment, treatment, and recovery, high base rates indicated by this study suggest a significant need for focused assessment of prior trauma and PTSD when assessing patients with intractable epilepsy.

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M. EPKER, M. AGOSTINI, D. MATHEWS, L. LACRITZ, & C.M. CULLUM. A Comparison of Methods to Localize the Epileptic Focus.

Selection of patients for surgical treatment of intractable temporal lobe epilepsy (TLE) is typically based on findings from a multidisciplinary neurodiagnostic evaluation. This study examined the relative contribution of various neurodiagnostic procedures to the determination of seizure laterality in 66 (left = 33; right = 33) temporal lobectomy candidates. Clinician interpretation of EEG, MRI, ictal and interictal SPECT, and comprehensive neuropsychological (NP) evaluation results were coded *concordant* or *discordant* depending on whether the findings agreed or disagreed with a multidisciplinary surgery team's consensus determination of seizure laterality. If a clear, lateralized decision (i.e., left or right) could not be discerned, results from the procedure were coded *indeterminate*. MRI and ictal SPECT produced the highest rates of concordance with the surgery team's designation (77%), followed by NP and EEG (64%), and interictal SPECT (58%). The highest rates of discordant decisions were produced by NP and ictal SPECT (20% and 15%, respectively), with interictal SPECT (6%), MRI (5%), and EEG (2%) disagreeing less often with the determined side of surgery. Indeterminant decisions were offered most by EEG and interictal SPECT (35%), followed by MRI (19%), NP (17%), and ictal SPECT (9%). Overall, these results emphasize the importance of using multiple neurodiagnostic procedures when determining seizure laterality in TLE, and provide further support for the use of NP evaluation procedures in the assessment of temporal lobectomy candidates.

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D. FUERST, C. WATSON, Q. POORE, B. HAYMAN-ABELLO, T. ERGH, A. HUTCHINSON, B. MAST, S. HAYMAN-ABELLO, A. YAMAMOTO, & K. ADAMS. Lateralize TLE and HS Using Wada Memory Scores and WMS-R LM and VR Subtests.

Studies have shown that Wada's test and the WMS-R Logical Memory and Visual Reproduction subtests (WMS-R LM and WMS-R VR) may predict laterality of seizure onset in patients with unilateral TLE. This study extends that research to patients with unilateral hippocampal sclerosis (HS) documented by VMRI. Seventeen participants had left temporal lobe seizure onset, 16 had right temporal onset. Measures were the difference between left and right injection memory scores from Wada testing (WADA), and the difference between WMS-R LM and VR percentile ranks at zero and 30-min delays (WMS-RI and WMS-RD). Two "clinical" prediction models were tested: (1) discrepancy of 2 or more memory score points on the Wada test (WADADIFF); (2) highest score on WMS-R, verbal *versus* nonverbal, dummy coded (WMPATT). Five discriminant function (DFA) models were also tested; (3) WADA score; (4) WMPATT; (5) WADA and WMPATT; (6) WMS-RI and WMS-RD; (7) WADA, WMS-RI and WMS-RD. The "clinical" models performed poorly (WADADIFF, 10 misclassifications; WMPATT, 8). DFA showed WMS-R models also performed poorly, with 10 misclassifications for both Models 4 and 6. DFA with WADA alone produced 3 misclassifications. Combining WMS-R and Wada data

improved accuracy. Model 5 resulted in 2 misclassifications, and Model 7 produced 1 misclassification (97% accurate). Of note, participants misclassified by WADA alone were accurately lateralized by both WMS-R models. The WMS-R LM and VR subtests improve accuracy of lateralization by the Wada test in patients with unilateral HS.

Correspondence: *Darren Fuerst, Ph.D., Department of Psychiatry, Wayne State University School of Medicine, Harper Hospital, 3990 John R, Detroit, MI 48201.*

S. KORTENKAMP, W. BARR, C. RANDOLPH, & A. ETTINGER. RBANS Performance in Patients With Temporal Lobe Epilepsy.

The Repeatable Battery for Neuropsychological Assessment (RBANS) has been shown to be a useful screening tool in neuropsychological evaluations. The current study investigated whether the test would be useful in an epilepsy population. Twenty-five temporal lobe epilepsy (TLE) inpatients referred for neuropsychological testing during continuous video/EEG monitoring were assessed using the RBANS. Analyses indicate that, as a group, the patients with epilepsy had worse performance on the Attention, Language, Visuospatial/Visuoconstructional, Immediate Memory, and Delayed Memory indices as well as on the Total Score Index than a group of age, education, and gender matched normal controls. When the TLE group was divided in those with right ($n = 8$) or left ($n = 15$) TLE, the patients with right TLE performed significantly worse than controls on subtests assessing visuospatial/visuoconstructional skills, language, attention, and delayed memory. The left TLE patients were worse than controls on tests of language, attention, and delayed memory but did not demonstrate worse performance on visuospatial/visuoconstructional tests. However, there were no significant right versus left group differences on any of the performance variables. Overall, we found that the RBANS does have some utility as a screening tool in the assessment of epilepsy. It is especially convenient for an inpatient population when, due to time constraints, a full standard neuropsychological battery may not be appropriate.

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Symposium 5/1:30–3:15 p.m.

VISUAL ATTENTION IN ALZHEIMER'S DISEASE

Organizer and Chair: David S. Goldmacher

D.S. GELDMACHER. Visual Attention in Alzheimer's Disease.

Impairments in visual attention have been recognized as a part of the syndrome of Alzheimer's disease (AD) for many years, but the nature and magnitude of AD patients' visual attentional problems are often neglected in the clinical setting. This symposium will address the problems of impaired visual attention and related constructs in AD from multiple experimental and theoretical perspectives. Dr. Raja Parasuraman will discuss experimental psychological approaches and findings. Dr. Steven Anderson will review more standard neuropsychological methods of assessing visual attention, as well as computer-based visual attention tasks, especially as they relate to driving ability. Dr. Nancy Foldi's group will address visual selective attention on cancellation tasks. Dr. David Goldmacher will report on the relationships between visual attention and eye-movement studies of visual exploration. Dr. Maurizio Corbetta will outline a theoretical framework that examines different elements of visual attention, and the ways in which experimental approaches can identify the components of attention. Together, the symposiasts will present a thorough review of essential concepts in recognizing, investigating, and understanding visual attentional dysfunction in Alzheimer's disease.

Correspondence: *David S. Goldmacher, M.D., Alzheimer Center, 12200 Fairhill Road, Cleveland, OH 44120.*

R. PARASURAMAN. Cognitive Tests of Visual Attention in Early Alzheimer's Disease.

Selecting visual information without eye movements involves two operations: (1) covert shifts of attention; and (2) changes in the spatial scale of attention. Location-cuing tasks have been used to investigate the former, with the typical finding being that a valid cue reduces RT to detect a target. To examine the latter operation, a novel visual-search task was developed using location cues that varied in size and hence in precision of target localization. Systematic decreases in the size of the cue towards the size of the target progressively decreased search RT. Mildly demented AD patients exhibited a specific "disengagement deficit" in which they were abnormally slow in shifting their attention from an incorrectly cued location. The AD group showed an overall benefit of cuing in the cued-visual search task but the amount of benefit was markedly reduced. Moreover, when the range of cue sizes was large, AD patients showed a benefit only for the most precise cue, suggesting that AD constricts the spatial scale of attention to a very narrow range. To examine at what stage these attentional deficits appear, nondemented adults at genetic risk for developing AD due to inheritance of the apoE gene were examined on the same tasks. Compared to those without an e4 allele of the APOE gene, e4 carriers exhibited a disengagement deficit and a reduced spatial scaling effect, the same pattern as shown by clinically diagnosed AD patients. The results indicate that tests of covert attention shifting and spatial scaling of attention provide sensitive behavioral assays of early attentional dysfunction in AD and in nondemented individuals at risk of developing AD.

Correspondence: *Raja Parasuraman, Cognitive Science Lab, C.U.A., 250 O'Boyle Hall, Washington, DC 20064.*

S. ANDERSON & M. RIZZO. Visual Attention Related to Cognition and Driving in Early Alzheimer's Disease.

Impairments of visual attention appear early in the course of Alzheimer's disease (AD) and likely contribute to performance reductions in other cognitive domains and to functional decline. We examined visual attention in AD in relation to basic and higher order visuo-perceptual abilities and cognition. Forty-two patients with mild probable AD (NINCDS-ADRDA criteria) and 22 matched controls without dementia were tested on a battery of standardized neuropsychological measures and computer-based visual attention tasks. There were no differences between groups on static visual acuity, stereoacuity, dynamic visual acuity or motion direction discrimination. However, AD patients performed significantly worse than controls on measures of visual sustained attention, divided attention, selective attention, and visual processing speed. Reduced attentional skills were strongly related to overall cognitive impairment. We also compared the performance of 21 licensed drivers with AD to that of 18 matched controls on simulated rear-end collision avoidance scenarios, and of 18 drivers with AD to that of 12 controls on an intersection incursion scenario on a driving simulator, and found that attentional defects were a significant risk factor for crashes by AD patients. The impairments of visual attention that appear early in the course of AD can have major implications for competency in real world activities; more routine assessment of visual attention in AD patients could give a more accurate view of their useful perception and help guide management.

Correspondence: *Steven Anderson, Department of Neurology, University of Iowa Hospitals, Iowa City, IA 52242.*

L.A. SCHAEFER, N.S. FOLDI, R. JOHNSON, JR., D. CAPUTO, R.E.C. WHITE, M. TORROELLA CARNEY, J.T. BERGER, L. MACINA, & A. STEINBERG. Effects of Physical Variables on Visual Selective Attention in AD: Analyses of Omissions and Commissions.

One reason patients with probable Alzheimer's disease (ADs) appear overwhelmed in common situations is due to deficits in selective attention. The present study was designed to investigate the impact of AD on a visual search task using selective cancellation tests. Visual load was manipulated by increasing the physical variables of *density* and degree of *physical similarity* between targets and distractors. We hypothesized that ADs would be more vulnerable to increased load than normals. Normals ($N = 15$) and

probable ADs ($N = 15$) were given 18 cancellation tests, each containing multiple targets and distractors. To elicit feature analysis, novel stimuli were used which were not identifiable with known semantic categories. Both omission and commission error types were measured. All participants were additionally given standard neuropsychological tests. Although ADs made more errors, normals and ADs were similarly vulnerable to load manipulations: omissions and commissions increased with greater physical similarity ($p < .01$), while only omissions increased with density ($p < .0001$). For ADs, omissions correlated with standard tests of attention, but were not significantly related to degree of dementia. In contrast, commissions were correlated with measures of dementia severity, as well as tests of executive functioning. Thus, we found that while ADs performed worse than normals, they responded to changes in density and physical similarity in comparable ways. The data suggest that omissions and commissions each represent different aspects of selective attention which are subserved by different neural mechanisms. Finally, analyses of these 2 error types may also provide ways of measuring therapeutic efficacy of cholinesterase inhibitors.

Correspondence: Nancy S. Foldi, Ph.D., Department of Psychology, Queens College-CUNY, 65-30 Kissena Boulevard, NSB E318, Flushing, NY 11367.

D.S. GELDMACHER & T. RIEDEL. Visual Exploration in Alzheimer's Disease: Eye Movements With "Pop-Out" Stimuli.

Daily life requires ongoing processing of multiple continuous visual stimuli. This aspect of visual function is not well captured by methods using brief stimulus presentations. Our group has investigated the stimulus properties which influence spatially directed attention in aging and AD on tasks requiring visual exploration. AD patients complete several different cancellation formats more slowly than healthy age matched adults. Age also impairs the efficiency, though not the accuracy, of cancellation performance. Eye-movement analysis allows direct examination of the patterns of visual exploration that contribute to continuous task performance. Using a computerized infrared eye position monitoring system, 8 AD cases and 8 controls were studied during inspection of easily detected "pop-out" stimuli and more difficult feature-detection stimuli. Significant group differences were observed for mean fixation duration [$F(1, 13) = 6.43, p < .03$] and fixation number [$F(1, 13) = 10.10, p < .01$]. Perhaps more importantly, interactions between group and stimulus type were identified for fixation duration [$F(1, 13) = 7.34, p < .02$] and fixation number [$F(1, 13) = 4.80, p < .05$], suggesting that people with AD and healthy controls manage the search for poorly discriminable stimuli differently. The results support a role for eye movement analysis as a useful adjunct to more traditional approaches of investigating visual and spatial selective attention.

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M. CORBETTA. Attentional Networks or Attentional Tricks in the Human Brain?

"Attention" is not a single cognitive function, and is not mediated by a single neural system. Rather, the brain hosts a set of functions and systems for selecting stimuli and responses of high behavioral relevance. Cognitive neuroscience aims to define *what* are the elements of attention, *where* are they localized in the brain, and *how* do they produce behavior. A clinically helpful distinction is between (1) vigilance, or focusing of attention in the absence of incoming stimuli, to detect important but infrequent stimuli; (2) perceptual attention, or focusing of attention on relevant incoming stimuli, while filtering out distracting information; and (3) selection for action, or selecting a response among competing ones. Another controversial issue is whether the brain contains dedicated "attentional" networks, analogously to language or memory networks, or whether attention is the emergent property of simple "selection" tricks that are embedded within sensory and motor systems. Lesion, psychophysical, and functional imaging studies will be reviewed to support these distinctions.

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Symposium 6/1:30–3:15 p.m.

NEUROPSYCHOLOGICAL RESEARCH IN PEDIATRIC BRAIN TUMORS

Organizer and Chair: M. Douglas Ris

M.D. RIS. Neuropsychological Research in Pediatric Brain Tumors.

As the number of survivors of childhood intracranial neoplasms increases, so does the need to better understand the neurobehavioral morbidity associated with these conditions. Brain tumors also provide natural experiments for inquiries into developmental perturbations that result from a host of insults to the brain including radiation, compression, neurosurgical trauma, and toxic chemotherapy agents. This symposium presents a sampling of neurobehavioral research on pediatric brain tumors. The stage is set by an overview paper, which is followed by recent empirical contributions by researchers who have established programmatic research efforts in this area. Dr. Spiegler and colleagues report their findings on early predictors of outcome—important in disentangling the pathophysiology of risk and in guiding psychosocial interventions. In a similar vein, Dr. Beebe describes the disease correlates of neuropsychological function/dysfunction in an unusually large sample of children who received only surgical intervention for their disease. Dr. Ris reports on intellectual outcome in a recent attempt to decrease treatment-related toxicity for children with average risk medulloblastomas, and Dr. Mulhern and colleagues provide imaging evidence of the neuropathological substrate for the behavioral morbidity in patients treated for this same disease. Finally, Drs. Butler and Copeland describe an innovative intervention for attention/concentration problems commonly seen in children following treatment for brain tumors. Overall, this symposium offers the attendee a cross-section of research on outcome, correlates of risk, neuropsychological substrate, and neuropsychological treatment from the area of pediatric brain tumors.

Correspondence: Douglas Ris, Psychology Division, Children's Hospital Medical Center, 3333 Burnet Avenue, Cincinnati, OH 45229.

M.D. RIS. Methodological Developments in the Neuropsychology of Pediatric Brain Tumors.

Published reviews documented the earlier state of neurobehavioral research in the area of pediatric brain tumors. This paper revisits those reviews to provide an updated "developmental trajectory" for the field as well as a summary of how research in this area relates to neurobehavioral inquiries into other childhood conditions, and to broad neurodevelopmental theory. Encouragement can be drawn from the significant progress made in many of the six prescriptions offered by Ris and Noll. More specifically, sophistication in neuropsychological measurement has improved somewhat and more homogeneous groups of children are being studied. Nevertheless, the investigation of biobehavioral factors in children with brain tumors is slowed by the relative rarity of these diseases compared to many other pathological conditions of childhood (e.g., head injury, learning disabilities) and by the medical priorities of cooperative groups able to assemble large samples for scientific study. Some trends can be discerned which hold promise for accelerating our progress, and they form the basis for an updated set of "Future Directions for the New Millennium."

Correspondence: Douglas Ris, Psychology Division, Children's Hospital Medical Center, 3333 Burnet Avenue, Cincinnati, OH 45229.

B. SPIEGLER, C. RONCADIN, M. DENNIS, & M. GREENBERG. Predicting Adaptive Outcome From Medical Events in Children After Cerebellar Tumors.

Children treated for tumors of the posterior fossa (PF) are at risk for later neurocognitive and adaptive deficits. The risk varies with age at treatment, time since treatment, and cranio-spinal radiation. We tested the hypothesis that neurocognitive and adaptive outcome is related to medical markers

and events at presentation and thereafter. Participants were 59 participants surviving at least 5 years after surgery for PF tumors: 30 had medulloblastoma and craniospinal radiation and 29 had cerebellar astrocytoma. For each participant, 34 events and/or symptoms were aggregated into 6 clusters: disturbances of consciousness, increased intracranial pressure, neurological events (e.g., bleeds, infections), cerebellar signs, bulbar signs, and sensory-motor symptoms. Events were coded and summed at each of 4 time periods (at presentation; peri-operative period; 5 years post diagnosis; beyond 5 years). Outcome measures assessed IQ, memory, and quality of life. The medulloblastoma group had significantly more events/symptoms beyond 5 years than the astrocytoma group, although the groups did not differ at earlier time points. Regression models using peri-operative events/symptoms, tumor group, age at diagnosis, and survival years significantly predicted outcome in each domain (adj. $R^2 = .47$ for IQ; adj. $R^2 = .29$ for memory; adj. $R^2 = .15$ for functional independence; and adj. $R^2 = .12$ for health-related quality of life). Each model had a different combination of significant regressors. Knowledge of medical events and/or symptoms helps to predict long-term outcome in survivors of childhood posterior fossa brain tumors.

Correspondence: *Brenda Spiegler, Hospital for Sick Children, 555 University Avenue, Toronto, ON M5G 1X8, Canada.*

D.W. BEEBE & M.D. RIS. Contributors to Neurobehavioral Outcome in Low-Grade Childhood Astrocytoma.

Survivors of childhood brain tumors are at increased risk for significant cognitive, adaptive, and behavioral difficulties. Radiotherapy has been identified as a particular risk factor, while chemotherapy may be a lesser risk factor. Though of considerable theoretical interest, data have been inconsistent with regard to the neurobehavioral effects of tumor size, location, and pre- and peri-surgical complications. This may be due to methodological limitations, including a relative lack of prospective studies and the use of small and diagnostically heterogeneous samples. Most studies have focused on children who have undergone multiple treatments, potentially masking the effects of factors other than radiation and chemotherapy. This presentation will discuss the neurobehavioral outcomes of over 200 children who underwent surgical resection for low-grade astrocytomas. This sample was unique in its large size, diagnostic homogeneity, and absence of chemotherapy and radiotherapy. Detailed medical records were prospectively maintained on surgical complications and on presurgical tumor size, location, neurological deficits, and hydrocephalus. Also prospectively gathered were data on intellectual ability, academic skills, and emotional, behavioral, and adaptive functioning. We predict that the large sample size and the lack of radiotherapy—and chemotherapy-related statistical “noise” will provide the power to reveal significant relationships between these neurobehavioral outcome measures and (1) brain tumor size and location and (2) presurgical and peri-surgical events. This information is intended to facilitate early identification of children who are at risk for neurobehavioral difficulties and to suggest areas in which clinical practice may be modified to minimize neurobehavioral morbidity.

Correspondence: *Dean Beebe, Psychology Division, Children's Hospital Medical Center, 3333 Burnet, Cincinnati, OH 45229.*

M.D. RIS, D. BEEBE, R. PACKER, J. GOLDWEIN, D. JONES-WALLACE, & J. BOYETT. Intellectual Outcome After Reduced Dose Radiation Therapy for Medulloblastoma.

Under a Children's Cancer Group protocol for children with average risk medulloblastoma/primitive neuroectodermal tumor (MB/PNET), the intellectual outcome of 43 children was studied longitudinally for up to 4 years post treatment. All had been treated with a reduced dose craniospinal radiation regimen (2340 cGy to the neuroaxis, 3180 cGy boost to the posterior fossa) and adjuvant chemotherapy. Outcome was modeled with an estimated curve defined by the average slope of all of the individual subjects' curves. There was a significant decline from baseline for Full Scale IQ (FSIQ), Verbal IQ (VIQ), and Nonverbal IQ (NVIQ) ($p < .001$ in each case). Rate of change was estimated to be -4.3 FSIQ points per year, -4.2 VIQ points per year, and -4.0 NVIQ points per year. Females were

more subject to VIQ decline than were males, and young children (<7 years of age) were more negatively affected than were older children. Patients with higher baseline scores suffered greater declines in IQ than did those with lower baseline scores. This study represents the largest series of patients with average risk PNETs treated with a combination of reduced dose radiation therapy and adjuvant chemotherapy. Intellectual loss was substantial, but suggestive of some degree of intellectual preservation when compared to published reports of effects associated with conventional radiation therapy dose.

Correspondence: *Douglas Ris, Psychology Division, Children's Hospital Medical Center, 3333 Burnet Avenue, Cincinnati, OH 45229.*

R. MULHERN, W. REDDICK, X. XIONG, J. GLASS, S. PALMER, T. MERCHANT, L. KUN, & A. GAJJAR. qMRI White Matter Changes and Neuropsychological Development in Medulloblastoma.

Medulloblastoma, also termed primitive neuroectodermal tumor (PNET) of the posterior fossa, is the most common malignant brain tumor of childhood. Oftentimes, aggressive multimodality treatment, including surgical resection and chemotherapy with or without local and/or craniospinal radiation therapy, is needed for long-term survival. However, effective treatment frequently comes with the price of compromised neuropsychological functioning, especially in very young children and those treated with higher doses of radiation therapy. We have previously published data that supports the argument that diffuse white matter damage is one neuroanatomical substrate that can explain intellectual deterioration and the failure to acquire information at an age-appropriate rate. White matter loss may also mediate the known adverse risks associated with a young age at treatment and a higher radiation therapy dose. In this presentation, we will discuss original data resulting from a longitudinal study of 26 children treated for medulloblastoma on a single institutional protocol who received routine qMRI and neuropsychological testing of attention (Conner's CPT), verbal memory (CVLT), academic achievement (WIAT), and intellectual development (WISC-III) on 4 occasions during the first 2 years after their initial diagnosis. Our primary hypothesis is that quantitative white matter loss will antedate or be concurrent with a decline in neuropsychological performance. Our secondary hypothesis is that performance on measures of executive function, especially those involving sustained attention and information processing speed, will precede deterioration on measures of memory, achievement and intellect.

Correspondence: *Raymond Mulhern, Behavioral Medicine, St. Jude Children's Research Hospital, 332 N. Lauderdale, Memphis, TN 38105.*

R. BUTLER & D. COPELAND. Psychological Remediation in Childhood Brain Tumor Survivors.

Brain tumors are the 2nd most common malignancy in childhood. While disease free survival of these tumors is increasing, many patients treated for brain tumors suffer severe deficits in attention/concentration, intelligence, motor abilities, memory, and academic skills. These deficits can be progressive in nature, and as survivors enter adulthood unemployment becomes extremely common, likely due to poor academic achievement secondary to attentional deficits. An increased incidence of psychosocial impairment has also been reported in this population. We developed a comprehensive, intensive cognitive and psychological remediation program designed to address the needs of this population. Specifically, therapies used in brain injury rehabilitation, special education, and child clinical psychology were combined in order to maximize skill acquisition. This treatment was administered to 10 children who were off treatment for a brain tumor. When compared to 6 children in a waiting-list control condition, the children who received remediation demonstrated statistically significant improvement on measures of attention/concentration, vigilance in particular. While continued research and development are needed, the remediation program does hold promise for improving cognitive functioning in children who have deficits secondary to childhood brain tumors.

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Paper Session 8/3:30–5:15 p.m.

DEMENTIA II: SUBCORTICAL DEMENTIAS**B.R. REED, J.L. EBERLING, D.M. MUNGAS, M.W. WEINER, H.C. CHUI, & W.J. JAGUST. Lacunes and Abnormal White Matter Differently Impair Cortical Function.**

In order to better define the pathophysiology of cognitive dysfunction associated with subcortical cerebrovascular disease, we performed MRI, PET, and cognitive studies of 35 patients with subcortical lacunar infarcts (radiologically defined). White matter signal hyperintensities (WMSH) and cognitive function were unselected and spanned a wide range. MRIs were segmented to measure volumes of WMSH and lacunes. Hippocampal volumes were drawn. All MRI volumes were normalized to intracranial volume. Cortical glucose metabolism was measured using high resolution PET, quantitated by drawing volumes of interest (VOIs) on the participant's volumetric MRI. The PET and MRI were coregistered, the VOIs transferred to the PET data set, and metabolic activity quantitated in the form of normalized count ratios. Metabolic rates were calculated when input functions were available. Cognitive function was measured using 3 composite measures, each developed using item response theory to have linear measurement characteristics: Global, Memory, and Executive. All scales were associated with WMSH and relative metabolism in dorsolateral frontal cortex. However, Global and Memory correlated with hippocampal volume but not lacunar volume, whereas Executive correlated with lacunar volume, but not hippocampal volume. Absolute whole brain metabolism was diminished by WMSH, but not by lacunes. Lacunes and WMSH have different effects on cortical metabolism and, hence, on cognitive function; WMSH broadly reduces neocortical metabolism and correlates with generalized cognitive loss. Lacunes selectively reduce prefrontal metabolism and likely impair executive function. Hippocampal atrophy is important and may reflect the presence of AD. Cognitive impairments in lacunar stroke likely reflect the interaction of multiple pathologies.

Correspondence: Bruce Reed, UC Davis Alzheimer's Disease Center, 150 Muir Road (127A), Martinez, CA 94553.

J. CARR, M. SINDEN, & J. MARTZKE. Effect of Pallidotomy on Conditional Associative Learning Is Moderated by Task Experience.

Prefrontal-subcortical circuits are thought to play a role in the development of strategies to solve cognitive problems. We tested whether the integrity of this circuitry becomes less important as subjects gain experience solving the Conditional Associative Learning Task (CALT), a task sensitive to deficits in the strategic control of memory. The CALT requires the use of trial and error to determine 6 abstract design-color associations. Six trials are given per administration. Learning is indexed by reductions in the number of errors/trial. Twelve patients with Parkinson's disease were randomly assigned to 2 groups. The late group was tested twice pre pallidotomy (PVP) and once post PVP ($n = 8$, 3 left hemisphere). The early group was tested once pre PVP, and twice post PVP ($n = 4$, all left hemisphere). The inter-assessment interval was two months. There was a significant Group \times Assessment \times Trial interaction. The late group learned over the course of their 1st and 2nd assessments. Learning was somewhat attenuated during their third (post-PVP) assessment. The early group learned over their first session. However, during their 2nd (post-PVP) assessment they made more errors/trial as the administration progressed. There was evidence of a return of learning during their 3rd assessment. This different effect of PVP in the early and late groups was also present in the data solely from the left PVP patients. These results suggest that prefrontal-subcortical circuits play a particularly important role during the acquisition of the CALT, and suggest that PVP produces a decrease in the strategic control of memory in patients with PD.

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J. HAMILTON, D.P. SALMON, J. COREY-BLOOM, S. JERKINS, J.S. PAULSEN, & G. PEAVY. Behavioral Ratings Predict Functional Decline in Huntington's Disease.

Introduction: Studies have examined the cognitive, behavioral, and motor correlates of functional decline in Huntington's disease (HD) individually, but no one study has examined the relative contribution of these correlates for predicting functional success. *Methods:* Twenty-seven HD patients and 13 presymptomatic, mutation carriers participated in the study. They were evaluated using the pattern recognition, spatial recognition, and spatial working memory tests from the Cambridge Neuropsychological Test Automated Battery (CANTAB), the informant-rated Frontal Lobe Personality Scale (FLOPS), and the Unified Huntington's Disease Rating Scale motor examination. Functional ratings included the informant-rated Huntington's Disease-Activities of Daily Living Scale (HD-ADL) and the clinician-rated Functional Capacity Scale (FCS). *Results:* The HD-ADL total score and FCS total score were dependent variables in univariate hierarchical multiple regression analyses. Independent variables were the motor examination score, cognitive composite score (averaged standardized performances on the CANTAB tests), behavioral composite score (average change rating on the FLOPS Executive Dysfunction and Apathy subscales), and the FLOPS Disinhibition subscale. The results of the two analyses were essentially identical. The FLOPS measures accounted for significant variance in both analyses ($p < .001$) above and beyond that accounted for by the motor ($p < .001$) and cognitive scores ($p > .5$). Only the motor score and behavioral composite yielded significant regression coefficients (both $p < .001$). *Discussion:* These results suggest that early changes in motivation, initiation, and executive functioning greatly affect functional decline in HD even after the effects of motor disability and cognitive dysfunction are controlled.

Correspondence: Joanne Hamilton, ADRC, 9500 Gilman Drive, La Jolla, CA 92093-0948.

C. NEHL, R.E. READY, J. HAMILTON, J.S. PAULSEN, & R. RODNITZKY. Effects of Depression on Working Memory in Presymptomatic Huntington's Disease.

Huntington's disease (HD) is an autosomally dominant terminal illness characterized by a gradual deterioration in motor, cognitive, and emotional functioning. HD is not clinically diagnosed until the presence of motor symptoms but there is a growing body of research suggesting that cognitive decline may precede the onset of motor symptoms. Depression is estimated to occur in 9 to 63% of individuals with HD and may also precede the onset of motor symptoms by 2 to 20 years. Additionally, depression is associated with changes in cognitive abilities. The contribution of depression to cognitive decline in presymptomatic individuals at risk for HD ($N = 15$) was investigated. Participants were administered tests from the Cambridge Automated Neuropsychological Assessment Battery measuring visual and working memory. Depression was assessed with the Beck Depression Inventory and the Unified Huntington's Disease Rating Scale. Time to disease onset was estimated with an equation using CAG repeat length and age of HD onset in the affected parent. Estimated time to disease onset and the BDI were significantly correlated ($p < .05$) with working memory ($r_s = .55$ and $-.65$, respectively). Regression analyses indicated that estimated time to onset and an aggregate of the 2 depression measures significantly predicted working memory [$F(2, 11) = 11.607$, $p < .01$]; both variables were significant predictors ($p < .05$). Findings indicate that both depression and estimated time to disease onset of HD affect cognitive performance. Thus, the early cognitive changes in HD may be exacerbated or partially attributable to depression in some individuals. It is important to identify and treat depression in individuals pre-symptomatic for HD as alleviation of depressed mood may result in increased cognitive performance.

Correspondence: Jane Paulsen, The University of Iowa, Department of Psychiatry, Psychiatry-Research 1-289 MEB, Iowa City, IA 52242.

R. FAMA, A. PFEFFERBAUM, & E.V. SULLIVAN. Relationship Between Motor Sequencing and Executive Abilities in Parkinson's Disease.

Although motor sequencing deficits in Parkinson's disease (PD) have been shown to be related to both primary motor dysfunction (nigrostriatal sys-

tems) and higher order cognitive sequencing dysfunction (frontostriatal systems), the relative importance of these processes to motor sequencing deficits has not been clearly established. We examined the extent and pattern of motor and cognitive sequencing deficits and the relationship between motor sequencing deficits and frontal executive abilities in 16 PD patients. Participants received quantitative tests of speeded movement (fine finger movement), motor sequencing (Ozeretski, Fist-Ring, Pronation-Supination, Fist-Edge-Palm), and cognitive sequencing/frontal executive abilities (Picture Arrangement, Wisconsin Card Sorting Test). All analyses were based on age-corrected Z scores derived from upwards to 89 normal controls. Relative to these norms, the PD group was impaired on most of the motor and cognitive sequencing measures. In general, severity of motor rigidity accounted for PD impairment on the motor sequencing tasks. Despite the predominant motor features of PD, however, cognitive sequencing and executive functioning test scores predicted motor sequencing performance in PD as well as and in many cases better than simple motor scores. The relationship between motor sequencing scores and scores on tests of executive abilities or cognitive sequencing could not be explained by age, estimated cognitive ability (WAIS-R Vocabulary), disease duration, or dementia severity (MMSE). These results suggest that the motor sequencing deficit in PD is not simply due to primary motor disability and that frontostriatal pathways, which mediate cognitive sequencing and executive abilities, substantially contribute to motor sequencing performance in PD.

Correspondence: R. Fama, SRI International, Neuropsychiatry Program, 333 Ravenswood Avenue, Menlo Park, CA 94025.

H. KATZEN, B. LEVIN, & M. LLABRE. Lateralization and Symptom Type at Disease Onset Affect Cognition in Parkinson's Disease.

The present study examined the effects of lateralization and type of motor symptom at disease onset on cognitive functioning in Parkinson's disease. While previous studies have examined these factors separately, no investigation has considered the effects of these variables simultaneously. The current study proposed that patients with right-sided disease onset would show fewer cognitive changes than patients with left-sided disease onset. In addition, patients with tremor only at disease onset were predicted to have less cognitive decline than patients with bradykinesia and rigidity. Further, it was also hypothesized that there would be an additive effect of lateralization and type of motor symptom at disease onset, where patients with right-sided tremor would be free from cognitive decline and patients with left-sided bradykinesia/rigidity would demonstrate the greatest cognitive impairments. Eight cognitive tasks assessing language, visuospatial, memory and executive functions were administered to 67 patients with idiopathic PD. MANCOVAs revealed patients with right-sided tremor at disease onset performed significantly better than the other PD subgroups across the entire neuropsychological battery. Further, this PD subgroup demonstrated preservation of cognition as compared to a group of healthy control participants, while patients with right-sided bradykinesia/rigidity, left-sided tremor, and left-sided-bradykinesia/rigidity at disease onset showed widespread deficits in cognitive functioning. No additive risk of cognitive decline was observed for patients with left-sided bradykinesia/rigidity. In sum, the findings indicate that a preservation of cognition in PD requires both a relative sparing of the right hemisphere and the frontal subcortical circuitry underlying bradykinesia/rigidity. If either system is disrupted, neuropsychological deficits will be observed.

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Paper Session 9/3:30–5:15 p.m.

PSYCHIATRIC DISORDERS

B.K. CHRISTENSEN, Z. J. DASKALAKIS, R. KAPUR, & S. KAPUR. Inhibitory Motor Control in Medicated and Unmedicated Patients With Schizophrenia.

The prefrontal cortex and basal ganglia are key structures that mediate the inhibition of competing or unwanted motor responses. In addition, these

brain structures have been strongly implicated in the pathophysiology of schizophrenia. Although motor abnormalities are an accepted feature of schizophrenia, few studies have directly investigated the ability of these patients to inhibit motor responses. Moreover, most studies examining motor control have involved patients treated with neuroleptic medications, which exert a deleterious effect on motor function. In order to accurately ascribe motor deficits to schizophrenia *per se*, studies must also examine motor function in neuroleptic-naïve patients. In the current study the performance of healthy controls ($n = 13$), medicated patients ($n = 11$), and unmedicated patients ($n = 13$) were compared on a well-developed measure of motor inhibition: the stop-signal task. In this task, participants attempt to inhibit lever-press responses to an imperative stimulus in the presence of a randomly presented stop signal (auditory beep). The groups did not significantly differ in their reaction time to the imperative stimulus [$F(2,30) = .15, p = .86$]. However, significantly longer stop-signal reaction times (i.e., less inhibition) were revealed among medicated patients as compared to controls or unmedicated patients [$F(2,30) = 3.34, p = .047$]. Importantly, the inhibitory performance of unmedicated patients was equal to that of controls. These data suggest that motor inhibition deficits among patients with schizophrenia may be attributed to the effects of neuroleptic medication.

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C. BRENNER, P. LYSAKER, & B. O'DONNELL. Motion Processing in Schizophrenia.

Deficits in early-stage visual processing may affect performance on higher-order cognitive measures, such as working memory, in schizophrenia. Neuroimaging and animal lesion studies have indicated the involvement of separate pathways, the ventral "what" pathway and the dorsal "where" pathway, for the identification and processing of form and trajectory information. The relationship between dysfunction of these pathways and their effect on short term working memory in schizophrenia is not well characterized. We administered two discrimination (form and trajectory) and two delayed matching to sample (form and trajectory) tasks to 15 medicated participants with schizophrenia or schizoaffective disorder and 8 normal controls. Additionally, to assess the relationships of early stage visual processing to working memory we administered WAIS-III subtests: Digit Symbol and Digit Span. The schizophrenia spectrum group exhibited significantly worse performance on both trajectory tasks [$F(1,22) = 5.63, p = .027$] compared to normals. Results indicate that the dorsal cortical pathway involved in motion processing, may be more affected than the ventral pathway in schizophrenia. Digit symbol coding correlated with form and trajectory working memory ($r = .568$ and $r = .466$ respectively), and digit span correlated with trajectory working memory ($r = .492$). This suggests that the delayed matching to sample tests used here are associated with attentional and working memory measures derived from neuropsychological tests. Moreover, these dynamic form and trajectory stimuli may provide a more concise measurement of the early visual processing dysfunctions of the dorsal and ventral streams and their relation to working memory in schizophrenia.

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S. PURDON, N. WOODWARD, S. DAVID, & E. STIP. Procedural Learning and Neuroleptic Treatment in Schizophrenia.

Sixty-five patients with early phase schizophrenia were enrolled in this 6-month prospective evaluation of double-blind treatment with olanzapine, risperidone, or haloperidol effects on procedural learning quantified with the Tower of Toronto Test. Procedural learning is presumed to be diminished by adverse effects of medication on structures in the dorsal striatum and a continuum of such effects was proposed ranging from maximal to minimal corresponding to haloperidol, risperidone, olanzapine, and clozapine. This hypothesis has been supported by reports of impaired performance and reduced striatal activation during tests of procedural learning in patients receiving first generation antipsychotics. Furthermore, a change from 1st generation neuroleptic treatment to clozapine showed evidence

of restoration of procedural learning. The present report undertook a prospective evaluation of 6 weeks and 6 months treatment with haloperidol, risperidone, or olanzapine relative to a medication-free baseline. Thirty-nine of the original 65 patients completed all 3 assessments. Procedural learning, defined as the improvement observed between 2 blocks of 5 trials of the Tower of Toronto, was preserved after 6 weeks of all 3 treatments but showed a substantial decline after 6 months of treatment with haloperidol or risperidone. These data are consistent with the differential activity of the 3 medications in dorsal striatum structures and suggest that the advantages of olanzapine over haloperidol and risperidone in relation to extrapyramidal syndromes may also generalize to procedural learning. The results also suggest that the procedural learning disadvantages of haloperidol and risperidone accrue slowly and are apparent after 6 months of treatment.

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C. WEINER, M. PRIMEAU, & D. ERHMANN. Activational Effects of Androgens and Affect in Women.

Understanding the organizational and activational effects of human gonadal hormones on behavior has depended on the study of endocrine disorders. Polycystic ovarian syndrome (PCOS) is a hormonal disorder that begins in puberty and is characterized by chronically augmented levels of free testosterone (FT). The purposes of this study were (1) to compare the negative mood states of women with PCOS to women with normal hormonal levels, and (2) to examine the relationship between negative moods and androgens. Twenty-seven women with PCOS were case-matched to 27 normal menstruating women on body mass index, since being overweight is a common symptom of PCOS and could affect mood states. FT, total testosterone, sex hormone binding globulin, estradiol, and progesterone levels were assayed. Group differences in self-reported anger, depression, anxiety, and aggression were analyzed, and scores across groups were correlated with hormone values. Analyses controlled for confounding symptomatology (negative stress, body image, acne, and hirsutism). Depression was significantly increased in the PCOS group [$F(2,51) = 5.49, p < .01$], and remained so even after considering the variance related to the syndrome's physical symptoms and the other mood states. Furthermore, a curvilinear relationship between FT and negative affect across groups was observed: the highest negative mood scores were associated with FT values just beyond the upper limits of normal, while decreased negative mood corresponded to normal and extremely high values of FT [state depression: $F(50) = 2.96, p < .05$; trait depression: $F(50) = 4.80, p < .01$]. These results are consistent with a model of activational influences of testosterone on adult female behavior.

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R. LISOTA, J. TSCHANZ, D. STEFFENS, I. SKOOG, R. PFISTER, K. WELSH-BOHMER, M. NORTON, B. PLASSMAN, B. WYSE, & J. BREITNER. Late-Onset Depression Does Not Predict Cognitive Decline in Nondemented Elderly.

The etiology of late onset depression (LOD) has emphasized the role of cerebrovascular disorders and prodromal Alzheimer's disease (AD). LOD individuals often exhibit cognitive impairment, but it is unknown to what extent these effects persist. We examined this issue in a population of 2,838 nondemented, community dwelling elders followed over 3 years. First onset of depression > age 59 was defined as LOD and onsets < 60 were defined as early onset (EOD). Cognitive status at baseline was assessed by an adapted version of the Modified Mini-Mental Status Exam (3MS), and cognitive change was assessed by 3MS delta scores. Analysis of covariance models (ANCOVA) including as covariates age, education, APOE4 genotype, presence of cardiovascular and central nervous system disorders and baseline score (in longitudinal models) revealed that individuals depressed at baseline scored significantly worse than their non-depressed counterparts [$F(2,3863) = 5.649, p = .004$]. These depressed individuals displayed a slight tendency towards improved 3MS scores after 3 years,

but did not differ significantly from the never depressed or those depressed in the remote past. Age of depression onset had no effect on cognition at either baseline or after 3 years. The present study suggests that the cognitive effects that accompany depression do not persist beyond the acute episode and these effects are equivalent between early and late onset depressives. Additionally, these results suggest that LOD is not an independent predictor of cognitive decline and may not necessarily suggest the presence of prodromal AD or cerebrovascular disease.

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Poster Session 7/3:30–5:15 p.m.

LANGUAGE

K. NAKATANI & B.L. MACAULEY. Gesture Production During Conversation in Japanese and English by Bilingual Speakers.

Gesture production by people of different cultures can vary greatly. However, it is not known whether the language spoken or the native culture is the greater influence on gesture production. The purpose of this study was to investigate the production of spontaneous gestures during conversations in a person's primary and secondary languages in order to determine language *versus* cultural influences on gesture production. To achieve this, videotaped conversations were obtained using a standard set of questions from eight native Japanese people who were fluent in both Japanese and English. Participants were told that the conversations were needed to assess their language skills so that the gestures would be produced spontaneously and unconsciously. The participants and the examiner spoke Japanese during the first conversation and English during the second conversation. The videotapes were scored independently by 2 trained judges who were also fluent in both Japanese and English but ignorant of the purpose of the study. Results indicated that 7 of the 8 participants produced twice as many gestures per min while speaking English than while speaking Japanese. In addition, the number of emphasis gestures differed significantly across the 2 languages but the number of content gestures did not. Therefore, it appears that the language spoken, rather than a person's cultural background, is of greater influence to the production of conversational gesture. To validate this finding, studies using native English speakers who live in Japan and speak fluent Japanese are needed.

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J.C. ADAIR, A.M. RAYMER, & D.J.G. WILLIAMSON. Dysnomia for Objects Relative to Actions in a Surface Dyslexic.

Aphasic patients with selective impairment in naming objects *versus* actions may inform cognitive models of lexical retrieval. Clinical observations resulted in speculation that neural networks mediating retrieval of nouns and verbs are anatomically discrete. We evaluated a patient with surface dyslexia and anomia following ischemic infarction of the left calcarine and inferotemporal cortices. The patient's ability to name objects was much less accurate than for actions (8% correct *vs.* 61%). Further characterization of the lexical retrieval deficit suggested that information from pictorial stimuli accessed relatively intact semantic systems to a similar degree for objects and actions. Analysis of reading performance by grammatical class was undertaken to distinguish between disrupted processing within the phonological output lexicon *versus* defective egress of information from semantics to the lexicon. The patient had difficulty reading both irregular nouns (36% correct) and irregular verbs (52%), though the advantage for verbs was maintained. The data support earlier views that grammatical class distinctions are a principle of the phonological lexicon's organization. The locus of our patient's lesions in the left temporal lobe may help specify 1 critical anatomical substrate for this function.

Correspondence: J.C. Adair, Neurology Svc. (127), Albuquerque VA Medical Center, 1501 San Pedro SE, Albuquerque, NM 87108.

L. MILMAN & A. HOLLAND. The Arizona Screen of Cognition and Communication: Construct Validity.

The research investigated construct validity for the Arizona Screen of Cognition and Communication (ASCC). The purpose of the ASCC is to quickly identify acquired cognitive and communication deficits in adults, and to assess how these deficits affect functional independence. The screen is intended to provide sufficient information to permit meaningful intervention and discharge recommendations in the acute setting, and to guide more in-depth assessment in other contexts. The ASCC differs from other screens by providing a measure of both traditional cognitive–language domains (oral expression, auditory comprehension, reading, writing, reasoning and memory) and a measure of functional abilities. A relatively short (40 min) administration time is made possible by (1) probing certain aspects of cognition and communication simultaneously and (2) by assessing either high or low level tasks based on patient responses to an initial set of probe items. Thirty mixed etiology neurological patients were assessed on the ASCC and on several other frequently used measures of cognition and communication, including the Mini-Mental State Examination, Western Aphasia Battery, Communicative Abilities of Daily Living, and the Functional Independence Measure. Results from these measures support specific aspects of construct validity for this screening instrument.

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J. SMITH, A. EKLUND, F.R. FERRARO, & T. PETROS. Circadian and Adult Age Differences in Memory for Narrative and Expository Text.

Adult age differences in memory for passages has been widely documented. Petros et al. have demonstrated that verbal ability and text genre modify the size of the age differences observed with larger age differences for low verbal participants and less organized passages. Recent work by May, Hasher, and Stoltzfus suggested that the time of day in which participants were tested would modify the size of age differences in memory observed. However, other work failed to find that adult age differences were modified by the time of day the participants were tested. In light of the importance of prose memory in many neuropsychological evaluations and the sensitivity of text memory to a wide range of neuropsychological conditions the present study examined adult age differences in memory for narrative and expository texts. Younger and older adults were tested at either 8:00–10:00 a.m. or 3:00–5:00 p.m. Participants were asked to listen to and immediately recall 2 narrative and 2 expository passages. The results indicated that younger adults recalled more than older adults only for information of medium and low importance from expository passages. The time of day when participants were tested did not modify the pattern of the age differences observed. The verbal ability of the older adults was considerably higher than the verbal ability of the younger adults. Perhaps time of day may modify age differences in prose memory when participants are more closely matched on their level of verbal ability.

Correspondence: *Tom Petros, Department of Psychology, Box 8380, University of North Dakota, Grand Forks, ND 58202.*

N.R. VILLEMARETTE-PITTMAN, M.S. STANFORD, & K.W. GREVE. Language and Executive Function in Impulsive Aggressive College Students.

Impulsive aggression (IA) is characterized by an aggressive response to a stimulus, grossly out of proportion to any precipitating psychosocial stressor. IA has been associated with a developmentally persistent pattern of antisocial behavior and cognitive deficits. Impulsive aggressive individuals exhibit planning and organizational difficulties as well as impaired expressive language. To demonstrate the differential contributions of language and executive function to the performance decrement observed in impulsive aggressors, the present study employs a battery of verbal tests ranging from those requiring little output (PPVT–III) to those demanding a high degree of integration and organization for output (Cookie Theft). Twenty impulsive aggressive college students participated, all reporting a lifetime history of physical aggression. They were compared to twenty nonaggressive controls matched for age, sex, and education. IAs scored significantly

higher on personality measures of impulsivity and aggression. A profile analysis revealed that, despite the fact that they did not differ on tasks requiring limited verbal output, the impulsive aggressors deviated further and further from controls as the demands of the tasks required increasing spontaneous organization. IAs exhibited inferior performance on discourse variables overall but most notably their performance was characterized by reduced accuracy of their accounts and “well-formedness” of their output when describing the Cookie Theft picture. Results suggest that language ability *per se* is not impaired in impulsive aggressors; rather inefficient executive functioning is responsible for a significantly poorer performance on complex verbal tasks.

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N. MAHENDRA, K.A. BAYLES, F.P. HARRIS, & E. PLANTE. Effect of Encoding Conditions on Episodic Memory in Aging and Dementia.

Memory deficits are the hallmark of Alzheimer’s disease and indices of episodic memory and learning are critical in early identification of AD. Poor performance on memory tests precedes detectable clinical changes and global psychometric deterioration in individuals who develop AD. Performance on delayed Story Recall tasks is a sensitive measure of memory impairments associated with dementia. This task involves presenting a short story, which participants recall at different time delays. There is, however, limited information on effects of different encoding conditions on this task. Given the high prevalence of hearing loss in older adults, administering a story recall test via standard auditory presentation may not enable optimal encoding of information. This could lead to spuriously poor performance on memory tests, an overlooked consideration when testing older adults. The primary purpose of this study was to investigate how varying encoding conditions influence episodic memory (recall and recognition), as measured by a Story Recall Task. Another purpose was to investigate learning effects and recognition abilities in individuals with dementia. All participants were administered a story recall task (using 3 different stories) in 3 modalities: (1) auditory only, (2) visual only (silent reading), and (3) auditory–visual combined. Recall was assessed immediately and at 15- and 30-min delays. After recall at 30 min, half the participants were given a recognition task and the stories were repeated for the other half. Following repetition, recall was reassessed for this latter half. The results have important implications for memory assessment of healthy, older adults and those with dementia.

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A. POREH & A. HADAR. The Effects of Second Language Acquisition on Verbal Fluency.

The effect of age of language acquisition on verbal fluency was investigated. A random sample of 196 elderly Israelis from 4 distinct ethnic groups of which 80% were bilingual and 20% native speakers were studied. Using conventional statistics it was shown that phonemic fluency was associated with education and age of language acquisition, while semantic fluency was associated with age. Within the 2 processes, phonemic switching was associated with education and age of language acquisition, whereas semantic clustering, but not switching, was associated with age. As for ethnicity, such differences were not maintained after controlling for age of language acquisition and education. The findings are consistent with recent functional imaging studies of bilingual individuals, namely, that native and second languages form distinct areas of activation in the dominant anterior language area, an area often associated within phonemic processing and switching. In contrast, an overlap is seen within the posterior language areas, areas that are often associated with semantic processing.

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L. TURKSTRA & E. KUEGELER. Executive Function and Conversational Fluency in Adolescents.

In extemporaneous conversations, speakers may exhibit maze behaviors such as revisions, repetitions, and false starts. These behaviors are thought

to reflect the on-line planning and organization of ideas, and therefore may be related to clinical measures of executive function. This relationship was studied in 45 normally-developing adolescents ages 13 to 21 (23 females and 22 males), engaged in three 1-min conversations with a partner. The frequency of occurrence of maze behaviors was compared to selected sub-scale scores from the Adolescent and Parent versions of the Behavior Rating Inventory of Executive Function. In a multivariate model, Parent BRIEF scores for inhibition, organization, and working memory were significantly related to the frequency of false starts in conversation ($p = .03$, $R^2 = .30$), with a trend for Parent scores to be related to the frequency of repetitions ($p = .06$, $R^2 = .25$). Adolescent BRIEF cluster scores for meta-cognition and behavioral regulation were not significantly related to scores on maze measures. Overall, both male and female participants produced an average of 1 maze in every 10 *t*-units. These results support the ecological validity of the BRIEF, particularly given the complex and multi-determined nature of conversations, and suggest directions for future study of executive function development in adolescence.

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NAMING AND FLUENCY

G. KAPTANOGLU, A. TUMAC, H.A. HANAGASI, O. OKTEM-TANOR, M. EMRE, & S. WEINTRAUB. Verbal Fluency and Naming in Turkish and American Alzheimer's Disease Patients.

Performance on measures of verbal fluency and naming were compared in English and Turkish speaking patients with Alzheimer's disease (AD) and controls of similar age and education. AD patients were matched for disease severity using Mini-Mental State Examination (MMSE) scores. Participants were 20 US AD patients and 27 controls, 20 Turkish patients and 27 controls. Groups were compared for semantic fluency (Animals), lexical fluency (FAS or KAS), and performance on the Boston Naming Test (BNT). Whereas AD patients from both populations were significantly impaired in semantic fluency and BNT scores compared to their matched controls, neither group was impaired in lexical fluency. In the analysis of the effect of dementia severity (*mild* = MMSE ≥ 24 vs. *moderate* = $24 > \text{MMSE} > 14$) on performance, the relatively small group of mildly impaired patients performed worse than controls in both fluency tests and naming, but the difference was not statistically significant. However, moderately impaired patients showed significant impairment in semantic fluency and not in lexical fluency. In AD patients, MMSE, semantic fluency and BNT scores were significantly correlated with one another, whereas lexical fluency scores did not correlate with any of the other tests. These results confirm that, similar to English speaking US AD patients, Turkish AD patients also show a deficit in semantic fluency and naming but not in lexical fluency.

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K. DOUVILLE, C. DOW, B. BELL, P. RUTECKI, R. SHETH, D. O'LEARY, V. MAGNOTTA, A. WOODARD, B.P. HERMANN, & M. SEIDENBERG. Dissociation of Fluency Tasks and Switching/Clustering Using MRI Volumetrics.

Variation in performance on letter and semantic fluency tasks has been identified in several neurologic groups and linked to focal lesions in different brain regions. In addition, 2 distinct cognitive operations, switching and clustering, have been identified as critical determinants of fluency performance and are presumed to be mediated by different neural systems. We examined the performance of 54 complex partial temporal lobe epilepsy subjects (CPTL) and 39 healthy controls on two fluency tasks (letter and animal) and on indices of switching and clustering. Quantitative MRI segmented (white and gray matter) whole brain volumes were related to performance. The CPTL group produced significantly fewer words than controls on the animal but not letter fluency task. Patients also generated

fewer and smaller sized clusters, but did not differ from controls on switching. Both switching and clustering indices were positively correlated with total words produced ($r_s = .50$, $p_s < .01$), but switching and clustering indices were not themselves significantly intercorrelated ($r = .20$, $p < .10$). The CPTL group showed significant bilateral reduction of both gray and white matter volumes compared to controls. Animal fluency was significantly correlated with white matter volume only, while letter fluency was not significantly related to either white or gray volumes. Switching was also significantly correlated with bilateral white matter volumes, and clustering was significantly correlated with bilateral gray volume. These data support the behavioral and anatomic dissociation between letter and semantic fluency tasks and between the operations of switching and clustering.

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E. TRITTSCHUH, S. MUSIL, & R. HANLON. Verbal Fluency Revisited: Error Patterns Among Elderly Inpatients.

Tests of verbal fluency tap multiple cognitive abilities, including sustained attention and executive function, and are often helpful in making differential diagnosis. Most verbal fluency research to date has focused on the number of *correct* words generated. However, other aspects of task performance might be of additional diagnostic utility (e.g., error patterns, temporal patterns of responding, etc.). While these variables have been investigated to some extent, research has traditionally focused on the performance of younger, healthy individuals. There is a paucity of information available about these aspects of verbal fluency performance in elderly patients with neurological or psychiatric conditions. The purpose of this study was to investigate the patterns of errors made in letter and category fluency tasks in elderly inpatients with diagnoses of delirium, dementia, or depression. Errors were defined as either *perseverative* or involving *set loss*. For letter fluency, inpatients with dementia made significantly more perseverative errors than the other 2 groups. However, for category fluency, delirious patients made more perseverative errors than the other groups. Additionally, a trend was observed across fluency tasks for delirious patients to make more set-loss errors than the other groups. These results indicate that, in addition to standard indices of verbal fluency performance, other quantitative aspects of these tasks, specifically error patterns, can be useful in making differential diagnoses in the elderly.

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V. BECKNER & D. TUCKER. Does Impaired Phonology Account for Anomia in AD Patients?

Word-finding difficulty is a common early symptom of Alzheimer's disease (AD), along with memory impairment. The prevailing evidence suggests that anomia in patients with AD results from the gradual deterioration of the semantic network, rather than from a specific linguistic deficit, such as impairment in phonological processing. Some studies have indicated, however, that AD patients do show impairments in phonology. We hypothesized that scores on a nonword spelling test (a measure of phonology) would correlate positively with scores on the Boston Naming Test (BNT) in 20 patients (M age = 76.4) with probable AD. This finding would have suggested that failures in lexical access in patients with AD might happen at the phonological level, rather than at the level of abstract semantic representation. In contrast to the AD group, we predicted that nonword spelling and naming scores would not be significantly correlated in a heterogeneous group of age-matched patients with memory problems of various etiology also demonstrating anomia. Presumably for this control group, word-finding difficulties reflect varied etiological pathways. A one-way ANOVA did not demonstrate a significant difference between the two groups on the BNT. However, the AD group was significantly more impaired than the control group on nonword spelling ($F = 10.45$, $p = .003$). Interestingly, although the AD group showed impairment in both phonology (nonwords = 6.3/10) and naming (BNT = 39.8), the performance on these tasks were not significantly correlated ($r = .163$, $p = .49$). Nor were they

correlated in the control group ($r = .013, p = .96$), as predicted. Thus in both groups, anomia does not appear related to phonological processing. Correspondence: Victoria Beckner, University of Texas at Austin, Mezes 330, Department of Psychology, Austin, TX 78712.

L. LU, E.B. FENNEL, K.M. HEILMAN, & J. ALGINA. A Test of the Articulatory Feedback Hypothesis of Naming.

The articulatory feedback hypothesis of naming posited that for individuals with articulatory awareness, having appropriate articulatory feedback facilitates name retrieval. This was tested using an interference paradigm. Naming performance during a condition that allowed for feedback was contrasted with a condition that interfered with feedback by providing inappropriate feedback. Because Montgomery found that dyslexic children had impaired articulatory awareness, performance of phonologically impaired readers was contrasted with those of normal readers. Subjects were also grouped by level of articulatory awareness, and performance between aware and unaware groups was compared. Results support modification of the hypothesis. For individuals with poor articulatory awareness, inappropriate feedback and name retrieval competed for limited neural resources. For those with articulatory awareness, inappropriate feedback did not slow name retrieval, and they did not spontaneously use appropriate feedback to assist naming. This is understood in terms of automatic processing and limited capacity. Those with articulatory awareness process name retrieval automatically and efficiently, and have sufficient neural resources remaining to process extraneous information. Those with poor awareness retrieve names less efficiently; they have limited capacity to process extraneous information at the same time. Articulatory awareness was not found to correlate with reading ability. Both normal and phonologically impaired readers demonstrated a wide range of articulatory awareness.

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M. EPKER, E. SMERNOFF, C. MARQUEZ, & C.M. CULLUM. Semantic Recognition Errors in Alzheimer's Disease.

A breakdown in semantic knowledge has been postulated to characterize the cognitive dysfunction associated with Alzheimer's disease (AD). Similarly, deficient recognition memory is well-documented in AD, with patients showing high rates of false positive (often semantically associated) errors. While AD patients tend to make semantically-related errors on verbal fluency tests, error patterns on other recognition measures are largely unknown. To examine qualitative features of recognition errors following a non-memory task, a recognition component to the Boston Naming Test (BNT) was designed and administered to 19 individuals with AD and 19 normal controls matched for age and education level. Participants were administered the standard 60-item BNT in its entirety, followed by a printed word recognition component for the first 15 test items. For each target stimulus (e.g., "bed"), semantically, phonemically, and functionally similar foils were presented (i.e., pillow, head, sleep), and participants were asked to circle words corresponding to pictures they were previously shown. As expected, AD participants performed worse than controls on the recognition task [$t(1,36) = 4.93, p < .001$], and made significantly more semantic [$t(1,36) = -4.03, p < .001$], phonemic [$t(1,36) = -2.45, p < .02$], and functional [$t(1,36) = -2.24, p < .05$], recognition errors than controls. Additionally, within-group comparisons revealed that semantically related errors were significantly more common than other error types in AD participants. Overall, these findings are consistent with error patterns reported on other cognitive tasks (e.g., verbal fluency), and provide additional support for a breakdown in semantic knowledge associated with AD.

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L. STRICKLAND, P. FISHER, M. RAYMER, & R.L. SCHWARTZ. Naming Impairments in Patients With Alzheimer's Disease: A New Assessment Method.

An early symptom of cognitive decline in patients with Alzheimer's disease (AD) is anomia, presumably related to semantic dysfunction. Picture naming tests used to assess anomia may not detect impairments in some

patients, as picture naming may not necessitate sufficient semantic resources. Alternative word retrieval tests, such as naming to spoken definitions, may be confounded by memory impairments present in AD patients. Schwartz et al. developed the Florida Action Recall Test (FLART) to assess praxis knowledge in brain injured patients. The FLART, which includes 45 pictured scenarios which imply necessary tools/actions (e.g., nail sticking in wood: hammer), can be adapted to assess word retrieval as well. In this investigation, we tested 4 individuals with presumed AD and 5 matched neurologically normal participants who passed a cognitive screening. Participants completed 3 word retrieval tests: (1) naming implied objects (FLART scenes); (2) naming actual pictured objects; (3) naming to spoken definitions. Each task included the same 45 objects administered in counterbalanced blocks across participants. The AD group was significantly impaired compared to normals in all conditions. A difference between test conditions was evident in only the AD group, which had significantly worse performance in naming implied objects compared to naming to actual pictures and spoken definitions. The implied object naming task, which presumably engages semantic mechanisms in the process of word retrieval, may be a useful clinical assessment tool to detect anomia in patients with AD.

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M. JÓNSDÓTTIR & S. DAVIDSDÓTTIR. Superordinate and Basic Level Concepts in Alzheimer's Disease.

Background: It has been proposed that semantic memory disintegrates in a predictable fashion with superordinate concepts being more resilient to damage than basic level concepts. Furthermore, it has been suggested that access to specific concepts is impossible unless knowledge of general concepts is intact. However, these ideas have been challenged. In order to compare superordinate and basic level knowledge, the test requirements at the 2 levels of abstraction have to be the same. This has generally not been the case. In this study we compared superordinate and basic level knowledge using tests that were designed to allow a comparison between superordinate and basic level knowledge. *Methods:* The tests were administered to 5 patients with probable Alzheimer's dementia (MMSE from 21 to 28) and 15 healthy controls. The tests, which all addressed both basic and superordinate levels, were (1) picture naming, indication of superordinate category as well as an attribute; (2) picture-word matching (auditory); (3) picture-word matching (reading); (4) definition of concepts; (5) category fluency; (6) and (7) sorting; (8) naming; (9) naming to definition. The stimuli were paired in word frequency and familiarity as was possible. Most of the pictures were from the Snodgrass and Vanderwart set. *Results:* Results did not reveal consistent differences between basic and superordinate level knowledge. It is known that the cognitive profiles of patients with AD can vary a great deal and this study indicates variability in semantic deterioration as well.

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B.K. LEBOWITZ, M.A. STEED, P.K. SHEAR, & S.M. STRAKOWSKI. Verbal and Design Fluency in Mania.

In contrast to the abnormally rapid speech associated with the manic phase of bipolar disorder (BPD), manic patients with BPD have been found to be impaired on tests of speeded verbal fluency. We have reported elsewhere that manic patients generate fewer words and more intrusion errors than healthy controls, suggesting dysfunction in the generation of verbal output. In the present study, we re-examined data for the previously reported sample to determine whether or not verbal and nonverbal fluency skills were uniformly affected in mania. Thirty-two inpatients with BPD (14 female; 18 male) who were acutely manic at the time of testing (mean Young Mania score: 19.1 ± 8.8) completed both a verbal (FAS) and a nonverbal fluency task. A sample of 27 healthy participants (15 female; 12 male) served as a comparison group (HC). The groups were equivalent with respect to mean age (BPD: 27.8 ± 8.2 ; HC: 30.6 ± 8.5), mean education (BPD: 11.9 ± 1.9 ; HC: 13.1 ± 1.1), and estimated premorbid IQ (BPD:

104.8 ± 9.2; HC: 110.3 ± 9.6). A 2 × 2 repeated measures ANOVA showed that the BPD group performed more poorly than controls overall ($p < .001$), and was impaired equivalently on the verbal and nonverbal tasks ($p > .8$). Similar to our report in verbal fluency, on design fluency the BPD patients generated fewer total designs ($p < .006$), fewer correct designs ($p < .002$), and more errors ($p < .003$). The results suggest that manic BPD patients exhibit deficient generative performance and self-regulation in both verbal and nonverbal fluency.

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A. MACKEY & L. CONNOR. Detecting Age-Related Change in Naming: Item Analysis of the Boston Naming Test.

An item-analysis of the percent correct before cues on the 60-item Boston Naming Test was performed in 3 groups of healthy adults, 61 individuals age 50–59, 81 individuals age 60–69, and 91 individuals 70–79, with the goal of determining which items are most sensitive to age-related changes in confrontation naming. Individuals were healthy community-dwellers from the Boston metropolitan area. Of the 60 items, approximately one-third showed the pattern predicted by the literature, that is, age-related ordering of means. For the other two-thirds of the items, there were either no differences or very slight differences between age-groups. We compare published short versions of the BNT, and propose a short version designed specifically to examine age-related change in confrontation naming and a short version designed to minimize age-related decline in confrontation naming in order to facilitate the detection of neurological impairment. Further, we discuss problems interpreting overall scores due to item-specific effects.

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L. BALSAMO, C. GRANDIN, B. XU, T. ELLIOTT, J. PETRELLA, G. BASSO, S. BRANIECKI, W. THEODORE, & W. GAILLARD. An fMRI Study of Auditory Responsive Naming in Children.

fMRI is a potential noninvasive alternative to the Wada procedure for identification of language cortex in children prior to surgery. We implemented an auditory language task in 9 children (5 girls, 4 boys; $M = 8.7$ years) and 24 adults (11 women, 13 men; $M = 28.3$ years). Participants alternately rested and listened to descriptors of nouns presented aurally and named the object silently. In the child group analysis, we found activation in the left superior and middle temporal gyri. There were smaller areas of activation in the right superior temporal gyrus, the cuneus and cingulate gyrus. Region of interest analysis of individual scans showed activation in the left frontal lobe. Voxel calculation showed strong left lateralization of the inferior frontal gyrus, middle frontal gyrus, and Wernicke's region. Hemispheric lateralization was clearly demonstrated in 8 children. The adult group analysis showed additional areas of activation including the left inferior temporal gyrus, bilateral superior frontal gyrus, left superior parietal lobe, and putamen. There was 1 significant difference in extent of activation with the children showing greater activation in Wernicke's region. There were no significant differences in lateralization. In conclusion, there appears to be minimal differences in areas of activation between the children and adults. Left hemisphere lateralization of receptive language, like adults, is present at age 8. Furthermore, the Auditory Responsive Naming task appears to be useful in determining language lateralization anteriorly and posteriorly in individual participants.

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L.D. RAVDIN, P. AGRAWAL, & N.R. RELKIN. Mild Depression and Verbal Fluency Performance in Older Adults.

The differential diagnosis of dementia is a very common referral question for neuropsychologists who evaluate older adults. Verbal fluency testing is often part of the evaluation, and the nature and degree of discrepancy between the various types of fluency tests (i.e., letter and category fluency) has been used in differentiating age-related diseases of the brain from normal aging. Often, the differential diagnosis includes ruling out depression,

since late life depression is a common psychiatric disturbance. Milder forms of depression are likely to go unrecognized or be misinterpreted as early signs of dementia because of the lesser degree of obvious cognitive or psychological deficit. We sought to identify the influence of mild depression, or dysthymia, on verbal fluency performance in a large sample of community dwelling older adults. One hundred ninety-four participants (M age 74.7, SD 6.22) were administered letter and category fluency tests as well as a self-report measure of depression, the Geriatric Depression Scale (GDS). Thirty-six participants had scores consistent with dysthymia (GDS) cut-off = 10–19; $M = 15.17$, $SD = 3.57$) as compared to 158 who scored within the normal range (<10 ; $M = 4.11$, $SD = 2.90$). None met the criteria for severe depression. ANOVA found dysthymic subjects performed significantly worse than the nondepressed group on letter fluency ($p = .0113$), but no different on the semantic fluency task ($p = .3094$). These results suggest that the presence of even mild depression may confound using letter vs. category discrepancies in the differential diagnosis of dementia.

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C.S. KUBU, L. CARSWELL, M. HARNADEK, & N. GALVAN. The Ecological Validity of the Boston Naming Test and the Benton Naming Test.

The goal of this study was to evaluate the utility of the Boston Naming Test (BNT) and the Benton Naming Test (MAE) in identifying epilepsy patients with word finding difficulties. Study participants ($N = 142$) were drawn from a series of adult patients referred to a surgical epilepsy unit whose 1st language is English. The presence of word finding difficulties was based on the patient's self-report and/or behavioral observations of word finding difficulties in conversational speech. Patients were placed into impaired (scores falling at or below ~10–12th %ile) or intact groups based on performance on the confrontation naming tests. Two (Presence/Absence of WFD) × 2 (Impaired/Intact Naming score) chi-square analyses did not reveal any significant findings. The data were also analyzed with respect to sensitivity and specificity. The data suggest that the BNT is a more sensitive measure to word finding difficulties in the "real world" (BNT sensitivity = 63%, MAE sensitivity = 31%) and that the MAE is a more specific measure (BNT specificity = 51%, MAE specificity = 77%). However, none of these values are particularly compelling. This was highlighted even further when the data were analyzed using likelihood ratios (range .72–1.3) which indicated that neither test significantly improves upon the pretest probability (~60%) of word-finding difficulties in this population. In summary, these data suggest that the BNT and MAE have limited ecological validity *vis-à-vis* word finding difficulties in the real world in patients with intractable epilepsy.

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J. NEILS-STRUNJAS, R. KRİKORIAN, M. SHIDLER, M. FRAAS, & S. LIKOY. Recall of Names and Faces in an Older Population.

It is well known that older adults have particular difficulty learning and recalling names of faces. The present study examined whether a verbal or imagery cognitive style was associated with recall of names and faces learned in an experimental training procedure. Cognitive abilities that are represented in current models of face recognition and name recall were also examined. These abilities included picture naming, verbal fluency, vocabulary comprehension, visual memory, and the learning of unassociated word pairs. Fifty older adults attempted to learn 20 first and last names of unfamiliar student actors and actresses pictured on videotapes. On the average, participants learned the most first names ($M = 7.3$), followed by last names ($M = 6.4$), and the fewest full names ($M = 4.6$). Improved name–face performance following training was associated with an imagery cognitive style. There was no significant relationship between a verbal cognitive style and the number of names of faces recalled. A regression analysis indicated that the best predictor of successful name–face learning

was the ability to learn and recall 5 unrelated word pairs ($p = .00, r = .58$). When this cognitive measure was deleted from the regression analysis, delayed visual memory and verbal fluency were the next best predictors of the older adult's ability to learn names and faces ($p = .00, r = .33$). These results suggest that the breakdown in naming of older adults may be attributed to difficulty in memory for words without meaningful associations as was demonstrated in poor full-name recall. An imagery style may reduce these negative effects.

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MOOD, ANXIETY, AND STRESS DISORDERS

M. BASSO, N. LOWERY, R. PURDIE, J. NEEL, & R. BORNSTEIN. Comorbid Anxiety Mediates Neurobehavioral Function in Unipolar Depression.

A growing body of research indicates that unipolar depressives are apt to show neuropsychological impairment, particularly involving executive function and memory. Yet not all depressed patients show such deficits. Recent research suggests that individual differences seem to mediate neurobehavioral impairment in depression. One factor that has not been examined in this regard is presence of comorbid anxiety disorder. Major depressive illness shares a high rate of comorbid anxiety disorder, and anxiety disorders involving phobia or panic tend to correspond with cognitive difficulties. Consequently, depressed individuals with comorbid anxiety disorders may be inclined to demonstrate more neuropsychological dysfunction than those with anxiety disorders. To address this question, we compared nonpsychotic depressed inpatients with ($n = 24$) and without comorbid anxiety disorders ($n = 48$) to a group of 25 control subjects on COWAT, Trailmaking Tests A and B, Grooved Pegboard Test, Digit Span, CVLT, and MMPI-2. Data were analyzed using ANOVA and LSD group comparisons. After correcting for age and education differences, depressed inpatients with anxiety disorders performed significantly worse than the controls and nonanxious depressed inpatients on Trailmaking Tests and Grooved Pegboard, but both patient groups showed equivalently worse recall than the controls on the CVLT. The 2 patient groups were equivalently more depressed than the controls. Thus, cognitive differences between patient groups is unlikely due to differential emotional distress. These findings suggest that comorbid anxiety disorders yield a specific deficit involving psychomotor speed in individuals with major depression. Clinical and theoretical relevance of the data is discussed.

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K. J.M. MCCOY, W. J. TRIGGS, K. M. HEILMAN, & S. E. NADEAU. SPECT Evidence of Depression Subtypes and Correlates of rTMS Treatment Response.

HMPAO single photon emission computed tomographic (SPECT) scans were obtained from 8 adults diagnosed with major depression resistant to medication (M age 53 years; 4 males) prior to and immediately following 10 days of 20-Hz repetitive transcranial magnetic stimulation (rTMS, 2000 stimuli/daily 30' treatment). In order to maximize the likelihood that SPECT scans reflected the state of depression, rather than uncontrolled responses of patients to poorly constrained environments, HMPAO was administered while subjects performed a single task involving continuous monitoring of the direction of a large arrow on a computer screen and continuously tapping with the left or right index finger according to the direction of the arrow. Mean baseline Beck Depression Inventory (BDI) score was 27.4 ($SD = 8.3$) and mean posttreatment BDI score was 17.5 ($SD = 8.5$). Treatment responders (defined by reduction in BDI score of $\geq 30\%$) had significantly less pre-treatment blood flow in the left amygdala compared with non-responders. Responders demonstrated two patterns of change in regional blood flow with treatment: a reduction in orbitofrontal blood flow and/or a reduction in anterior cingulate blood flow. Nonresponders did

not demonstrate any regional changes in blood flow with treatment. Results are consistent with recently published research suggesting that rTMS treatment response may be predicted by patterns of baseline cerebral metabolism. Utilization of functional imaging to assess cerebral activity may assist in determination of diagnostic subtypes and appropriate treatment, as well as in definition of the neural substrates of depressive states.

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S. L. REMINGER, A. W. KASZNAK, P. R. DALBY, & B. T. DAVID. Medication Effects on Self-Reported Mood in Individuals With Parkinson's Disease.

Self-reported mood and motoric functioning was examined in 19 individuals with Parkinson's disease (PD) both on and off antiparkinsonian medication. PD patients completed the Profile of Mood States (POMS) questionnaire once in an afternoon session following normal administration of levodopa therapy and once in a morning session when they had not taken their antiparkinsonian medication for the past 12 hr. The POMS measures self-reported mood in 6 domains: Anxiety, Depression, Anger, Vigor, Fatigue, and Confusion. The POMS scores of PD patients were compared to the scores of 23 matched elderly controls who had also completed the POMS on 2 comparable morning and afternoon sessions. Session order was counterbalanced for both patients and controls. PD patients reported greater overall mood disturbance, and more anxiety and confusion when not taking levodopa medication. Although their motor performance significantly improved while taking medication, PD patients' reports of mood disturbance were not correlated with their performance on a standard clinical motor examination. An unanticipated result was a significant effect of session order. That is, both patient and control groups consistently reported less mood disturbance on the second testing session. This finding suggests that self-reported mood is subject to extrinsic effects that must be accounted for when examining medication effects on mood disorders in individuals with neurologic disease.

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N. HARTWELL, P. MARZUK, L. PORTERA, & A. LEON. The Neuropsychology of Suicidal States in Depressed Inpatients.

Depression, the diagnosis most commonly associated with suicidal behavior, has been related to frontal lobe dysfunction. Suicidal thinking may result from a maladaptive "executive" decision made by someone who exhibits cognitive rigidity (i.e., fails to see solutions to problems other than suicide). As the "executive" decision center of the brain, the frontal lobe may be dysfunctional in suicidal persons. The aim of this study was to test the hypothesis that depressed, suicidal individuals would perform worse than depressed nonsuicidal persons on measures of executive frontal lobe function. The study involved 53 severely depressed psychiatric inpatients, 28 of whom were actively suicidal. Both groups were administered a series of neuropsychological measures assessing frontal lobe functioning. Two primarily nonfrontal measures were also administered to assess the specificity of dysfunction to the frontal lobe. The 2 study groups were similar with respect to demographic characteristics and levels of depression, anxiety and impulsiveness. Compared to nonsuicidal depressed inpatients, the suicidal inpatients demonstrated significantly worse performance on the *Wisconsin Card Sorting Test* (perseverative errors), *Trail Making Test (B minus A)*, verbal fluency, *Stroop* interference and *WISC-III Mazes*. No group differences were noted in *WCST* categories or failures to maintain set and nonverbal fluency. As hypothesized, no significant group differences were noted on the *Boston Naming Test* and *Rey copy condition*. These findings suggest that suicidal mental states among severely depressed inpatients are associated with frontal lobe dysfunction. Understanding frontal lobe dysfunction in depressed patients may prove helpful in the prediction, treatment and prevention of suicide.

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E.R. LARSON, P.K. SHEAR, R. KRIKORIAN, & S.M. STRAKOWSKI. Spatial Working Memory in Manic and Euthymic Patients With Bipolar Disorder.

Bipolar disorder (BPD) is a severe psychiatric illness characterized by abnormal mood episodes. In addition to the affective symptoms associated with this disorder, deficits have been reported in higher order cognitive functions. Few studies, however, have examined the integrity of fundamental information processing capacities in BPD. The aim of the present study was to characterize working memory performance across increasing interference intervals in patients with BPD, and to determine whether mood state affected that process. We anticipated that working memory would be more impaired in patients with mania than in healthy controls or patients with BPD who were experiencing affective remission. Seventeen healthy participants and 14 patients with bipolar disorder (6 with mania and 8 who were in remission) were administered the Delayed Response test, a task requiring intact spatial working memory. All groups performed similarly on the shorter delay intervals, but the patients with mania performed significantly worse than other groups as the working memory load increased [$H(2) = 6.5, p < .04$]. Further, patients with mania experienced a significantly greater performance decline across interference intervals of increasing length than did the patients in remission. These findings suggest that BPD patients who are experiencing mania can successfully focus their attention for short periods of time, but that they suffer a potentially reversible working memory deficit under more demanding conditions.

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B.H. JOHNSEN, T. OLSEN, & A.E. ASBJØRNSEN. Hemispheric Asymmetry Effect for Visual Short-Term Memory During Sleep Deprivation.

The present study focused on lateralized effects of sleep deprivation on visual short-term memory. Thirty-six healthy naval academy cadets were tested with the lateralized version of the Bergen Facial Recognition Test (BFRLAT), with manual registration of response time. All subjects were tested both after rest and after a 96-hr sleep-deprivation period in a balanced design, as a part of a military maneuver. The participants showed a right hemisphere dominance for visual processing on inclusion. The results showed significantly longer response times for the presented stimuli after sleep deprivation compared to after rest, and the change was obvious for both right and left hemisphere presentations. However, analyses of difference scores showed a reduction in laterality scores from the non-deprived to sleep-deprived condition, and the change in performance was more pronounced for the right hemisphere. In addition, 11 out of 36 changed from a right hemisphere dominance at rest to a left hemisphere dominance after sleep deprivation. The results suggest that sleep deprivation mainly affects processing in the right hemisphere.

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C. PALUMBO, R. WHITE, & D.A. YURGELUN-TODD. fMRI of Persian Gulf War Veterans During a Visual Working Memory Task.

Veterans of the Gulf War (GW) have reported adverse health symptoms including deficits in neurocognitive functioning, including impaired memory and attention. This study examined whether neurophysiological correlates could be identified to confirm previously identified neuropsychological deficits. We hypothesized that fMRI during a visual working memory (WM) task would reveal differences in levels of activation between GW veterans who reported a relatively high number of health symptoms and those who reported relatively few symptoms. We hypothesized that differences in regional activation between these groups would be evident in frontal lobestructures subserving working memory, specifically, the dorsolateral prefrontal cortex (DLPFCx). We have studied 23 GW veterans using functional and conventional MR techniques. Cortical activation was measured using neuroanatomically defined regions of interest obtained from both high-resolution and echo planar MR images. Significant differences in brain activation were found for the DLPFCx region

between the high and low symptom GW veterans. The low symptom group showed significantly more activation in the right DLPFCx compared to the high symptom group. We have recently reported similar differences in level of activation in the frontal lobe between these same groups during a task of sustained attention. These are the first investigations to examine functional neurobiological alterations in GW veterans. The results of these preliminary studies indicate that there are differences in frontal regional activation between high and low symptom GW groups. These results suggest that altered neurobiological functioning may be the basis for reported cognitive changes experienced by some GW veterans.

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K. LINDEM, R. WHITE, J. VASTERLING, M. KRENGEL, P. SUTKER, J. WOLFE, S. PROCTOR, T. HEEREN, & T. KEANE. Stress and Neuropsychological Impairment in Gulf War Veterans.

A number of scientists and expert panels who have considered the problem of unexplained health problems in Gulf War (GW) veterans have concluded that the neuropsychological symptoms reported in this group are attributable to "stress." This conclusion has been reached despite the fact that rates of posttraumatic stress disorder (PTSD) are low among GW veterans (at baseline for the US population). In order to test the stress hypothesis, we decided to study PTSD symptoms on a continuum in order to determine how severity of PTSD or stress symptomatology relates to neuropsychological complaints and test findings in this population. Study participants included 240 from 3 cohorts of GW and GW-era veterans. A comprehensive evaluation of each participant was completed, including neuropsychological assessment, structural psychiatric and PTSD interviews, health questionnaires, and an interview about environmental exposures. Study results showed the incidence of diagnosable PTSD to be very low. However, severity of subclinical PTSD symptomatology (i.e., scores on PTSD diagnostic inventories below cut-off for diagnosis) was related to specific neuropsychological performance impairments. Mild PTSD symptoms were associated with attentional difficulties and mood complaints. Moderate PTSD symptomatology was associated with difficulties in the same domains, motor performance and short-term memory. These results suggest that stress symptoms below the level required to diagnose PTSD are indeed significantly related to performance on neuropsychological tests in GW veterans. However, stress does not fully explain the lowered scores in this group, which appear also to be related to factors such as exposure to specific environmental toxicants.

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C. CÁ CERES, P. PRIMEAU, L. COX, L. KONOPKA, & J. ZADECKI. Verbal Strategic Memory in Combat-Related Posttraumatic Stress Disorder.

Memory processes have been hypothesized to play a role in the genesis and maintenance of crucial posttraumatic stress disorder (PTSD) symptoms. Nevertheless, neuropsychological studies to date have failed to consistently demonstrate learning impairments in PTSD, partly because they have failed to assess specific memory processes that would allow the identification of the memory systems involved. This study examined explicit verbal memory in combat-related PTSD based on Moscovitch's model of associative and strategic memory. It was hypothesized that PTSD would be characterized by deficits in strategic memory in the context of relatively intact associative memory functions. Eighteen Vietnam veterans with PTSD, 18 veterans with a matched history of substance abuse and without PTSD, and 18 normal controls completed measures of associative and strategic memory. Associative and strategic memory indexes were computed to facilitate the interpretation of constructs. A 3 (group) \times 2 (memory index) mixed ANOVA revealed a significant interaction ($p = .01$) such that veterans with PTSD had lower strategic memory index scores than the substance abuse and normal control groups, while groups did not differ significantly on associative memory. These findings were not attributable to age, simple attention, estimated premorbid intelligence, self-reported dis-

tress, severity of substance abuse, use of psychotropic medications, or extent of combat exposure. This study provides evidence of selective strategic memory deficits in PTSD, rather than global and generalized memory dysfunction. Findings hold implications for neurobiological models of PTSD that suggest frontal-executive dysfunction in this disorder, and for the design of therapeutic interventions.

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R. COMPTON & D. MINTZER. Effects of Worry and Evaluation Stress on Interhemispheric Interaction.

Theories of cognitive functioning in anxiety propose increased effort and decreased processing efficiency associated with worry, but have paid scant attention to possible neural mechanisms. The present study examined the efficiency of interhemispheric processing in individuals differing in self-reported worry. Forty-one participants completed a worry questionnaire and measures of interhemispheric processing either in the presence or absence of an experimenter (high vs. low evaluation conditions). Measures of interhemispheric processing were letter-matching tasks, with matches occurring either in the same visual field (within-hemisphere) or in different visual fields (across-hemisphere). One task required a physical identity match (e.g., A vs. A) and the other a name identity match (e.g., A vs. a). Overall results replicated previous research indicating a greater across-hemisphere advantage (AHA) for the more difficult name identity task [Task \times Across/Within; $F(1,29) = 51.8, p < .0001$]. This AHA for the name identity task was exacerbated under the high evaluation condition [Task \times Across/Within \times Evaluation; $F(1,29) = 4.2, p < .05$], indicating that dividing processing between the hemispheres was especially beneficial for the more difficult task under the additional processing load of evaluation stress. Analyses of individual differences in worry found that regardless of task or evaluation condition, high worriers displayed a decreased AHA compared to low worriers [Anxiety \times Across/Within; $F(1,18) = 4.2, p = .05$], a finding confirmed by a negative correlation between anxiety score and AHA ($r = -.33, p < .05$). This result suggests that high worriers benefit less than low worriers from pooling the resources of both hemispheres, possibly reflecting inefficient organization and coordination of interhemispheric resources.

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B. ZUMBO, M. GELIN, & A. HUBLEY. Psychometric Study of the CES-D: Factor Analysis and DIF.

We report on a psychometric study of the Center for Epidemiologic Studies Depression (CES-D) scale with 600 community-dwelling adults between the ages of 17 and 87 years. The mean age for males is 46 years ($N = 310$) and 42 years for females ($N = 290$). We propose and test a unifactorial measurement model with confirmatory factor analysis which takes into account method effects. The method effects represent the distinction between positively and negatively worded items. Also, we studied gender-based differential item functioning (DIF) using a method proposed by Zumbo. Our preliminary results indicate that the proposed measurement model fits and hence helps one understand the disparate literature on the factorial structure of the CES-D. Only the item, "I had crying spells" displayed gender DIF. This is the first study to have modeled the method effects in a unifactorial measurement model and to have examined gender DIF using Zumbo's method in the CES-D.

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DRIVING ASSESSMENT

R. COLEMAN, T. ERGH, L. RAPPORT, R. HANKS, S. MILLIS, J. RICKER, & C. KOVIK. Determinants of Driving Status Following Brain Injury.

The relationship between driving status following brain injury and neuropsychological performance was examined in 71 brain-injured patients and

their caregivers ($N = 142$). Years post injury ranged from 4 months to 10 years ($M = 4.34, SD = 2.61$). Univariate analyses of variance indicated that Drivers and Non-Drivers were equivalent in age, education, and years post injury. In contrast, significant differences were noted ($p < .05$) between these groups on neuropsychological performance (WAIS-III Matrix Reasoning, Colored Trails 1 and 2). Motor ability at the time of discharge (FIM Motor), neuropsychological performance (Matrix Reasoning, Letter-Number Span, and Colored Trails 1 and 2), and both patient and caregiver perceptions of patients' driving abilities post injury were modestly correlated with miles driven by patients post injury ($r_s = .3-.7$). Caregivers' perception of patients' driving abilities correlated more highly with patients' neuropsychological performance than did the patients' perceptions of their own driving abilities, but these respective correlations were not significantly different from each other. Hierarchical multiple regression indicated that both motor functioning at the time of discharge ($R^2 = .07$) and neuropsychological performance (R^2 change = .16) significantly contributed to the prediction of miles driven by patients post injury; however, caregiver perceptions of the patients' driving abilities (R^2 change = .28) made the greatest contribution to the regression model (Total $R^2 = .51$, all $p_s < .05$). Contrary to skepticism regarding the utility of neuropsychological performance in the prediction of driving ability following brain injury, these results suggest that even a brief neuropsychological assessment may be of value. However, caregiver perception of patients' driving abilities is the most powerful determinant of patients' actual driving status.

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M.T. SCHULTHEIS, J. DELUCA, & E. GARAY. The Influence of Cognitive Impairment on Driving Performance in Multiple Sclerosis.

It is now well established that cognitive impairment is a major consequence of multiple sclerosis (MS), with deficits reported in information processing speed, attention, and executive functions. Among neurological populations (e.g., TBI, stroke), it has been demonstrated that deficits within these cognitive domains can result in impairments in the ability to drive an automobile. Despite this, there exists a paucity of studies which have examined driving skills following MS. The purpose of this study was to directly examine the influence of impaired cognitive processing on measures of driving skills in persons with MS. Twenty-nine participants with documented MS, were divided into 2 groups matched in age, sex, illness duration, and physical impairment: MS with (MS+, $n = 15$) and without cognitive impairment (MS-, $n = 14$). Seventeen matched healthy controls (HC) were also included. Driving skills were measured using 2 computerized driving programs: the Neurocognitive Driving Test (NDT) and the Useful Field of Vision (UFOV). Results demonstrated that the MS+ group performed significantly worse than both the MS- and HC group on the latency to perform several driving-specific functions on the NDT ($p = .000$), and a trend was observed for the number of actual errors performed in driving behavior ($p = .08$). Similarly, performance on the UFOV subtests was significantly poorer for the MS+ group when compared to MS- and HC subjects. These findings represent the first controlled study to show that cognitive impairment can negatively affect driving related skills in persons with MS, and that such impairments should be considered in determination of driving ability.

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E. RICHARDSON, J. BECKER, R. MAROTTOLI, & S. INOUE. Cognitive Intervention to Improve Visual Attention Among Older Drivers.

Older drivers have a higher incidence of crashes per mile driven, and these crashes are associated with greater morbidity and mortality. In our previous research, we found that visual attention, involving visual search, selective attention, and switching attention, is a cognitive skill critical to driving. In the current study, we pilot tested a cognitive intervention to determine its potential effectiveness in improving visual attention among older drivers. The intervention incorporated cognitive rehabilitation prin-

ciples, and included computerized tasks, instructional activities, and homework assignments. Twenty active drivers recruited from the community completed the study, with 50% ($n = 10$) females, mean age 72.6 years ($SD = 6.3$), mean education 15.8 years ($SD = 2.0$), and mean MMSE 29.2 ($SD = 1.0$). Baseline and follow-up assessments were conducted, which included cancellation tasks, Trails B, and computerized visual reaction time tests. The intervention involved 8 1-hr sessions of visual attention training over 1 month. Pair-wise t tests on the group of 12 “at-risk” drivers (those scoring below the median on Digit Cancellation, a measure used in our prior risk factor research) indicated significant improvement in speed on Trails B [$t(11) = 2.83, p < .02$]. Additionally, an average improvement of nearly 7 points was obtained by this group on Digit Cancellation, though this difference failed to reach significance [$t(11) = 1.62, p < .15$]. These results provide the basis for implementing a larger controlled trial to determine whether the intervention improves visual attention for impaired drivers beyond practice effects and whether this improvement has an impact on driving safety.

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AGING

R.S. WILSON, L.A. BECKETT, L.L. BARNES, J.A. SCHNEIDER, J. BACH, D.A. EVANS, & D.A. BENNETT. Individual Differences in Rates of Change in Cognitive Abilities of Older Persons.

We analyzed data from the Religious Orders Study, a longitudinal clinical-pathologic study of aging and Alzheimer’s disease (AD). Participants are Catholic clergy members who were aged 65 years and older and free of clinical evidence of Alzheimer’s disease at baseline; they underwent annual clinical evaluations for up to 6 years, with over 90% follow-up participation in survivors. Cognitive function was assessed at each evaluation with a battery of tests, from which summary measures of story retention, word retention, word generation, word knowledge, working memory, perceptual speed, and visuospatial ability were derived. A growth curve approach was used to characterize change in these measures. Analyses were based on 701 persons (M age = 75.9 years; M education = 18.1 years; M MMSE = 28.3; 63.9% female; 93.8% White, 5.7% Black, 0.4% other racial/ethnic groups). On average, decline occurred in each domain of ability and was more rapid in older persons than in younger persons, but substantial heterogeneity was evident at all ages. Initial level of function in a given domain was not strongly related to rate of change in that domain ($MDN r = .29$). A principal-components analysis of the person-specific slopes in each cognitive domain yielded a single factor that accounted for 62% of the variance. The results suggest that individual paths of change in cognitive function in older people are highly variable, that level of function at a given point in time does not strongly predict how an individual will change, and that change is mostly global rather than confined to specific cognitive domains.

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M. POPE, A.B. ZONDERMAN, & M. LAMAR. Homocysteine Levels as They Relate to Spatial Copy Task Complexity in Older Adults.

Elevated levels of plasma homocysteine (Hcy), an amino acid, have been associated with age-related syndromes known to impair cognitive functioning, such as vascular disease and vitamin B12 deficiency. However, few studies have investigated the direct relationship between homocysteine and cognitive functioning in the elderly. Based on previous findings of higher concentrations of plasma Hcy associated with decreased visuo-constructive performance, we examined copying performance in elderly participants with high or low homocysteine levels. Participants aged 60–95 ($N = 48$; age = 73.2 ± 8.9) in the Baltimore Longitudinal Study of Aging were grouped into tertiles according to their plasma Hcy concentrations. HIGH Hcy ($\geq 12 \mu\text{mol/L}$; $n = 13$; age = 74.9) and LOW Hcy ($< 9 \mu\text{mol/L}$; $n = 10$; M age = 71.6) groups were compared on three spatial copy measures of increasing complexity. We examined group differences in perfor-

mance on a simple construction task, Clock Drawing to command and copy, and the Rey Osterrieth Complex Figure (ROCF) in a series of univariate analyses of variance. The HIGH group performed significantly worse than the LOW group ($p < .05$) on the copy condition of the Clock Drawing task, but there were no group differences on the other measures. These findings suggest that spatial construction impairment associated with increased Hcy differs with task demands. Qualitative examination of specific errors on Clock Drawing will be discussed as they relate to more specific aspects of neuropsychological functioning such as attention, executive functioning, and spatial memory.

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J.P. KING, B.K. CHRISTENSEN, C. MILLIKIN, J. TAUSCHER, M. JAVANMARD, & S. KAPUR. Serotonin 5-HT_{1A} Receptor Availability Mediates the Effect of Age on Cognition.

Although it has been shown that the density of serotonin-1A (5-HT_{1A}) receptors decreases with age, little is known about the cognitive consequences of this decline. The relationship between 5-HT_{1A} and cognition is potentially important since the serotonin system has been implicated in several cognitive processes including attention, memory, and behavioral inhibition. This study investigated the role of 5-HT_{1A} receptor availability as a mechanism of age-related cognitive decline. Nineteen healthy volunteers aged 22–53 were studied with positron emission tomography and [¹¹C]WAY-100635 to assess 5-HT_{1A} receptor binding potential (BP). Participants were also administered tests of attention/psychomotor speed, which are sensitive to the effects of aging. To test the hypothesis that the relationship between age and cognitive decline is mediated by a reduction in 5-HT_{1A} receptor availability, a series of regression equations were conducted according to methods outlined by Baron & Kenny. Conditions supporting a mediational relationship were met for 2 measures: Trail Making Test A and WAIS–R Digit Symbol. That is, performance on these measures declined as a function of age ($r = .484, p = .036$; $r = -.563, p = .012$) and 5-HT_{1A} BP in the dorsolateral prefrontal cortex ($r = -.59, p = .02$; $r = .47, p = .04$) and parietal cortex ($r = -.51, p = .03$; $r = .54, p = .02$). However, after controlling for 5-HT_{1A} BP, the relationships between age and cognition were markedly attenuated and no longer significant. These results suggest that age-related serotonergic changes are mechanisms of age-related cognitive decline.

Correspondence: *Bruce K. Christensen, Centre for Addiction and Mental Health—Clarke Division, 250 College Street, 7th Floor, Toronto, ON M5T 1R8, Canada.*

J.G. BUCKWALTER, G. REGER, T.D. PARSONS, L.M. LUNA, C. CLASON, & A.A. RIZZO. Aging and Cognition: A Test of the Common Cause Hypothesis.

Despite a large number of studies that have analyzed the nature of cognitive changes associated with aging, there is little consensus. Early conceptualizations argued aging impacts fluid abilities but not crystallized abilities. More recent work has identified specific domains more prone to age-related decline including processing speed, working memory, executive functioning and episodic memory. Whether these domains decline separately or if they decline due to a “common cause” is unclear. We determined to test the common cause hypothesis. Thirty individuals between the ages of 64 and 86 (M age = 73.6; M years education = 15.4; % women = 50) participated in a study designed to validate a new test of spatial ability administered in virtual reality. As part of this project a standard neuropsychological battery was administered. To test the common cause hypothesis, a principal component factor analysis was conducted. Extension analysis was used to control for the 1st principal component, which by definition best represents the common variance present in the matrix. When analyzing uncorrected correlations, age showed significant associations with the Judgment of Line Orientation ($r = -.45$), animal naming ($r = -.60$), Matrix Reasoning from the WAIS–III ($r = -.48$), Trails B ($r = .39$), and Visual Reproduction I ($r = -.57$) and II ($r = -.49$) from the WMS–III. After controlling for the first principal component, only animal naming

remained significant ($r = -.45$). This suggests that many of the tests that show decline with aging share a common element, yet there may be a distinct aspect to declines in verbal fluency.

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G. POTTER & M. HARTMAN. Nonneuropsychological Predictors of Memory Complaints Among Older Adults.

A number of nonneuropsychological factors, such as depression and anxiety, have been found to contribute to memory complaints among older adults. The contribution of perceived stress, however, has received little attention in previous research and was the focus of the current study. Seventy-two healthy community-dwelling older adult women completed measures of perceived stress (Perceived Stress Scale), depression (Geriatric Depression Scale), anxiety (Beck Anxiety Inventory), life events (Geriatric Scale of Recent Life Events), and activity level (Activities Checklist), in addition to measures of neurocognitive function. Zero-order correlations indicated that higher levels of memory complaints (Memory Functioning Questionnaire: General Frequency of Forgetting scale) were significantly associated with increased stress, depression, anxiety, activity level, and decreased neurocognitive performance. When these variables were entered into a simultaneous regression equation, perceived stress and activity level emerged as significant predictors of memory complaints, whereas depression, anxiety, and life events did not. An index of neurocognitive functioning comprised of measures of attention and memory only approached significance. These results suggest the following conclusions: (1) memory complaints among some older adults reflect underlying stress; (2) perceived stress appears to be a more sensitive predictor of memory complaints than depression or anxiety; and (3) active individuals are more prone to memory complaints, possibly because they have more opportunities in which to experience memory lapses. Further research into attributional styles and types of activity in which older adults engage is needed to better understand the role of perceived stress and activity level in contributing to memory complaints.

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L.D. RAVDIN, A. BENNETT, & N.R. RELKIN. Hopkins Verbal Learning Test Normative Data in Community-Dwelling Older Adults.

Memory problems are a very common complaint of older adults referred for neuropsychological evaluations. Some commonly used list learning tests contain a large number of stimuli to be learned. This can be overwhelming for the aged population, and may confound the assessment of memory functioning. The Hopkins Verbal Learning Test (HVLT) provides a relatively brief assessment of memory, is well tolerated by older adults and impaired persons, and has 6 equivalent alternate forms. We report normative data on a revised version of the HVLT, which includes measures of delayed recall. The sample is a large group of community dwelling older adults ($N = 161$, aged 65–92) in self-reported good health, free of any significant neurologic or psychiatric history. Means and standard deviations are presented for 20-min delayed free recall, cued recall, and recognition memory stratified by age. Analysis of the HVLT variables between different age groups suggests differences between the young-old and the older age groups, thus signifying the importance of stratified normative data for adults over age 65.

Correspondence: *Lisa Ravdin, NY Presbyterian Hospital–Weill Medical College of Cornell University, 525 East 68th Street, Department of Neurology, Suite F-610, New York, NY 10021.*

B. LEUNG & A. CHAN. Effects of Engaging in Reading and Writing on Cognitive Functioning in Elderly.

The engagement hypothesis stated that individual's intellectual involvement in various activities may delay the decline in cognitive functioning commonly observed in aging. Preliminary data were collected to investigate the effect of engaging in reading- or writing-related activities to the maintenance of cognitive functioning in elderly. Thirty healthy community-

dwelling elderly (6 males, 24 females), aged 65 to 84, were recruited. Participants who engaged in daily-life reading or writing activities such as reading newspapers, novels or writing diaries for at least 3 hr per week were classified as *high engager* ($N = 17$), otherwise they were identified as *low engager* ($N = 13$). Five standardized neuropsychological tests (MMSE, Verbal Fluency, Color Trail Test 2, Boston Naming & Hong Kong List Learning Test) and 3 physical functioning measurements (Hand Grip Strength, Peak Expiratory Flow & Groove Pegboard Test) were administered. Age ($M = 72.23$) and level of education ($M = 3.07$) were matched between the 2 groups. Significant differences ($p < .05$) were found in the former three neuropsychological tests between the 2 groups but not in BNT and HKLLT, although consistent nonsignificant trends ($p > .05$) were also observed. High engagers performed better in all measures. However, no significant difference was found in all physical tests ($p > .05$). These results partially supported the engagement hypothesis and suggested that the beneficial effects of engaging in reading and writing-related activities may generalize to other domains of cognition. More data is being collected to reach a more solid conclusion. Further studies investigating the relationship between the levels of engagement in cognitive-related activities and intellectual functioning were suggested.

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J. SMITH, A. EKLUND, F.R. FERRARO, & T. PETROS. Circadian and Adult Age Differences in Performance on the Wechsler Memory Scale.

Elderly adults perform worse than younger adults on a wide range of memory tasks. May, Hasher, and Stoltzfus reported that the time of day in which persons were tested modified the size of age differences in memory observed. However, other work failed to find that adult age differences were modified by the time of day the respondents were tested. The recent publication of the Wechsler Memory Scale–Third Edition (WMS–III) and the frequent use of the WMS–III when evaluating older adults, led us to examine whether time of day modified adult age differences in memory for the word lists and prose passages used on the WMS–III. Older and younger adults were tested at either 8:00–10:00 a.m. or 3:00–5:00 p.m. with the passages and word lists from the WMS–III. Younger adults remembered more words than older adults on most measures of immediate and delayed recall, but the size of the age difference was much larger when participants were tested in the afternoon. No age differences in memory for the passages was observed when recall was scored by the number of major themes recalled from the passage. However, large age differences were observed when scoring the number of ideas remembered from the passage. Time of day did not modify the pattern of age effects on passage memory. The present study indicated that the influence of circadian variation on age differences in memory performance will vary as a function of the task employed.

Correspondence: *Tom Petros, Department of Psychology, Box 8380, University of North Dakota, Grand Forks, ND 58202.*

B.A. STEINBERG, L.A. BIELIAUSKAS, R.J. IVNIK, & G.E. SMITH. Age- and IQ-Adjusted MOANS Norms for the WMS–R.

The use of education-adjusted norms in neuropsychology represents an attempt to refine interpretations of examinees' test scores by taking into account the potential relationship between educational attainment and task performances. However, such demographically-based norms may fail to capture score variance that results from differences in innate cognitive abilities, effort, and school quality. Because intelligence tests are performance-based, they may be more sensitive to the interactions among examinees' scholastic aptitudes and the academic milieu to which they were exposed. In a previous study, we reported age- and IQ-adjusted MOANS norms for the Boston Naming Test, the MAE Token Test, and the Judgment of Line Orientation Test; in the present investigation, we present data from 1,053 MOANS participants (ages 56–99) who completed the Wechsler Memory Scale–Revised (WMS–R) and the Wechsler Adult Intelligence Scale–Revised (WAIS–R). Age-adjusted MAYO primary index scores (Verbal,

Visual, and General Memory; Attention/Concentration; Delayed Recall; and Percent Retention) were more strongly correlated with age-adjusted MAYO FSIQ scores ($r = .366-.631$) than with years of formal education ($r = .179-.310$), and FSIQ scores were associated with larger unique increments in primary index score variance in multiple regression models (.097-.321) than was years of education (.000-.004). Similar patterns were found for age-adjusted MOANS subtest scaled scores (e.g., Logical Memory and Visual Reproduction). Based on these results, we constructed tables of age- and MAYO FSIQ-adjusted WMS-R scores.

Correspondence: Brett Steinberg, Department of Psychology, University of Connecticut, 406 Babbidge Road, U-20, Storrs, CT 06269-1020.

B. RICHARDS & J.B. RICH. Aging and Mild TBI: Aggregate Effects on Cognition.

Clinically, elderly individuals show poorer outcome compared to young individuals following an equivalent traumatic brain injury (TBI). This could be due to either additive (aggregate) or synergistic (interactive) effects of age and TBI. This study examined the separate and combined effects of age and mild TBI (MTBI) on neuropsychological performance in four groups of 20 participants each: healthy young (M age = 26.8), Young MTBI (M age = 27.5), health elderly (M age = 69.1) and elderly MTBI (M age = 66.7). Standard clinical measures of attention, memory, language and executive function were examined. Age-related declines were observed on measures of focused attention, verbal learning, and executive function. Error rates were low, indicating that older individuals were less efficient but generally accurate. MTBI participants performed more poorly than healthy controls on attention, verbal learning and executive function tasks. The effects of age and MTBI had a combined impact on performance in the elderly MTBI group leading to overall poorer performance as compared to other groups. This relative performance deficit was due to additive rather than interactive effects of MTBI and aging factors, indicating that age and MTBI produce independent decrements. The findings may be best explained in terms of brain reserve capacity theory, which posits a protective factor of reserve capacity that is vulnerable to depletion via organismic and extrinsic events, and a threshold level of functioning neurons below which normal function can no longer be maintained.

Correspondence: B. Richards, Department of Psychology, Baycrest Centre for Geriatric Care, 3560 Bathurst Street, Toronto, ON M6A 2E1, Canada.

J. O'NEILL, L. BIELIAUSKAS, B. STEINBERG, & L. GREEN-FIELD. A Longitudinal Study of Cognitive Test Performance and Retirement in Aging Surgeons.

The variability of cognitive decline with aging leads to questions of efficient performance in many risk-laden occupations. A decision to retire may or may not be affected by this decline. In this longitudinal study, cognitive abilities of aging surgeons were tested using the *MicroCog: Assessment of Cognitive Functioning*, Finger-Tapping, Visual Search and Grooved Pegboard tests in order to evaluate the overall cognitive change over a 5-year period. A self-report survey evaluating neuropsychological symptoms, performance assessment, work intentions and retirement issues was also administered. These measures were correlated to determine if cognitive decline and self-assessment could predict retirement strategies. The cognitive tests and surveys were administered 5 years apart to the same surgeons. The mean age at initial testing was 56.27 years and the mean age at final testing was 59.63 years. Findings indicated that although there was a significant relationship between information processing speed, general cognitive functioning and age, these measures were not related to retirement. The best predictor of retirement was age, as indicated by the survey. These findings show that while this neuropsychological battery does not predict retirement, self-evaluation measures and performance reviews may yet be instrumental in self-monitoring and maintaining safe practice. These measures may also account for individual variability in cognitive decline. This study is the first to examine the relationships between aging, cognitive change and the decision to retire among surgical practitioners.

Correspondence: Jillian O'Neill, 7704 S. 10th Street, Kalamazoo, MI 49009.

A. HUBLEY. Is the Modified Taylor Figure Comparable to the Rey-Osterrieth in Older Adults?

Complex figures are commonly used in neuropsychology to measure visuospatial abilities. Over the past 10 years, considerable research has shown that the Rey-Osterrieth Complex Figure (ROCF) and its companion figure, the Taylor Complex Figure, are *not* comparable measures of visuospatial memory. Recently, comparable visuoconstructive performance and visuospatial memory performance has been shown for the ROCF and a Modified Taylor Complex Figure (MTCF) in young adults. The present study examined the comparability of the ROCF and MTCF in 64 adults aged 55-78 years ($M = 65.5$ years) whose education ranged from 9-18 years ($M = 12.9$ years). All participants scored >24 on the Mini-Mental State Examination and ≤ 14 on the Geriatric Depression Scale. A between-groups design was used wherein participants received either the ROCF or the MTCF. Participants in the 2-groups were matched for age and education. Results showed a statistically significant difference between the two figures on the copy trial with slightly higher performance on the MTCF. No statistically significant differences were found between the ROCF and MTCF on the immediate recall and 20-min delayed recall trials, although, again, performance was slightly higher on the MTCF. The length of time taken to produce the figures was unrelated to performance on all trials for both the ROCF and the MTCF.

Correspondence: Anita Hubley, Department of ECPS, Faculty of Education, 2125 Main Mall, The University of British Columbia, Vancouver, BC V6T 1Z4, Canada.

M.S. LEWIS, L.S. MILLER, & FAMILY RELATIONS IN LATE LIFE STUDY (FRILL). Elder Caregiver Cognitive Status and Quality of Elder Care Over Time.

Older people in the community are increasingly relying on family members to care for them when they become ill or disabled. Past research in our lab has shown, however, that in 1 sample of elderly caregivers 44% were at least mildly cognitively impaired according to a cognitive screening measure, and that decreased cognition in caregivers was negatively associated with both caregiver emotional status and the quality of care provided to care recipients. The current study presents findings from second wave data collected 12 months later in this ongoing longitudinal study of the caregiving relationship. Data replicate previous results, indicating caregiver cognitive status was at least mildly impaired in approximately 40% ($N = 39$) of the 105 elderly community caregivers in the current study. Two-tailed correlational analyses indicated that caregiver cognitive status was related to recipient report of psychological abuse ($r = .414, p < .01$) and psychological neglect ($r = .351, p < .01$), as well as to recipient report of overall quality of care ($r = .407, p < .01$), on a measure consisting of items measuring abuse, neglect and financial exploitation. Hierarchical multiple regression analyses revealed that quality of care for elderly care-recipients was successfully predicted by the combined effects of caregiver cognition and anxiety [adj. $R^2 = .206, F(2,67), p < .005$]. No changes in quality of care as related to caregiver cognition were observed as a result of changes from Wave 1 to Wave 2, likely due to limited variance occurring over a short time period in a relatively small N . Data from both collection waves are presented and implications discussed.

Correspondence: Monica Lewis, Department of Psychology, University of Georgia, Athens, GA 30602.

S.L. BELL. Neuropsychological Tests of Executive Function in Predicting Instrumental Activities of Daily Living.

Older adults are at risk for functional impairment in performing instrumental activities of daily living. Previous research has demonstrated that poor functional performance is associated with executive dysfunction. The current study investigated neuropsychological tests of executive function in determining functional ability in older adults. Fifty study participants consisted of community-dwelling and nursing home volunteers, and participants referred for a neuropsychological evaluation for assessment of dementia. Executive function tests accounted for 58% of the variance in functional status, with Trail Making Test-Part B demonstrating the stron-

gest predictive power. Results also suggested that tests of executive function contribute significantly to the prediction of functional status, even after statistically controlling for memory function and global cognitive function. Depression had a low, statistically significant association with functional ability. In conclusion, results supported the hypothesis that common clinical measures of executive control predict functional status in older adults.

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Symposium 7/3:30–5:15 p.m.

THE INHIBITORY CONTROL OF BEHAVIOR: MECHANISMS AND RELATED DISORDERS

Organizer and Chair: **Sharon Nichols**

S. NICHOLS. The Inhibitory Control of Behavior: Mechanisms and Related Disorders.

Behavioral dysregulation is a hallmark of several psychiatric and neurological disorders. In recent years, a better understanding of the brain mechanisms underlying behavioral regulation and disorders of inhibition has emerged. Several fields have made important contributions, including neuropsychology and neurology, clinical psychology, psychiatry, and cognitive neuroscience. This symposium provides a cross-section of research on the development of behavioral regulation and disorders associated with its failures and has as its goal stimulating discussion across research areas. The focus is on theories and mechanisms of behavioral regulation and new methods of approaching the issue, including recently developed cognitive and neuroimaging techniques. The role of frontal-subcortical areas and circuits in behavioral regulation is a theme cutting across the presentations. Topics include (1) the normal development of inhibitory functions and studies of children with early, focal brain damage (S. Nichols), (2) behavioral and neuroimaging studies of response inhibition in children with Attention Deficit/Hyperactivity Disorder and Tourette's Syndrome (S. Mostofsky), (3) models of the mechanisms underlying disinhibition in psychopathy (J. Newman), (4) the role of frontal-subcortical circuits in self-regulation and obsessive-compulsive disorder (P. Malloy), and (5) the role of the basal ganglia in behavioral control and its relationship to deficits seen in Huntington's and Parkinson's diseases (J. Stout).

Correspondence: *Sharon L. Nichols, Ph.D., Department of Neurosciences, University of California, San Diego, 9500 Gilman Drive #0935, La Jolla, CA 92093.*

S. NICHOLS. Response Inhibition in Children With Early, Focal Brain Injury.

Problems with behavioral regulation are one of the central features of early childhood itself, and a failure to develop adequate inhibitory controls is a hallmark of several disorders that first appear in childhood, such as ADHD. The association of poor behavioral inhibition with frontal lobe damage in adults, and the fact that the protracted development of this function coincides with the equally protracted development of the frontal lobes, has contributed to theories that disinhibitory psychopathology is related to frontal lobe damage. However, studies of inhibition in children with early, relatively discrete structural damage to the frontal lobes are lacking. Our knowledge of the impact of early damage on other functions, such as language and memory, suggests that postulating developmental mechanisms based on the brain-behavior relationships seen in adults can be misleading. In this presentation, preliminary results of an ongoing study of school-age children who sustained focal, pre- or perinatal brain damage will be presented. The performance of these children on tasks involving response

inhibition, and on tests of other executive functions such as working memory and problem solving, will be presented and compared to normal development. The relationship of laboratory measures of inhibition to parent ratings of behavior and adaptive functioning will also be presented. The implications of the findings for our understanding of the normal and abnormal development of self-regulation will be discussed.

Correspondence: *Sharon L. Nichols, Ph.D., Department of Neurosciences, University of California, San Diego, 9500 Gilman Drive #0935, La Jolla, CA 92093.*

S. MOSTOFSKY. Response Inhibition in Developmental Disorders: ADHD and Tourette Syndrome.

Leading hypotheses suggest that a deficit in motor response inhibition is an important mechanism underlying the clinical presentation of attention deficit hyperactivity disorder (ADHD). Data examining this hypothesis, as well as mechanisms of response inhibition in Tourette syndrome (TS), in which ADHD is a frequent comorbidity, will be discussed. This will include presentation of data from a study in which motor response inhibition and motor persistence was examined in children with ADHD, as well as oculomotor studies of children with ADHD and children with TS that include tests that directly examine motor response inhibition. Data examining correlations between these neurobehavioral measures and volumetric imaging data (particularly of the frontal lobes and interconnected subcortical structures hypothesized to be important for response inhibition and motor persistence) will be presented. In addition, functional MRI data examining brain activation patterns associated with response inhibition in children with ADHD, children with TS, and controls will be discussed.

Correspondence: *Stewart Mostofsky, M.D., Kennedy Krieger Institute, 707 N. Broadway, Baltimore, MD 21205.*

J. NEWMAN. Neuropsychological Anomalies in Psychopathic Offenders.

Psychopaths are infamous for their disinhibited, and frequently antisocial, behavior. Based on an animal model involving the septohippocampal-frontal system, we have proposed that their disinhibitory psychopathology reflects a deficit in response modulation. Response modulation involves a brief and relatively automatic shift of attention from the effortful organization and implementation of goal-directed behavior to accommodate peripheral information. Consistent with the response modulation hypothesis, (1) psychopaths are deficient in inhibiting punished responses on a go/no-go discrimination task when doing so requires them to alter a dominant response set, though not when doing so is consistent with their primary focus of attention; (2) psychopaths are relatively insensitive to emotionally-neutral peripheral cues as well as peripheral threat cues; (3) psychopaths are deficient in using emotional valence and word frequency cues to facilitate performance on lexical decision tasks; and (4) psychopaths' failure to process secondary information appears to be specific to conditions that differentially activate the left hemisphere [e.g., trial blocks involving right-hand as opposed to left-hand responses on a lexical decision task; memory for secondary (i.e., location) cues in a serial recall task when words appear in the right-, as opposed to the left-, visuospatial field]. Overall, this program of research supports speculation that psychopaths' inhibitory deficits involve a deficit in response modulation that hampers their use of secondary/peripheral information and, thus, interferes with adaptive self-regulation. Correspondence: *Joseph P. Newman, Ph.D., Department of Psychology, University of Wisconsin-Madison, 1202 West Johnson Street, Madison, WI 53706.*

P. MALLOY. Frontal-Subcortical Circuits in Obsessive-Compulsive Disorder.

Research from behavioral and neuroimaging studies has implicated frontal-subcortical circuits in obsessive-compulsive disorder (OCD). For example, PET studies have demonstrated that the orbital frontal lobe and caudate nucleus show abnormal activity in symptomatic OCD, and that some of this activity normalizes with successful treatment. Research in our labo-

ratory exploring this circuit and its role in self-regulation will be reviewed. This review will include (1) an overview of frontal-subcortical connections important to behavioral inhibition; (2) demonstration of orbital frontal hyperactivity in OCD on quantitative EEG; and (3) pre-post neuropsychological findings in OCD patients undergoing Gamma knife lesioning of the anterior internal capsule (linking subcortical and orbital frontal zones).

Correspondence: *Paul Malloy, Ph.D., Director of Psychology, Butler Hospital, 345 Blackstone Boulevard, Providence, RI 02906.*

J. STOUT. Regulation of Neurocognitive Functions in Huntington's Disease and Parkinson's Disease.

Huntington's disease (HD) and Parkinson's disease (PD) are both neurodegenerative diseases that have primary effects on basal ganglia function and are associated with dramatic alterations in neurochemistry (e.g., dopamine, GABA, glutamate). Both HD and PD result in a broad range of cognitive, motor, and psychiatric symptoms, most of which tend to be more severe in HD. Among the cognitive abilities affected are attention, episodic and working memory, and psychomotor and executive functions. Frequently, neuropsychological findings in these diseases are interpreted as reflecting frontal system dysfunction. For example, increased problems with interference on Stroop tests, perseverative responses in memory tests, and increased susceptibility to distraction in attention tests are often interpreted as failures of cognitive control, disinhibition, or problems with self-regulation. In this talk, I will describe recent theory and data regarding the role of the basal ganglia in cognition. From this starting point, I will describe hypotheses and testable predictions that can be made regarding behavior in HD and PD. Next, I will present data from a series of recent cognitive neuropsychological studies in our laboratory that address cognitive control and self-regulatory behavior in HD and PD including tests of selective attention, working memory, decision making, and response reversal.

Correspondence: *Julie C. Stout, Ph.D., Indiana University, Department of Psychology, 1101 East 10th Street, Bloomington, IN 47405-7007.*

Symposium 8/3:30–5:15 p.m.

ECOLOGICAL VALIDITY OF NEUROPSYCHOLOGICAL TEST PERFORMANCE

Organizer and Chair: Charles Hinkin

C.H. HINKIN. Ecological Validity of Neuropsychological Test Performance.

The ecological validity, or "real-world" correlates, of neuropsychological evaluation is a critically important, though to-date understudied, issue within the field of neuropsychology. Historically, the vast majority of research studies examining neuropsychological test validity have focused on the utility of neuropsychological testing in differential diagnosis, lesion detection and localization, and determination of level of impairment relative to normative comparison groups. Increasingly, however, neuropsychologists are being asked to render opinions on topics such as whether patients can make sound financial decisions, can safely function independently, or are occupationally disabled, questions that have received but scant empirical study. The degree to which neuropsychological tests, originally developed with other goals in mind, can now be validly employed in such new arenas must now be determined. Several of the papers comprising this symposium address methodological and theoretical issues relevant to this research question while others provide empirical data addressing the ecological validity of neuropsychological testing among patient populations. Topics addressed by the symposiasts include neuropsychological predictors of (1) employment outcome status post traumatic brain injury and HIV in-

fection; (2) driving ability; (3) everyday functioning and activities of daily living; (4) functional outcome in schizophrenia; and (5) medication adherence. The Discussant (A. Kaszniak) will then review key issues raised in the symposium and suggest future research directions.

Correspondence: *Charles H. Hinkin, UCLA School of Medicine, 760 Westwood Plaza, Room C8-747, Los Angeles, CA 90024.*

M. GREEN. Neurocognitive Deficits and Functional Outcome in Schizophrenia.

There is an increasing awareness that many patients with schizophrenia have difficulty in community functioning even when the psychiatric symptoms are well controlled. These deficits in social functioning, vocational outcome, and independent living contribute to the high levels of disability in schizophrenia. The determinants of disability have been difficult to identify. However, the literature is consistent in pointing to certain neurocognitive deficits, including problems in attention, memory, and problem solving, as key determinants for functional outcome in schizophrenia. This presentation will review the existing literature on neurocognition and functional outcome in schizophrenia. The importance of neurocognitive deficits for acquiring skills in psychosocial rehabilitation will be emphasized. Some key mediators (e.g., social cognition) that act between the deficits in neurocognition and functional outcome will be discussed.

Correspondence: *Michael Green, Ph.D., UCLA Neuropsychiatric Institute and Hospital, 760 Westwood Plaza, Rm. C9-420, Los Angeles, CA 90024.*

M. SHERER. Neuropsychological Assessment and Employment Outcome After TBI.

Neuropsychological status of persons with traumatic brain injury (TBI) is assessed for a number of reasons. Neuropsychological assessments may be used to provide feedback to the patient, family, and healthcare professionals regarding the patient's current cognitive status, supervision needs, ability to understand and recall safety precautions, capacity for driving, ability to return to work, and many other issues. Early neuropsychological assessment may be used to guide rehabilitation interventions. The initial assessment provides a baseline against which later assessments may be compared to facilitate detection of improvement or deterioration. Serial neuropsychological assessments may be used to evaluate the effectiveness of pharmacologic trials. Neuropsychological assessment may also be used to predict eventual functional outcome such as return to work. Employment outcome is a difficult outcome to predict as it is influenced by a variety of factors not associated with the patient's neurologic or neuropsychological status. Such factors include pre-injury employment status, demographic variables, availability of environmental supports, and family support. Investigations of the relationship of neuropsychological status to employment outcome may be organized in three categories: (1) late neuropsychological assessment with concurrent assessment of employment outcome, (2) postacute neuropsychological assessment with later assessment of employment outcome, (3) early neuropsychological assessment with late assessment of employment outcome. While studies of all 3 types generally support the ability of neuropsychological assessment to predict employment outcome, a number of issues remain unresolved. The present paper reviews these previous investigations and discusses the relevant conceptual and methodologic issues.

Correspondence: *Mark Sherer, Ph.D., ABPP, Mississippi Methodist Rehabilitation Center, 1350 East Woodrow Wilson, Jackson, MS 39216.*

R. HEATON, D. MOORE, T. MARCOTTE, C. REICKS, K. WEINBERG, I. GRANT, & THE HNRC GROUP. Everyday Functioning in Individuals With HIV-Associated Neuropsychological Impairment.

Traditional neuropsychological (NP) tests have been shown to be sensitive to cognitive impairment in HIV infection; however, the relationship of such impairment to activities of daily living needs further exploration. The objective of the current study was to determine if HIV-related NP deficits are related to complaints of everyday cognitive difficulties and to labora-

tory measures of vocational functioning and other activities of daily living. *Method:* We examined 255 HIV+ participants. Based upon results on a comprehensive NP battery, participants were classified as NP impaired (NPI; $n = 98$) or NP normal (NPN; $n = 157$). The NPI and NPN groups were similar with respect to age, education, gender, disease stage, and percent with an AIDS diagnosis. *Results:* The NPI group had significantly more cognitive complaints, were less likely to be currently employed, and had lower scores on standardized work samples than the NPN group. In addition, the NPI group was more likely to fail laboratory measures of activities of daily living that assessed skills related to medication management, meal preparation, and financial management, among others. More NP deficits (as measured by a greater number of impaired NP ability areas) predicted greater likelihood of failure on the laboratory measures of activities of daily living. Overall, global NP ratings of impairment were accurate in predicting performance on all laboratory measures of activities of daily living (range 64.7–84.1%). The NP ability areas of abstraction, verbal skills, learning, and motor skills appear to have the strongest relationship with impaired performance on measures of activities of daily living. *Conclusion:* Even relatively mild HIV-associated NP impairment is associated with both subjective and objective evidence of decreased everyday functioning.

Correspondence: R.K. Heaton, 140 Arbor Drive, San Diego, CA 92103.

C. HINKIN, S. CASTELLON, M. LAM, D. HARDY, M. STEFANIAK, & B. ZOLNIKOV. Neuropsychological Compromise Predicts Poor Medication Adherence in HIV+ Adults.

The introduction of highly active antiretroviral therapy (HAART) has resulted in considerable improvement in morbidity and mortality among HIV+ persons. However, it has been demonstrated that without high levels of medication adherence, viral replication will ensue and HAART-resistant viral strains will arise. The present study, which examines whether neuropsychological (NP) test performance is predictive of medication adherence, provides a test of the ecological validity of neuropsychological evaluation. *Method:* One hundred ten participants (80 HIV+; 30 HIV-) were administered a battery of neuropsychological tests. Principal Components Analysis with oblique rotation yielded the following 6-factor solution: Speeded Executive Functions; Untimed Executive Functions; Memory, Mood, Reaction Time, Prospective Memory. Medication adherence was objectively verified using the Medication Event Monitoring System (MEMS caps) technology. *Results:* Medication adherence was significantly associated in the expected direction with performance on both the speeded ($r = -.40, p = .002$) and unspeeded ($r = .30, p = .02$) executive function factors. There was a trend in the direction of poorer performance on memory testing being predictive of medication adherence ($r = .24, p = .07$). The other factors were not significantly associated with medication adherence. An interesting dissociation emerged when NP outlier status (NP normal vs. NP impaired) was used to predict adherence. Among those patients who were NP impaired, fully 74% were poor adherers whereas only 26% were good adherers. In contrast, NP normal status was not predictive of adherence status. *Discussion:* These data suggest that NP test performance, specifically executive functioning, is indeed associated with medication adherence among HIV+ persons. Of note, while the positive predictive power of neuropsychological compromise was high, the negative predictive power was low. In other words, false negatives far outnumbered false positives. With regards to the ecological validity of NP evaluation, this suggests that NP test impairment does have significant “real-world” correlates whereas normal NP performance may not.

Correspondence: Charles H. Hinkin, UCLA School of Medicine, 760 Westwood Plaza, Room C8-747, Los Angeles, CA 90024.

W.G. VAN GORP, E.R. RYAN, J.R. RABKIN, S.J. FERRANDO, & K. WALTON. Neuropsychological Predictors of Return to Work in HIV+ Individuals.

With the advent of combination therapy including the use of protease inhibitors, many HIV+ individuals are experiencing improved health and

immune function, and with this, some have decided to return to the workplace. Nevertheless, it is not clear to what extent the neuropsychological status of the individual will predict success or difficulty in returning to work. Up to now, no study has prospectively followed a cohort HIV+ individuals seeking return to work to determine the degree to which neuropsychological status at entry relates to eventual success or difficulty in finding employment. This study seeks to address this question. This presentation will provide initial data on the relationship between neuropsychological function and employment status over a 6-month period in a cohort of 75 HIV+ individuals recruited from the community. These individuals have stopped work, and are now seeking to return to work in the context of improved health. They will be administered a battery of neuropsychological tests assessing attention, intelligence, memory, language, spatial, executive, and motor abilities. These individuals will be followed for a 6-month interval. We will examine the relationship between neuropsychological function at entry and success/failure in returning to work over this time frame. Based upon our findings to date, we hypothesize that performance on tasks of executive function will be most predictive of success or failure in returning to work.

Correspondence: Wilfred van Gorp, Weill Medical College of Cornell University, 525 East 68th Street, Box 147, New York, NY 10021.

T. MARCOTTE, R. HEATON, R. GONZALEZ, C. REICKS, I. GRANT, & THE HNRC GROUP. Assessing Driving Abilities in HIV-Infected Individuals With Mild NP Impairment.

We have previously shown that mild HIV-related neuropsychological (NP) dysfunction is associated with both poor performance on a driving simulator and worse driving record (more “real-life” accidents). This study examines (1) whether HIV-related NP deficits result in unsafe driving (evaluated via an on-road assessment) and (2) the utility of NP and simulator assessments in identifying unsafe drivers. *Methods:* Participants (36 HIV+, 20 HIV-) completed an NP battery and were classified as impaired or not. Driving skills were assessed by (1) performance on two simulations, and (2) a 30-min on-road evaluation by a rehabilitation driving instructor. The instructor determined whether subjects were “safe” to be driving. All evaluators were blinded to subject serostatus and results on all other tests. *Results:* Ten (28%) of the HIV+ participants were classified as NP impaired (none with greater than a mild-to-moderate level of impairment). Although it was rare for HIV seronegative and HIV+ NP normals to be considered “unsafe” on the road (5% and 7.7%, respectively), 4 of 10 participants (40%) with HIV-related NP dysfunction were so classified. NP impaired participants also did more poorly on each of the simulations. NP and simulator performance were each significant predictors of on-road failure. *Conclusion:* Even mild levels of HIV-associated cognitive impairment may result in impaired driving skills in a subset of individuals. Further study is needed to refine the use of NP and other predictors for identifying individuals at risk for dangerous driving behaviors.

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Presidential Address/5:30–6:30 p.m.

**REFLECTIONS UPON
DEVELOPMENTAL NEUROPSYCHOLOGY:
DIFFERENTIAL CONSEQUENCES
OF DEVELOPMENTAL ANOMALIES
VERSUS EARLY ACQUIRED
LESIONS OF THE BRAIN**

Martha Denckla

SATURDAY MORNING, FEBRUARY 17, 2001

Paper Session 10/9:00–10:45 a.m.

TRAUMATIC BRAIN INJURY

K.R. BONESTEEL, R.E. HANLON, & J.P. KELLY. Neuropsychological Status of Litigating Versus Nonlitigating Postconcussive Patients.

Postconcussive symptoms are frequently reported by patients who have sustained a mild traumatic brain injury. Previous studies have documented that post-concussive symptoms are often related to emotional, personality, neuropsychological and neurological variables, although some inconsistency has been noted. There is also some evidence to suggest that involvement in litigation may contribute to the development and persistence of reported postconcussive symptoms and response bias for symptom report in general. Less is known, however, about the relationship between symptom severity and non-injury related variables (e.g., litigation). The present study was designed to assess the difference between 51 litigating and 69 nonlitigating patients with respect to postconcussive symptoms, neurological variables, and neuropsychological status. Litigants reported a significantly greater number of symptoms than nonlitigants of comparable neuropsychological status ($p < .01$), suggesting that litigation can contribute to symptom endorsement. Furthermore, results indicated that patients with severe postconcussive syndrome (≥ 10 symptoms) did, in fact, demonstrate worse neuropsychological status than either moderate (7–9 symptoms) or mild (≤ 6 symptoms) patients. Litigants and nonlitigants, however, displayed a comparable degree of neuropsychological dysfunction at each level of symptom severity. Taken together, these findings suggest that severity of postconcussive symptoms may not only be a litigation related response bias but may also be related to objective neuropsychological dysfunction.

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C. CHRISTODOULOU, J. DeLUCA, J.H. RICKER, N.K. MADIGAN, B.M. BLY, G. LANGE, A.J. KALNIN, W-C. LIU, J. STEFFENER, B.J. DIAMOND, & A.C. NI. A Functional MRI Study of Working Memory Impairment After Traumatic Brain Injury.

Objectives: To examine patterns of brain activation while performing a working memory (WM) task in persons with moderate to severe traumatic brain injury (TBI) and healthy controls. WM is an area of cognition that is especially vulnerable to disruption following TBI. While much has been learned about the system of cerebral representation of WM in healthy individuals, little is known about how this system is disrupted by TBI. **Methods:** Functional magnetic resonance imaging was performed on a 1.5 Tesla GE scanner to assess brain activation during a WM task (i.e., a modification of the Paced Auditory Serial Addition Test) in 9 TBI patients and 7 healthy controls. Raw scan data were analyzed with Statistical Parametric Mapping (SPM96) software. SPM maps were thresholded to a stringent alpha level (.001). A random effects procedure identified significantly activated regions in each group, as well as differences between groups. Indices of activation laterality and dispersion were also calculated. **Results:** TBI participants could perform the task, but made significantly more errors than controls. Cerebral activation in both groups was found in similar regions of the frontal, parietal, and temporal lobes, and resembled patterns of activation found in previous neuroimaging studies of WM in healthy persons. However, compared to the controls, the TBI group displayed an activation pattern that was more regionally dispersed and more lateralized to the right hemisphere. Differences in lateralization were particularly evident in the frontal lobes. **Conclusions:** Working memory impairment in TBI appears to be associated with alterations in functional cerebral activity. Correspondence: J. DeLuca, Neuropsychology Lab, Kessler Medical Rehabilitation & Education Corp., 1199 Pleasant Valley Way, West Orange, NJ 07052.

M. SHERER, A. SANDER, W.M. HIGH, JR., T.G. NICK, J.F. MALEC, & M. ROSENTHAL. Prediction of Employment Outcome After TBI From Early Neuropsychological Status.

Early neuropsychological assessment after traumatic brain injury (TBI) serves many purposes. Such assessments document the patient's current neuropsychological status and may be used to guide treatment and to make decisions about need for supervision, return to driving, and return to work. Early neuropsychological assessment may also be used to predict long-term employment outcome. However, existing studies do not clearly show that neuropsychological assessment makes an additional contribution to such predictions beyond that made by indices of severity of injury, demographic factors, and measures of preinjury functioning. The present study investigated the ability of early neuropsychological assessment to predict employment outcome after TBI. Participants were 416 persons with TBI from the TBI Model System National Database. Initial neuropsychological assessment was obtained at resolution of posttraumatic amnesia (PTA) and employment outcome was assessed at 1 year post injury. Predictors investigated were neuropsychological status, age, education, initial Glasgow Coma Scale score, duration of PTA, and preinjury employment status. Results indicated that neuropsychological assessment makes a unique contribution to predicting employment outcome even when adjusted for all the other predictors. After adjustment for other predictors, persons scoring at the 75th percentile of overall neuropsychological status (less impaired) were 1.53 times as likely to be employed at follow-up as persons scoring at the 25th percentile. Without adjustment, persons scoring at the 75th percentile were 2.3 times as likely to be employed at follow-up as persons scoring at the 25th percentile. Duration of PTA and preinjury employment status also made independent contributions to predicting employment outcome.

Correspondence: Mark Sherer, Ph.D., ABPP, Mississippi Methodist Rehabilitation Center, 1350 East Woodrow Wilson, Jackson, MS 39216.

H.M. NISSLEY & M. SCHMITTER-EDGEcombe. Perceptually-Based Implicit Learning Following Closed-Head Injury.

This study used a covariation learning paradigm to examine perceptually based implicit learning following closed-head injury (CHI). Nineteen severe CHI participants (>1 year post injury) and 19 matched controls were presented with a series of 4 visual matrices across 8 blocks of 48 trials. Their task was to indicate the quadrant in which a target appeared. For each of the matrices, the location of the target was determined by the arrangement of the digits within the matrix. Participants were exposed to the following covariation pattern: AAAABAAA. Thus, for the A blocks, the matrices systematically co-occurred with a unique location of the target. In covariation B, however, the relationship was changed. We found that although CHI participants were significantly slower at responding to the stimuli than the controls, both groups demonstrated similar patterns of performance across the blocks. A significant decline in response times was noted across the first 4 patterned blocks (AAAA), indicating that participants' performances were improving with practice. Introduction of the covariation revealed that part of this improvement was due to implicit rule learning. Response times significantly increased with the introduction of covariation B and returned to levels consistent with those prior to the switch when covariation A was reintroduced. Additionally, this level of learning was maintained after a 20-min delay. For both groups, these results occurred despite a lack of conscious awareness of the covariation. This study suggests that perceptually based implicit learning may either remain intact following a severe CHI or show recovery by 1 year.

Correspondence: Maureen Schmitter-Edgecombe, Department of Psychology, Washington State University, P.O. Box 644820, Pullman, WA 99164-4820.

U. SATISH, S. STREUFERT, & P.J. ESLINGER. Cognitive Simulation: Novel Assessment of Executive Deficits After Head Injury.

Despite good medical recovery, 15 to 27% of mild to moderate closed head injury (CHI) patients experience continued subtle deficits involving dim-

intuition of cognitive/behavioral skills, social dysfunction, and lost vocational productivity. Standard neuropsychological tests often cannot detect and characterized these subtle deficits. To address this assessment need, we investigated a novel approach to quantitative measurement of executive functions. Strategic Management Simulation (SMS) is a complex simulated environment with decision-making demands that occur over 4 hrs. It has been established to be a reliable and valid quantitative test of complex decision-making. A sample of 24 CHI patients in the chronic recovery phase participated in cognitive simulation assessment. Neuropsychological tests showed minimal to no impairments in executive functions. Simulation results showed significant impairments. Mean values for 2 measures of Activity, all 4 measures of Initiative, 1 measure of Response Timing, 1 measure of decision-making Breadth, and 1 indicator of Emergency Responsiveness were statistically impaired relative to controls. Several other performance scores (e.g., Speed of Response to Information) were borderline. CHI patients became focused on 1 salient problem, ignoring other concurrent task demands. They also spent extraordinary amounts of time searching for information but applied it sparingly in decision-making. As a complement to standard neuropsychological testing, this cognitive simulation technique appears to have promise for quantitative detection of subtle residual deficits in CHI patients with good recovery. This approach may advance both characterization and future remediation of subtle executive deficits after head injury.

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Paper Session 11/9:00–10:45 a.m.

MEMORY

E.V. SULLIVAN, L. MARSH, K.O. LIM, & A. PFEFFERBAUM. Equivalent Hippocampal Volume Deficits in Korsakoff's Syndrome and Alzheimer's Disease.

Alcoholic Korsakoff's syndrome (KS) is characterized by a dense, global amnesia that is more salient than other cognitive deficits accompanying chronic alcoholism. A longstanding controversy persists regarding the neural substrate of this amnesia. Studies of amnesia of nonalcoholic etiologies, including anoxia, herpes encephalitis, stroke, and surgical resection, have traditionally concluded that the neural substrate of amnesia is hippocampal damage. By contrast, postmortem and *in vivo* studies provide evidence for damage in thalamus, diencephalon, or both regions as underlying alcoholic KS amnesia but diminish or exclude altogether a potential role for hippocampal shrinkage in producing alcoholism-related global amnesia. Herein, we measured hippocampal volumes in 9 men with KS and 22 men with Alzheimer's disease (AD), which is known to have primary pathology in hippocampus. Compared with 37 age-range matched control men, both the KS and AD groups had bilateral volume deficits in the anterior (left $p = .0001$; right $p < .005$) but not posterior hippocampi; the 2 patient groups did not differ from each other. Further, the hippocampal volume deficits were equally severe in KS subgroups with ($N = 4$) and without dementia ($N = 5$) accompanying the amnesia. These results draw into question dualistic theories of memory impairment based on differential involvement of hippocampal versus diencephalic/thalamic pathology. We hypothesize that hippocampal volume deficits underlie the KS-defining global amnesia for declarative, nonstrategic memory and that diencephalic/thalamic and also frontal lobe involvement in KS underlie the strategic and remote memory impairment also typical of KS and possibly confounding a simple characterization of KS amnesia.

Correspondence: E.V. Sullivan, Department of Psychiatry and Behavioral Sciences, Stanford University, 401 Quarry Road, Stanford, CA 94305-5717.

R. HOPKINS, L. WEAVER, C. HESSEL, D. TATE, E. BIGLER, & D. BLATTER. Hippocampal Atrophy Following Carbon Monoxide Poisoning: Gender Differences.

Introduction: CO poisoning may cause neuroanatomical lesions and cognitive impairments. We have observed hippocampal atrophy following CO

exposure in a small group of selected severely CO poisoned patients. The purpose of this study was to prospectively assess the effect of CO poisoning on the hippocampal size using a prospective within-subjects design. *Methods:* Brain MRIs and neuropsychological tests of 65 patients were acquired within 24 hr (Day 1), 2 weeks, and 6 months following CO poisoning. The Day 1 scans were used as the patients' baseline scan. Hippocampal volumes were analyzed in the coronal plane using ANALYZE. Data was analyzed using repeated measures, multivariate analysis. *Results:* Although there were no differences in hippocampal atrophy over time, there was a trend in that direction ($p = .15$) for which 78 more participants would be needed to reach significance. Fifty-two percent of the patients had LOC. Significant differences were found for gender ($F = 9.54, p = .002$) and for the scant time by LOC interaction ($F = 9.2, p = .003$). *Post-hoc* analysis showed that for gender there was no significant differences at Day 1, but females had significantly greater atrophy than males at 2 weeks ($F = 4.39, p = .04$) and 6 months ($F = 4.33, p = .04$). There was no 3-way interaction between Gender \times LOC \times Hippocampal Volume. *Conclusions:* Carbon monoxide poisoning may result in hippocampal atrophy. Results of this study showed no gender differences on Day 1 (baseline); however there were significant gender differences at 2 weeks and 6 months. Females had significantly greater hippocampal atrophy compared to males. Correspondence: Ramona O. Hopkins, Ph.D., Department of Psychology, 1122 SWKT, Brigham Young University, Provo, UT 84602.

S.C. JOHNSON. Hippocampal Response to Repeating Verbal Events: An fMRI Study of Learning.

Hippocampal involvement in acquisition of new information has been well documented in lesion studies but has been an inconsistent finding in functional imaging studies of memory. Acquisition of new information is a dynamic cerebral process that generally occurs in time and may therefore not be captured by steady-state paradigms. This event-related functional MRI (fMRI) study was designed to address the temporal aspects of learning by comparing the hemodynamic response (HR) of discrete repeating verbal events to a decreasing linear covariate over time. This is a test of the Time \times HR interaction. If present, this effect would take the form of response suppression or adaptation of fMRI signal over repeated trials. Eight individuals participated (5 male, 3 female; M age = 27, $SD = 3$). Through a goggle projection system, subjects saw repeating new words pseudorandomly mixed with previously overlearned repeating words and null events. The average ISI was 3 s; the actual timing of presentation was jittered around the TR for equal temporal resolution over the volume. Data were preprocessed in SPM99 and analyzed using a multisubjects fixed-effects procedure. Results of the novel *versus* familiar analysis revealed a focus in the anterior left hippocampal region. The Time \times HR interaction analysis revealed an area of response suppression within the right hippocampus, presumably reflecting learning of the repeating new words. These results emphasize that acquisition of new information is a process that occurs along the time dimension and this important concept should be considered when designing and analyzing studies of learning.

Correspondence: Sterling Johnson, Neurology, Barrow Neurological Institute, 222 W. Thomas Road, Suite 315, Phoenix, AZ 85013.

J. LENGENFELDER, J.H. KRAMER, L.A. KEMENOFF, K. YAFFE, & D.C. DELIS. Verbal Memory in Pre- and Postmenopausal Women.

Previous studies highlighting the relationship between estrogen and verbal memory in women have raised the hypothesis that estrogen has a protective effect on memory. One way to address this question is to examine age-related changes in memory in premenopausal and postmenopausal women compared with men. The California Verbal Learning Test-II (CVLT-II) was administered to 309 males and 329 females between the ages of 16–45 and 235 males and 242 females between the ages of 55–84. Verbal memory was assessed by the number of words retained from a word list after a delay period. Correlations between recall and age were significant for the 16–45-year-old men ($r = -.156, p < .01$), the 55–84-year-old men ($r = -.298, p < .01$), and the 55–84-year-old postmenopausal women ($r = -.191, p < .01$) but not for the 16–45-year-old premenopausal women ($r = .041, p > .05$). Gender differences in age-related changes were fur-

ther analyzed with multiple regression. In the premenopausal cohort, the Age \times Gender interaction term explained a significant portion of the memory variance (after forcing in age and gender), indicating different age-related changes in men and women ($p < .01$). In contrast, the interaction term did not explain additional variance in the postmenopausal cohort ($p > .05$). These results indicate that unlike men and postmenopausal women, premenopausal women do not show age-related declines in verbal memory. These findings are consistent with the view that estrogen has a protective effect on verbal memory, although further research directly assessing the role of estrogen on memory is needed.

Correspondence: Jean Lengsfelder, UCSF Memory & Aging Center, Box 1207, San Francisco, CA 94143.

M. MORAN, R. ARIAS, S. LEACH, M. HAUT, & H. KUWABARA. Neural Activation During Frequency Versus Recognition Judgments.

Lesion studies have demonstrated that frequency memory, or memory for the frequency of occurrence, is associated with prefrontal and not temporal lobe lesions. This observation has not been confirmed using functional imaging. This study examined patterns of neural activation using $H_2[^{15}O]$ positron emission tomography in healthy individuals during performance on a frequency judgment task and a recognition memory task. Both tasks, and the control task, used auditory presentation of words as stimuli. Nine healthy, right-handed individuals (4 females) served as study participants. Participants were young ($M = 23.1$ years, range 19–29) and well-educated ($M = 16.0$ years, range 13–19). Compared to the control task, peaks of activation during frequency memory were observed in the left ventrolateral prefrontal cortex and typical areas associated with working memory (dorsolateral prefrontal cortex and posterior parietal cortex). Recognition performance was associated with activation in the same left ventrolateral prefrontal peak that occurred during frequency memory performance. When comparing activation during recognition memory independent of the activation during frequency memory, there was bilateral hippocampal activation. In contrast, activation during frequency memory independent of the effects of recognition memory resulted in activation in the left premotor cortex. The results of this study were consistent with lesion data and support a neuroanatomical distinction between frequency and episodic memory. Frequency memory occurs independent of the hippocampal system, relies more heavily on the frontal cortex, and in general resembles activation observed during working memory.

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Poster Session 8/9:00–10:45 a.m.

FRONTAL/EXECUTIVE FUNCTION

S. MOSTOFSKY, M. GOLDBERG, M. ABRAMS, S. ARNOLD, Y. CHOE, V. CALHOUN, J. PEKAR, & M. DENCKLA. Functional MRI Examination of Motor Response Inhibition.

Response inhibition, necessary for controlled expression of unwanted thoughts/impulses and motor actions, is important for normal behavior and cognition and is thought to be crucial for understanding the neurologic basis of some developmental disorders, in particular attention deficit hyperactivity disorder (ADHD). An awareness of the neural mechanisms involved in response inhibition has come from animal studies, examination of humans with brain lesions, and, most recently, functional imaging. In this study, event-related (single-trial) functional magnetic resonance imaging (fMRI) was used to examine brain regions involved in response inhibition. Six normal right-handed adults (3 males and 3 females) with a mean age of 25.5 years (range 20–33 years), performed a go–no-go task with their right hands; motor response inhibition was investigated by examining brain activation associated with presentation of no-go stimuli. Talairach-normalized group analyses revealed activation associated with the go stimuli (corrected $p < .001$) in the left motor cortex, left supplementary motor area, left thalamus, and right anterior cerebellar cortex. Dur-

ing no-go stimuli (corrected $p < .01$), activation was seen bilaterally in medial inferofrontal regions and in the left dorsolateral prefrontal cortex, with smaller regions of activation in the left inferior temporal, left occipital and left posterior parietal cortices. These findings complement the results of previous fMRI studies (as well as lesion studies) that implicate a contribution of ventral frontal regions in motor response inhibition, but also suggest involvement of a more distributed neural network that includes dorsolateral prefrontal and posterior cortical areas.

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A.A. TURK, K.B. BOONE, A.R. KEUNING, I.M. LESSER, B.L. MILLER, & J.G. BUCKWALTER. The Mediating Effect of Processing Speed on Age-Related Declines in Executive Abilities.

Neurological evidence indicates that the overall size and weight of the brain decreases with age: The frontal lobes show signs of atrophy sooner than other parts of the brain and also exhibit a greater proportional change. Given these structural changes, one would expect age-related deficits in cognitive functions associated with the frontal lobes. Age-associated cognitive declines in verbal fluency, switching and maintaining set, perseveration, and inhibition support the hypothesis that executive functioning is particularly sensitive to age. However, some studies have failed to confirm these observations. Recent literature has suggested that declines in processing speed may underlie collateral losses in other cognitive skills. We thus determined to assess the mediating effect of processing speed on executive abilities in older adults. For 201 adults between the ages of 60 and 85, significant correlations were found between advancing age and verbal fluency (FAS; $p < .05$), design fluency ($p < .05$), Wisconsin Card Sorting Test perseverative responses ($p < .05$) and percentage of conceptual level responses ($p < .005$), Consonant Trigrams ($p < .0005$), and Stroop Color interference ($p < .0005$). However, after controlling for processing speed (as measured by Digit Symbol), significant correlations only remained for Consonant Trigrams ($p = .05$) and Stroop C ($p < .05$). These results suggest that executive functioning may not decline independently but rather as a result of declines in general processing speed.

Correspondence: Anne Turk, Department of Psychiatry, F9 Annex, Harbor-UCLA Medical Center, 1000 West Carson Street, Torrance, CA 90509.

K. BECHTOLD, M. HORNER, & W. WINDHAM. Trail Making Test, Part B: Cognitive Flexibility or Ability to Maintain Set?

The Trail Making Test (TMT) is a well-established test sensitive to impairment in multiple cognitive domains. There has been ambiguity about the cognitive demands of TMT Part B, over and above those required to perform TMT Part A. Two competing hypotheses are cognitive flexibility and ability to maintain a complex response set. The present study examined which of these two abilities primarily contributes to Part B performance. Comprehensive neuropsychological evaluations were administered to 121 patients clinically referred to a VA Neuropsychology Clinic. Multiple regression was used to determine whether the ability to maintain complex response set (operationalized as Wisconsin Card Sort Test, WCST, failure to maintain set), flexibility (WCST, percent perseverative errors), or other executive or cognitive functions predicted Part B performance, after accounting for variance attributable to Part A. Other neuropsychological tests included in the equation were COWA, WAIS–R Digit Span, and CVLT (total score for Trials 1–5 and long-delay free recall). After accounting for Part A variance, only mental flexibility (WCST percent perseverative errors) contributed significantly to the prediction of Part B performance (R^2 Change = .07, $p < .001$). Simple regressions revealed that scores on Part B were significantly correlated with scores on Part A ($r = .72$, $p < .001$), and with all other measures of cognitive functioning except set maintenance (WCST, failure to maintain set; $r = .02$, n.s.). These results provide preliminary support for the hypothesis that TMT Part B is more sensitive to deficits in cognitive flexibility than ability to maintain set.

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M. McGARRAUGH, M. WELSH, P. RETZLAFF, J. EHMKE, & R. STROM. Associations Among Executive Function, Speed of Processing, and Intelligence.

There is a large literature suggesting that the cognitive constructs of speed of processing and intelligence are related. There also is an emerging body of evidence indicating that the construct of executive function (EF) may be associated with both intelligence and speed of processing. The associations among these constructs were investigated in a principal components analytic study. A test battery consisting of a two-choice reaction time task, the Stroop, Vocabulary and Matrix Reasoning from the WAIS-III, the Tower of London (TOL-R), and Spatial Span from the WMS-III was administered to 67 male and female college students. Principal components analysis revealed a 3-factor solution reflecting the factors of speed of processing, intelligence, and EF. The tasks loaded on these factors as expected, with the exception of the TOL-R, which loaded on the intelligence factor. A significant correlation between the speed of processing and intelligence factors was found ($r = -.27$), partly driven by an unexpected correlation between choice reaction time and TOL-R performance. These findings suggest that EF is composed of working memory and inhibition components: however, the use of the TOL-R as an assessment of EF requires further investigation.

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W. MANSFIELD & S. ACHESON. Conduct Disorder, ADHD, and the Frontal Lobes: A Double Dissociation.

Questions remain regarding the core neuropsychological deficit(s) in sociopathic behavior. Research regarding attention deficit hyperactivity disorder (ADHD) has yielded evidence supporting an executive dysfunction-ADHD connection. However, many studies have attempted, unsuccessfully, to extend an executive dysfunction hypothesis to conduct disorder (CD). We tested Damasio's *somatic marker* hypothesis by relating his nonverbal gambling task (NVGT) to CD and ADHD symptomatology in a non-referred adolescent sample. In an attempt to double dissociate these symptoms we also related CD and ADHD symptomatology to several common frontally mediated executive measures. Our hypothesis was that CD symptoms would be uniquely associated with the NVGT (independent of ADHD) and conversely, that ADHD symptoms would be uniquely associated with measures of executive function (independent of CD). Eighty-four males were randomly selected from a local middle school and their teachers provided ratings on behaviors such as hyperactivity, inattention, and conduct problems. The neuropsychological battery consisted of several executive tasks and an orbitomedial function measure (i.e., the NVGT). Using hierarchical multiple regression, results indicate that there was a significant relationship between CD and the NVGT (R^2 change = .08, $p = .04$) and no relationship between ADHD and the NVGT (R^2 change = .03, $p = .3$). Conversely, ADHD was related to several executive function measures while CD was not: Tower of Hanoi (ADHD: R^2 change = .11, $p = .009$; CD: R^2 change = .003, $p = .9$), figural fluency (ADHD: R^2 change = .11, $p = .01$; CD: R^2 change = .01, $p = .6$), Trails B (ADHD: R^2 change = .19, $p \leq .0009$; CD: R^2 change = .009, $p = .7$), selective attention (ADHD: R^2 change = .098, $p = .01$; CD: R^2 change = .06, $p = .08$), and Stroop Color-Word scores (ADHD: R^2 change = .1, $p = .01$; CD: R^2 change = .06, $p = .07$).

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M. HISCOCK, J. CAROSELLI, S. ECKERT, & F. INGRAM. A Computerized Measure of Sensitivity to Future Consequences: Normative Data.

Bechara and colleagues have used a simulated gambling task to demonstrate a striking behavioral deficit in patients with damage to the ventromedial frontal region of the cerebrum. When asked to choose repeatedly among 4 decks of cards, patients continue choosing the 2 risky decks long after normal participants have learned to prefer the 2 less risky decks. We devised a computerized version of this task, which was administered to 140 university students (72 females, 68 males) with an average age of 21.7

years. ANOVA for the number of good (less risky) choices in each of 5 blocks of 20 trials yielded a largely quadratic effect, $p < .0001$, which indicated asymptotic performance by the third block of trials (Trials 41-60). However, the mean percentage of good choices was only 43.1%. Many of the university undergraduates performed the task as poorly as patients with ventromedial frontal brain damage. No sex difference was found. Participants who ended the 100 trials with more than \$2000 differed from those who ended with less than \$1000, not only in the percentage of good choices (49.7% vs. 30.3%, $p < .0001$), but also in the pattern of choices across trial blocks ($p < .005$). The difference between groups increased linearly across trial blocks. Questionnaire measures of impulsivity, risk taking, and consideration of future consequences failed to predict performance at any stage of the laboratory task. The results raise the possibility that the simulated gambling task, if applied to certain populations (e.g., delinquent adolescents or children with ADHD), may tap a dimension of problematic behavior that is not accessible through self-reports.

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M. NORTZ & D. WHITE. Encoding and Retrieval: Developmental Patterns in a Divided Attention Study.

Encoding and retrieval processes in adult memory have been previously examined using divided-attention (DA) paradigms. The present investigation included two experiments that examined DA effects during either encoding or retrieval across 3 age-groups corresponding to different stages of frontal maturation (ages 9, 13, and 20 years). The DA paradigm involved concurrent performance of a verbal list-learning task and a continuous reaction-time (RT) task. Experiment 1 examined free recall. In all groups, DA during encoding resulted in large recall costs but small RT costs relative to baseline (full-attention) performance; DA during retrieval resulted in small recall costs but large RT costs. Participants at earlier stages of frontal maturation exhibited reliably larger RT costs than adults during DA at retrieval, but no developmental differences in RT costs were observed during DA at encoding. Experiment 2 examined recognition memory. In all groups, DA during encoding resulted in recognition costs but no reliable RT costs; DA during retrieval resulted in no reliable recognition or RT costs. Developmental differences in the pattern of DA-related performance costs were not identified. Overall, these results replicate past DA studies of adult memory. In addition, developmental patterns of dividing attention separately during either encoding or retrieval were identified for the first time. The developmental findings provide support for previously proposed links between DA effects in memory and their underlying neuropsychological mechanisms. Specifically, we relate the developmental findings to dissociable medial-temporal and frontal (strategic) contributions to memory function, as delineated in current neuropsychological models of memory.

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S. ANDERSON & K. MANZEL. Matrix Reasoning as an Index of Fluid Intelligence Following Frontal Lobe Damage.

Fluid intelligence refers to the ability to solve novel problems and manipulate abstract symbols with minimal dependence on previously acquired knowledge, and has been linked to prefrontal cortex functions. Previous work has suggested that tests requiring analysis of patterns in matrices (e.g., Raven's Progressive Matrices, Cattell's Matrices) may be sensitive to impairments of fluid intelligence in patients with frontal lobe dysfunction, but this idea has not been rigorously tested. We analyzed WAIS-III Matrix Reasoning subtest performance in 36 participants selected from a larger pool on the basis of neuroanatomical factors. All had stable focal lesions caused by stroke, neurosurgery for treatment of benign tumor or epilepsy, or herpes simplex encephalitis. Standardized lesion analysis with 3-dimensional magnetic resonance imaging was conducted blind to the neuropsychological data. Eighteen had lesions in the prefrontal cortex (Group PF) and 18 had damage to brain areas other than the frontal lobes (Group NF). There were no significant differences between groups in mean

age (PF = 54.4, NF = 55.3), education (PF = 13.8, NF = 13.6), or WAIS-III Verbal IQ (PF = 105, NF = 101). There also were no significant differences between groups on the Matrix Reasoning subtest. The mean age-corrected scaled scores (*SD*; range) on Matrix Reasoning for the PF and NF groups, respectively, were 10.4 (3.1; 4–15) and 9.8 (3.0; 5–15). These findings do not support the idea that prefrontal cortex damage causes impairments of fluid intelligence, which can be measured by Matrix Reasoning. Correspondence: Steven Anderson, Department of Neurology, University of Iowa Hospitals, Iowa City, IA 52242.

A. KNIGHT & D. OSMON. Contingency Naming Test as a Measure of Executive Ability in Visual Attention.

The utility of the Contingency Naming Test to discriminate different measures of attention was examined within a global–local reaction time paradigm. Performance on the Contingency Naming Test is related to executive abilities of response speed and inhibition when shifting mental set. As a measure of executive function, the Contingency Naming Test was hypothesized to predict reaction time performance on a more effortful task requiring shifted attention, but not on tasks of sustained or divided attention. In this study, participants completed reaction time tasks using hierarchical stimuli with global and local features in 3 conditions designed to demonstrate sustained, divided, and shifted attention. Reaction times were compared to performance on neuropsychological tests that have been linked to attention and executive abilities. The current study found that different attentional demands altered the relative contribution of executive functions as measured by neuropsychological tests. The Contingency Naming Test predicted a significant portion of the variance in the reaction time task requiring shifted attention, but did not predict performance in either the sustained or divided attention tasks. The regression models generated from the results of this study demonstrate the utility of the Contingency Naming Test as a discriminative measure of executive ability in visual attention.

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R. HOLTZER, B. CHOUDHURY, J. FARGIONE, F. KOU, M. MURRAY, J. SALVAGGIO, R. BURRIGT, & P. DONOVICK. Concomitant Allocation of Attention in Mildly Demented and Nondemented Elderly.

This study examined differences in concomitant allocation of attention to verbal and visual tasks between mildly demented and nondemented elderly individuals. Baddeley and Hitch's model of the "Central Executive" served as a template for the construction of two, theory-based and clinically suited, dual-task measures designed to evaluate concomitant allocation of attention. The participants were assigned to 3 equal-number ($n = 20$) and demographically comparable groups. The 1st group comprised mildly demented individuals who were residential facilities dwellers. The 2nd group comprised nondemented residential facilities dwellers. The 3rd group, served as a control condition for both dementia status and place of residence, comprised nondemented community residents. Dementia Rating Scale (DRS) scores were used to assign a mildly demented or nondemented status to each participant. Multivariate Analysis of Covariance (MANCOVA) with dual-task scores as dependent measures and group status as independent variable showed that mildly demented elderly individuals were compromised in their ability to concomitantly allocate attention relative to nondemented elderly. Furthermore, a canonical discriminant function analysis using dual-task scores as predictors placed accurately 95% of the participants into a 2-level dementia criterion of mildly demented ($n = 20$) and nondemented ($n = 40$) groups. The statistically significant correlations between the dual-task measures provided construct validation for these measures that also were strong predictors of functional competence in daily living. Finally, the short administration time, diagnostic accuracy, and strong association with everyday behaviors all make these dual-task measures attractive for clinical assessment of dementia and perhaps of other disorders as well.

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S.G. SHAMAY, J. AHARON-PERETZ, B.D. BERGER, & R. TOMER. Cognitive Predictors of Empathy Deficits in Patients With Orbitofrontal Lesions.

Patients with orbitofrontal (OFC) brain damage frequently show altered social behavior. Impaired empathy may contribute to this deficit. The present study was designed to evaluate the empathic ability of OFC patients and to assess the contribution of cognitive abilities, and specifically aspects of cognitive flexibility, to the empathic response. To test this hypothesis, the relationships between the degree of empathy and the performance on several tasks of spontaneous flexibility (Alternate Uses, Design Fluency, Torrance Test of Creative Thinking) and reactive flexibility (WCST, Trail Making Test) was examined in 9 OFC patients, and compared to that of 4 parietal patients and 13 healthy controls. OFC patients performed significantly lower than both control groups on scales that assess cognitive empathy [ANOVA: $F(2,23) = 5.0, p < .02$]. In addition, whereas OFC patients displayed impaired spontaneous flexibility (Design Fluency: $p < .001$; Alternate Uses: $p < .0001$; Torrance: $p < .016$), their reactive flexibility was intact. Moreover, an analysis of multiple regression demonstrated that spontaneous cognitive flexibility scores *but not* reactive flexibility scores are significant predictors of empathy [$r = .444$; $F(3,22) = 7.66, p < .001$]. These results suggest that the OFC plays an important role in mediating empathic response, and that cognitive empathy is related to spontaneous cognitive flexibility. Thus, the disturbances in social interaction observed in patients with damage to the OFC might be due to a deficit in processes that underlie generation of a diverse and creative responses that requires bypassing automatic responses and strategies, in order to attend to features and aspects of knowledge of others.

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K. WALTER & J. HALPERIN. Differentiation of Perceptual and Motor Inhibition.

Research suggests that efficient behavioral functioning requires early perceptual inhibition to prevent the interfering effect of irrelevant stimuli and later motor inhibition to prevent execution of inappropriate responses. Most measures of inhibitory control (e.g., Stroop paradigms) do not allow separable investigation of these theoretically distinct neuropsychological processes. For this study, a task was developed to differentially assess early perceptual and late motor inhibition processes, and to determine whether these processes utilize the same or separate cognitive resources. The computerized Motor and Perceptual Conflict Task consists of 6 subtests in which an arrow appears in various locations, and subjects respond by pressing a key on either the left or right side of the keyboard. Correct responses in different subtests were based on either arrow location or arrow direction. Perceptual inhibition was assessed by requiring the subject to ignore stimulus location and respond to a conflicting arrow direction. Motor inhibition was assessed by having the subject respond in the direction opposite to that indicated by a centrally located arrow. Reaction time analyses yielded significant *motor* and *perceptual* main effects, such that performance was slower under conflict conditions. A significant gender effect indicated that males performed faster. There was no significant Motor \times Perceptual interaction, indicating that these 2 processes utilize distinct resources. Performance on the motor and perceptual conflict tasks did not correlate with behavioral measures of inattention and behavioral impulsivity. Neuroimaging studies with this task can be used to elucidate the neuroanatomical mechanisms underlying these distinct perceptual and motor inhibitory processes.

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R. JUNG, T. LOVE, R. YEO, M. BARLOW, S. CHIULLI, & W. BROOKS. Mood, Biochemistry, and Frontal Lobe Functioning: A Proton MR Spectroscopy Study of Normal Human Brain.

Researchers utilizing magnetic resonance spectroscopy (MRS) have found neurometabolic abnormalities in the frontal lobes of patients diagnosed with mood disorders and neuropsychological dysfunction. We hypoth-

esized (1) that frontal spectroscopy would be most sensitive to normal variations in mood, and (2) that neurometabolism in the frontal lobes would predict performance on frontal cognitive measures. Twenty-five neurologically normal participants were included. All MR acquisitions were carried out on a 1.5 Tesla clinical MR scanner. Spectroscopic sequences sampled three voxel locations within left occipitoparietal, left frontal, and right frontal white matter. The Positive Affect Negative Affect Scale (PANAS) was utilized to assess mood. Neuropsychological examination quantified a broad range of cognitive functioning. A model including only left frontal choline best predicted positive affect in our experimental sample ($F = 31.31, p < .0001$). Participants were split into *high* and *low* choline groups, and were significantly different on WAIS-3 PIQ, WAIS-3 PSL, Trails A & B, and Verbal Fluency (all $p < .05$). Recent research has demonstrated that mood induction modulates activation in left dorsolateral prefrontal cortex, and subsequent performance during verbal fluency performance in normals. Since clinical mood dysfunction was not present in this normal cohort, the choline resonance likely reflects level of myelin repair.

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M.B. SPITZNAGEL & J. SUHR. Executive Function Deficits in Persons With High Scores on OCD and Schizotypy.

While schizophrenia has been linked to dorsolateral prefrontal cortex (DL), OCD has been associated with orbitofrontal prefrontal cortex (OF). We used a high-risk design to assess whether persons with schizotypy and persons with high OCD symptomatology show executive function patterns suggesting DL and OF involvement. Twenty-five individuals in a normal control condition (CON), 17 high scoring individuals on the Maudsley Obsessional Compulsive Inventory (OCD), and 24 high scoring individuals on the Schizotypal Personality Questionnaire (SCH) participated. Participants were evaluated with a battery combining standard clinical neuropsychological tests (i.e., WCST, SCWT, TMT, and COWA) with comparative tests (Object Alternation Test; OAT, and Delayed Alternation Test; DAT). Groups were matched on intelligence using the WASI; depressed persons were excluded from all groups with the BDI-II. We predicted that the OCD group would demonstrate deficits on tests sensitive to OF damage and that the SCH group would be impaired on tests sensitive to DL damage. Results indicate the OF measures were sensitive to OCD; the OCD group performed more poorly than the CON group. However, OF tests were not always specific to impairment in OCD; the SCH group also performed more poorly than the CON group on some OF variables. The SCH group was not more impaired on DL tasks than other groups. Lack of difference between groups on DL measures may be due to the selection method for schizotypy, lack of structural specificity of executive measures used, or poor performance of the CON group.

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W. WHELihan & M. DiCARLO. The Maze Navigation Test: Normative Data and Preliminary Psychometric Properties.

The Maze Navigation Test (MNT) is a novel elaboration of the Porteus Mazes created to provide a measure of executive functioning that might have relevance to real-world applications like driving. In addition, the MNT incorporates unique demands that require subjects to develop a strategy to arrive at a goal with no experimenter feedback and thus may add to the armamentarium of the neuropsychologist in the executive domain. The MNT consists of a sample and 8 progressively more complex paper-and-pencil mazes. All mazes are administered, and both time to completion and number of errors committed are recorded. Normative data with a sample of 23 elderly individuals between the ages of 61 and 85 are presented. Participants had an average of 14.3 ($SD = 2.4$) years of education and an average MMSE score of 29.3 ($SD = .8$). Construct validity was initially supported by correlational analyses that revealed significant relationships between the MNT and other executive measures. MNT time was related to Trail Making Test Part B time ($r = .42$), Ruff Figural Fluency ($r = -.63$), and Letter Cancellation time ($r = .57$). MNT errors were related to Wisconsin

Card Sort Test number of categories ($r = -.56$) and Letter Cancellation time [$r = .64$]. Preliminary data on concurrent validity indicated that time on the MNT was significantly related to road test performance for a sample of 26 participants with mild cognitive impairment but not for the 23 controls. It is anticipated that the MNT will be particularly useful in making determinations about competence to drive in adults with early cognitive decline. Subsequent studies will focus on the utility of the MNT for younger individuals and for other conditions that may impact executive functioning.

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E. MITSIS & J. HALPERIN. The Construct of Executive Functions: Unitary or Multidimensional?

Executive functions (EF) are a set of loosely related cognitive functions that are believed to be dependent upon the integrity of the frontal lobes. However, few studies have examined the degree to which these functions are interrelated, and represent a unitary construct, independent of IQ. The present study utilized Principal Components Analysis (PCA) to determine the extent to which tests of EF measure a unitary construct. Subsequently, varimax rotation was used to assess the extent to which subcomponents of EF could be delineated. Seventy-seven undergraduate students ranging in age from 18–25 years were administered an EF battery consisting of the Stroop, FAS, Trail Making Test, Competing Motors Program, Continuous Performance Test, and Letter–Number Sequencing and Digit Span Backward subtests of the WAIS-III. EF scores from each test were standardized and controlled for IQ, as estimated using the Vocabulary and Block Design subtests of the WAIS-III. Factor 1 from the PCA, which accounted for 33% of the variance, indicated moderate to substantial factor loading for most EF tests; FAS and Stroop Interference had somewhat lower loadings. Data indicate that most tests of EF assess a unitary construct that is independent of IQ. Varimax rotation resulted in a 3-factor solution accounting for 65% of the variance. These factors appear to represent (1) motor planning, (2) verbal working memory, and (3) effortful, cognitive processing. Results of the present study suggest that EF represents a unitary construct independent of IQ; however, within the construct of EF separate meaningful subfactors exist.

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P. MALLOY, L. AZZARA, & J. GRACE. Normative Data for the Frontal Lobe Personality Scale (FLOPS).

Normative data are reported for the Frontal Lobe Personality Scale (FLOPS), a rating scale designed to measure behavioral change due to frontal systems damage or dysfunction. The FLOPS Family form has been shown to have high intrascale reliability for ratings of frontal behavior. The FLOPS also has been shown to be sensitive to behavior change in dementia. In addition, Norton et al. demonstrated that FLOPS Apathy scores were better predictors of ADLs than cognitive measures in dementia patients. In this study, a normative sample of 388 included 173 males (45%) and 215 females (55%). Ages ranged from 18 to 84 with a mean of 45.2 ($SD = 16.34$), and education ranged from 10 years to doctoral level with a mean of 14.0 ($SD = 2.31$). Data was collected using a group administration process, with groups limited to 30 people. The FLOPS was administered to volunteers and to a family informant. Analyses of variance demonstrated significant effects for age, education, and gender for Family ratings of Apathy, Disinhibition, and Executive dysfunction. Some higher-order interactions were also demonstrated. Patient self-ratings on the FLOPS were found to have similar age, gender effects, as well as age by gender interactions on all subscales. All effect sizes were small. In general, scores were higher (more pathological) for males, those below 40 years of age, and those with less than college education. Normative tables are provided with means, standard deviations, and z scores stratified by age, education, and gender.

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O. OUSLEY, M. MORRIS, & R. MORRIS. Relations of Executive Function to Other Cognitive Tasks and Ratings of Behavior.

Executive functioning (EF) may influence performance on complex cognitive tasks as well as influence behavioral self-regulation. To examine these possible relations, the correlations between EF and multiple indices of attentional, organizational, and behavioral functioning were examined in 274 college students referred for a learning disabilities evaluation. EF was assessed via 4 measures, including the Trail Making Test-Part B, the Verbal Fluency Test (FAS), the Stroop, and the Visual Search and Attention Test (VSAT). Performance on standardized measures of auditory-verbal attention, short-term memory, and visual-constructional ability was also examined. These measures were chosen due to their presumed high attentional and organizational demands. Two domain behavioral functioning (i.e., inattention and hyperactivity/impulsivity) were assessed based on self- and significant others' report on an AD symptom checklist. Correlational analysis revealed significant, moderate relations between EF and auditory-verbal attention, short-term memory, and visual constructional ability. Correlations between EF behavioral measures were non-significant or accounted for minimal variance and were similar for both self- and other report. The results suggest that EF, as assessed by traditional neuropsychological measures accounts for some variance in performance on cognitive tasks but accounts for little variance in reports of behavioral functioning. Independence of underlying constructs, method-related variance, and poor ecological validity of traditional measures might account for the results.

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M. MATSUI, J. MATSUZAWA, T. KONISHI, K. NOGUCHI, & R.C. GUR. Age-Related Volumetric Changes of Brain Gray and White Matter in Healthy Infants and Children.

To date there is little information about brain development during infancy and childhood, although several studies have showed quantitative changes in adult brain. We performed 3-dimensional magnetic resonance imaging (3D-MRI) in 28 normal children aged 1 month to 10 years to investigate age-related quantitative changes of the brain. We analyzed the volumes of whole brain, frontal and temporal lobes with advanced method for segmenting images into gray matter (GM), white matter (WM), and cerebrospinal fluid (CSF) compartments. Our results showed growth spurts of whole brain, frontal and temporal lobes could be seen during the 1st 2 years after birth. In the group of infants under 2 years, there were growth spurts showing significant correlation with age in both frontal and temporal lobes. During this period, the frontal lobes grew more rapidly than the temporal lobes, the right-left asymmetry was more noticeable in the temporal lobes than in the frontal lobes, and increase of GM was larger than that of WM in the temporal lobes. Subsequently, WM volume increased at a higher rate than GM volume throughout childhood. This suggests that the early rapid growth of frontal lobe is related to development of motor cortex area. Quantitative information on normal brain development may play a pivotal role in clarifying neurodevelopmental abnormalities.

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CHILD TBI, NEUROLOGIC AND PSYCHIATRIC DISORDERS**W. HUCKEBA, L. CHAPIESKI, & M. HISCOCK. Math Performance in Children With Tourette Syndrome: Contribution of Attention and Visuospatial Skills.**

Mathematics difficulties are commonly reported in children with Tourette syndrome (TS), but the underlying basis of these difficulties is not well understood. One hypothesis is that their weaknesses in math are part of a nonverbal learning disability. An alternative hypothesis is that their poor performance on math tests reflects problems with inattention, a common problem in this population. Fifty-four children with TS and 25 normal con-

trols between the ages of 8 and 16 were evaluated using a neuropsychological battery including measures of math calculation, sustained attention, and visuospatial skills. The competing hypotheses regarding the basis of math deficiencies were tested by (1) correlating math performance with scores on measures of visuospatial ability and sustained attention, (2) manipulating the amount of structure provided during administration of the math tests, and (3) analyzing calculation error patterns. The children with TS performed significantly worse than controls on math tests, but not on tests of visuomotor coordination or motor-free visual perception. Their poor math performance was correlated with both visuospatial and attentional scores, even though the math performance of the control group was correlated only with visuospatial scores. Providing additional structure improved math performance for both groups, although the benefit was greater for controls. Analysis of math errors revealed that children with TS made more errors due to inattention than errors due to visuospatial confusions. The findings indicate that even though visuospatial skills contribute to calculation ability, poor visuospatial skill is not a sufficient explanation for poor calculation ability in children with TS.

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M. KIRKWOOD, D. WABER, M. WEILER, & J. BERNSTEIN. Dynamic Assessment of Metacognitive Skills in LD Children Using the ROCF.

Children with developmental learning difficulties (LD) display consistent organizational and memory deficits on the Rey-Osterrieth Complex Figure (ROCF). We used a dynamic assessment approach to determine whether the source of these problems is primarily visual/spatial or metacognitive. Participants included 202 school-age children referred for LD. The ROCF was administered first in the *Standard* format and later in an *Experimental* format that visually highlighted the organizational structure of the design. If the source of the problem was primarily metacognitive, manipulating encoding in this way should normalize *recall*. As predicted, performance on Standard immediate recall (IR) was below normative expectation; however, performance on Experimental IR exceeded expectation. Further analysis compared characteristics of subgroups who either substantially benefited (BEN; $N = 58$) or did not benefit (NOBEN; $N = 32$) from the Experimental format. These groups were matched for Standard IR scores, which were sufficiently low to avoid a ceiling effect. The groups did not differ in age, sex, SES, or Full Scale IQ, but the NOBEN group performed more poorly on measures of visual/spatial skill (WISC-III Object Assembly, Block Design), suggesting that they have more primary visuoperceptual deficits. We conclude that the majority of children with LD who have difficulty with the ROCF do so because of metacognitive problems; for a minority, the source is more primary visuoperceptual. Supplementing the standard ROCF with a dynamic assessment procedure can have diagnostic utility in specifying the significance of poor performance on the ROCF in children with LD and other developmental disorders.

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S. HAYMAN-ABELLO, D. FUERST, & B. ROURKE. Psychosocial Sequelae of Pediatric TBI: Subtype Analysis Using the Child Behavior Checklist.

The present study was designed to identify subtypes of psychosocial functioning in a sample of children who had sustained traumatic brain injury (TBI). Child Behavior Checklist (CBCL) profiles were subjected to cluster analysis and then to Q-Factor analysis. The participants consisted of 92 children and adolescents aged 12 to 18 who had been treated at either a community or an acute rehabilitation center following a mild, moderate, or severe TBI. Sixty-four were classified into a 4-category psychosocial typology using Q-Factor analysis. Based on the mean clinical scale elevations of the 8 CBCL syndromes, the subtypes were labelled *normal* ($n = 32$), *attention* ($n = 14$), *delinquent* ($n = 10$), and *withdrawn-somatic* ($n = 8$). This typology was found to overlap in part with previous TBI psychosocial typology and with 3 of the clinical profile types derived by Achenbach for the CBCL. The majority of participants, including those who

sustained severe TBI, were assigned to the *normal* subtype. The overall level of psychosocial deviance was relatively mild in the other 3 subtypes. Some evidence suggested that children who were injured at younger ages were more likely to exhibit psychosocial problems compared to those who were injured later in their development. The results of this study support previous typology efforts and confirm the heterogeneous presentation of social and emotional functioning following TBI.

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H.G. TAYLOR, K.O. YEATES, N. MINICH, N. WOOD, & S. ARMSTRONG. Long-Term Educational Interventions After Traumatic Brain Injury in Children.

Although educational difficulties following traumatic brain injury (TBI) in children are well documented, few studies have tracked educational interventions over time. The purpose of the present study was to examine these outcomes in three groups of children injured between 6 and 12 years, including 42 with severe TBI, 42 with moderate TBI, and 50 with orthopedic injuries only. Severe TBI was defined on the basis of a GCS score of <9, and moderate TBI in terms of a GCS score of 9–12, an abnormality on neurologic or CT exam, or a loss of consciousness >15 min. The children were assessed at a baseline evaluation soon after injury, at short-term follow-ups 6 and 12 months post baseline, and at an extended follow-up a mean of 4 years postinjury. Assessments included tests of achievement and neuropsychological skills, parent and teacher behavior ratings, and surveys of special education and other school interventions. At the extended follow-up, 45% of the severe TBI group was in special education, compared to 7% or the moderate TBI group and 8% of the orthopedic group ($\chi^2 = 26.12, p < .000$). Group differences were similar when children who were in special education prior to injury were excluded, and most children with TBI continued in special education across the follow-up interval. Factors associated with special education were more severe TBI, poorer test performance, lower preinjury adaptive behavior, and lower social status. Nevertheless, a number of children with TBI were not receiving these services in spite of ongoing neurobehavioral deficits. Rates of special educational assistance are high following severe TBI, but existing programs fall short of addressing children's educational needs.

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S. NICHOLS & S. WALLER. Plasticity of Planning and Problem Solving in Children With Early, Focal Brain Injury.

Tests of planning and problem solving, such as the Tower of London (TOL) and Wisconsin Card Sorting Test (WCST), have been used as measures of frontal lobe functioning in research on a variety of disorders, both adult and developmental. For example, problems in performing these tasks by children with attention deficit hyperactivity disorder have been interpreted as indicating possible frontal dysfunction. However, little is known about the performance of children with structural damage to the frontal lobes on these measures. These tasks have been used in studies of childhood head injury, which has the potential to cause diffuse damage to the brain, but rarely with children who have more focal structural involvement. The purpose of this study was to examine the performance of a group of children with early (pre- or perinatal), unilateral, focal brain damage (FL group) on the TOL and WCST. Preliminary comparisons of 11 FL children, age 7–13, with 67 normally developing control children shows the FL group performing within the normal range but significantly below controls and suggests mild impairment in problem solving. Impairment on the WCST was primarily seen in, but not restricted to, children with left frontal lesions, and TOL performance had even less clear cut relationships to lesion location. The findings indicate incomplete plasticity of problem-solving in the case of early, focal brain damage.

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S.L. GUGER & J.B. RICH. Implicit and Explicit Memory in Children With Moderate Closed Head Injury.

Widespread memory problems have been reported following closed head injury (CHI), including deficits in encoding and retrieval of both verbal and nonverbal material. Shum and colleagues have demonstrated that adults with severe CHI exhibit preserved pictorial implicit memory despite impaired explicit memory. Since children and adults are in different phases of the developmental trajectory, head injuries often have different effects at different ages. Therefore, it is of theoretical interest to determine if head-injured children would show this same dissociation. We compared implicit and explicit memory functioning in 24 school age children with moderate CHI (*M* age 11.4 years) and 24 age- and gender-matched controls. In an initial study task, children named pictures of concrete objects. Subsequently, a picture-fragment completion test was administered in which fragmented pictures were shown (from the most degraded to progressively more complete versions) until they were identified. Implicit memory, or pictorial priming, was defined as the difference in identification thresholds between previously studied pictures and new pictures. Explicit memory was assessed using a yes–no recognition test. Analyses indicated that not only did the CHI participants show significant priming on the pictorial implicit memory test, but the magnitude of their priming was equivalent to that of the control participants. On the explicit memory task, however, the CHI participants demonstrated significantly impaired recognition of the studied pictures relative to the control group. These results are consistent with those reported in the adult CHI literature and have implications for rehabilitating memory impairments in children with CHI.

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K. ARMSTRONG, J. JANUSZ, K.O. YEATES, H.G. TAYLOR, S. WADE, T. STANCIN, & D. DROTAR. Long-Term Attention Problems in Children With Traumatic Brain Injuries.

The long-term prevalence and correlates of attention problems following childhood closed-head injuries (CHI) were examined using data drawn from a prospective, longitudinal study. Participants included 40 children with severe CHI, 41 with moderate CHI, and 50 with orthopedic injuries (OI). Parent ratings of attention problems were obtained an average of 4 years post injury, and compared to ratings of premorbid attention problems obtained shortly after injury. Measures included the Child Behavior Checklist (CBC), completed at baseline and 4-year follow-up, and the ADHD Rating Scale, completed only at the 4-year follow-up. At the follow-up, parents also completed measures of family functioning (Family Burden of Injury Interview, Impact on Family questionnaire), and children were administered a neuropsychological test battery. The CHI groups displayed significantly more attention problems than the OI group at 4 years post injury. Group differences were larger for children with more premorbid attention problems than for children with fewer premorbid problems. Certain measures of executive functions (i.e., Consonant Trigrams, Word Fluency) were significantly related to ratings of attention problems, but they accounted for a small proportion of the variance. As a set, they did not account for additional variance in attention ratings after controlling for group membership, race, and socioeconomic status. In contrast, attention problems at 4 years post injury were related to family burden and distress in all groups, even after controlling for premorbid attention problems. The findings suggest that CHI exacerbates premorbid attention problems. Long-term attention problems are not strongly related to neuropsychological functioning, but do predict post-injury family functioning.

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K. ARMSTRONG & K.A. KERNS. The Assessment of Parent Needs Following Pediatric Traumatic Brain Injury.

The pediatric version of the Family Needs Questionnaire was administered to parents of children with traumatic brain injuries (TBI, *n* = 19) 1 year or more post injury. Parents of diabetic children (DIAB; *n* = 21) and parents of orthopedically injured children (ORTHO; *n* = 14) were included as control groups. Parents rated 40 items in terms of their impor-

tance and how well these needs have been met. The ORTHO group rated significantly fewer items as important relative to the TBI and DIAB groups. Items rated as important by TBI parents were more likely to remain unmet relative to both the DIAB and the ORTHO groups; out of 28 items rated important, 19 needs were still unmet for TBI parents. Furthermore, within the TBI group, those needs reported as met were endorsed by fewer than half of the parents, indicating a large proportion of TBI parents still felt those needs were unmet. DIAB and ORTHO parents more consistently reported their needs as met both across items and within groups. Needs most often rated as unmet for TBI parents include the need for health/medical information, professional support, community support networks, and the need to be involved in their child's care. These results present important findings for TBI rehabilitation professionals. Future studies need to investigate whether TBI parents' needs are unmet because of a lack of community resources or if the resources available are unused, or not adequately targeting the needs TBI parents feel are most important.

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C.A. LUIS. Risk Factors for Psychiatric Disturbance Following Mild Head Injury in Children.

The relationship between mild head injury (MHI) in children and a subsequent psychiatric disturbance is complex and mediated by multiple determinants. Furthermore, the development of a psychiatric disorder following MHI often complicates recovery, and contributes to functional impairment, post-concussion symptoms, medical costs, and caregiver burden. Examination of the impact of MHI on emotional status and identification of factors influencing the subsequent development of a psychiatric disturbance has important clinical implications. Participants of the study included 42 children (ages 6–15) hospitalized for mild head injury and 35 children (age 6–15) admitted for skeletal fractures without head trauma. Groups were matched on demographic characteristics, history of previous head injury, premorbid psychiatric illness, and developmental disorders. Children were assessed 6 months post injury using portions of the Diagnostic Interview Schedule for Children–4th revision and the Social Readjustment Rating Questionnaire for Children. Head injured children reported significantly more postinjury onset psychiatric disorders than controls (38% vs. 14%). Furthermore, emotional disturbance in the MHI group was also related to post-injury stress ($r = .58, p < .001$) and history of developmental delay ($r = .36, p = .02$). Assessment of psychosocial factors in treatment planning and therapeutic interventions such as improving coping strategies or stress management skills training may therefore be useful in mitigating the potential emotional consequences of MHI in children.

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S. HOOPER, L. SIKICH, B. HEDDING, A. MALEKPOUR, B. SHEITMAN, & J. LIEBERMAN. Neuropsychological Functioning of Children and Adolescents With Psychotic Disorders.

Schizophrenia-related disorders are hypothesized to be of neurodevelopmental origin with abnormalities in perception, cognition, affect, and social relatedness. Unfortunately, little is known about the neuropsychological functioning of children and adolescence with schizophrenia-related disorders or, more generally, childhood psychotic disorders. This study was conducted to provide neuropsychological information on children and adolescents with psychotic disorders, and to compare the neuropsychological functioning of children with schizophrenia-related disorders to children with nonschizophrenia psychotic disorders. Participants included 40 children and adolescents, ages 8 to 19 years. The sample was 62.5% male, 65% white, and fell within the middle socioeconomic stratum. Subjects exhibited significant psychotic symptoms, satisfied DSM–IV criteria via the KID-SCID, and were free of depot antipsychotic medication for at least 6 months. Half of the sample was diagnosed as having schizophrenia-related disorders ($n = 20$), and the other half was diagnosed with psychotic disorders that were not schizophrenia-related ($n = 20$). For the overall sample, baseline neuropsychological testing revealed low average IQ, ac-

ademic skills, fine-motor speed and control, memory and learning, and selected executive functions. Significant deficits were evident in visual attention, visuconstruction, organizational fluency, set-shifting, and working memory. Significantly higher percentages of subjects fell at least one standard deviation below the normative mean across nearly all tasks. When children with schizophrenia-related disorders were compared to those with affective-related psychotic disorders, a clear level of function differentiation was apparent, with the schizophrenia-related group performing significantly lower in nearly every domain.

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B. GJAERUM, E.B. FENNEL, & A.D. HUTSON. Neuropsychological Profiles in Preschoolers With Neuropsychiatric Disorders.

A heterogeneous sample of 218 mostly preschool children with various neuropsychiatric disorders and otherwise extensive multiaxial comorbidity had been assessed neuropsychologically, psychiatrically, and medically. Mean CA = 5.5 ($SD = 1.8$, range 1.1–11.9). Mean MA = 4.0 ($SD = 1.5$, range 0.25–6.75); 66% boys; 18% severely retarded; 22% mildly retarded; and 60% in the normal range. Neuropsychological scale scores, based on NPM-X were subjected to cluster analysis, using a nonhierarchical, iterative procedure, and a hierarchical stepwise procedure to validate the results. Three specific research questions were addressed: (1) Do neuropsychological test scores for preschool children with heterogeneous neuropsychiatric problems divide the children into groups on the basis of neuropsychological developmental characteristics? (2) If they do, could these functional profiles be interpreted within a developmental brain behavior framework? (3) If they do, are these functional profiles different according to psychiatric diagnoses of the children in the clusters, and are there distinctive neuropsychological profiles for each psychiatric condition? Based on developmental scores in the area of language comprehension and expression, motor skills, social skills, memory span and mental age, 5 clusters captured all children. Four clusters, including 212 children, consisted of a sufficiently high number of children (35–75) to permit neuropsychological description and interpretation. Neuropsychological characteristics, brain-behavior hypotheses and clinical validation of the profiles will be presented.

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C. CIANCIULLI, J. CAREY, G. DE VRIES, V. LABRUNA, & L. VINCENT. Declarative Memory, Cortisol Reactivity, and Psychological Symptoms in Chronically Abused Girls.

Declarative memory functioning, cortisol reactivity, and psychological symptoms are examined in 19 adolescent female victims (9 depressed and 10 nondepressed) of emotional, physical, and sexual abuse and compared to 11 healthy controls. Salivary cortisol measurements at 3 times were used to assess cortisol reactivity (initial baseline assessment, assessment after an emotionally challenging task, followed by 2nd baseline 1 week later). The relation between patterns of cortisol reactivity and declarative memory functioning, operationalized as scores on selected subtests of the California Verbal Learning Tests, was assessed. Similarly, the relation between patterns of cortisol reactivity and psychological symptoms, as reported on the Trauma Symptom Checklist for Children, was also assessed. Results indicated the presence of different patterns of cortisol reactivity during a challenging task between chronically abused girls (depressed and nondepressed) and comparison girls. The abused girls most frequently exhibited *increased cortisol* release from the initial baseline to the subsequent measurement times, while cortisol levels generally *decreased* in comparison participants. Furthermore, in the abused girls, the pattern of increasing cortisol release was related to lower declarative memory scores and to more symptoms of dissociation, depression, posttraumatic stress, anger, and anxiety. Although the sample was small, the results supported the existence of a link between exposure to trauma, adrenocortical reactivity, and declarative memory functioning. Similar results have been widely documented in adults with post-traumatic stress disorder. These findings have implica-

tions in terms of long-term neurobiological development, emotional regulation, and behavioral adjustment of child and adolescent victims of trauma. Correspondence: *Caterina Cianciulli, Ph.D., HSC T12, Neurology Department, State University of New York at Stony Brook, Stony Brook, NY 11794-8121.*

F. ANDERSON, C. JORDAN, E. SHAPIRO, & M. GUNNAR. Salivary Cortisol Levels in Lead- and Non-Lead-Burdened Inner-City Children.

The goals of this study were to examine salivary cortisol levels and the effect of lead burden on cortisol in a population of ethnically diverse, inner city children. Participants included a total of 73 children from a larger longitudinal study (the DREAMS Project), 24 of whom were considered to have a high lead level (>9 mcg/dl). Cortisol levels were tested in the laboratory at 14, 20, and 26 months of age, at arrival, and immediately before and 20 min after a frustration paradigm. Cortisol levels were obtained as a measure of hypothalamic–pituitary–adrenal (HPA) axis functioning and physiological stress reactivity. We hypothesized that cortisol levels would follow similar daily patterns to those seen in some studies of middle to upper-middle socioeconomic groups, and that high lead levels would correlate with increased cortisol levels following the frustration task, indicating dysregulation of the HPA axis. Results indicated that cortisol levels generally declined throughout the testing session, and there were no significant time-of-day effects. Among lead-burdened children, lead levels were not found to correlate significantly with cortisol levels overall. However, by 26 months of age, lead burdened children had higher cortisol levels than non-lead-burdened children when they arrived and after the frustration task, suggesting that the effects of lead burden on the HPA system may not emerge until this later age. Future analysis of behavioral response to the frustration paradigm may clarify the nature of these findings. Correspondence: *Fiona S. Anderson, Pediatric Neuropsychology, Division of Pediatric Neurology, F-UMC Box 486–420 Delaware Street S.E., Minneapolis, MN 55455.*

M. DENNIS & T. HOPYAN. Rhythm and Tonal Memory in Adolescents After Left or Right Temporal Lobectomy.

The right temporal lobe has been proposed to be important for the processing of music. Studies comparing music skills after right or left temporal lobectomy have produced inconsistent results, possibly related to differences in participants (e.g., age at test, age at onset of seizures), lesions (e.g., amount of temporal lobe excision), and music tasks. We studied rhythm and tonal memory from the Seashore Measures of Musical Talents in 22 adolescents who had undergone right ($N = 9$) or left ($N = 13$) temporal lobectomy for intractable epilepsy an average of 4.1 years before testing. The right and left groups did not differ in test age, age at nonfebrile seizures, time from onset of nonfebrile seizures to test, time from temporal lobe resection to test, amount of temporal lobe resection, Verbal IQ or Performance IQ, or performance on a test of memory for word sequences. No group effects were found for rhythm. For tonal memory, there was a significant effect of side of lobectomy that was qualified by a significant interaction between side of lobectomy and test age: adolescents with right temporal lobectomy had lower scores than those with left temporal lobectomy, and only adolescents with right temporal lobectomy obtained higher scores with increasing chronological age. For neither group was there a relation between tonal memory and age at nonfebrile seizures, time from onset of nonfebrile seizures to test, time from temporal lobe resection to test, linear amount of temporal lobe resection. The results are discussed in terms of laterality effects in the development of tonal memory. Correspondence: *M. Dennis, Department of Psychology, The Hospital for Sick Children, 555 University Avenue, Toronto, ON M5G 1X8, Canada.*

M.G. BIGEL & M.L. SMITH. The Impact of Neuropathology on Cognitive Functioning in Children With Epilepsy.

The neuropathologies associated with childhood epilepsy are heterogeneous. There is evidence to suggest a relationship between neuropathology and cognitive function in children with epilepsy. Selected neuropsychological measures of 61 children with single histopathological

diagnoses of either hippocampal sclerosis (HS), temporal lobe tumor, cortical dysplasia (CD), or dual pathology of either HS + tumor and HS + CD, were studied retrospectively. ANOVA analyses revealed no effect of lesion laterality and sex on standardized measures of IQ but showed that children with single pathologies performed significantly better than children with HS + CD. Although only a statistical trend ($.05 < p < .2$), this pattern was also noted on a test of receptive language and academic reading. The most salient finding was that children with temporal lobe tumors consistently scored higher than other groups on all measures of IQ and on delayed memory for a complex figure. These results support prior research which showed IQ differences between children with mass *versus* developmental lesions and extends the findings to include children with dual pathology and additional neuropsychological measures. Due to small sample sizes in the dual pathology groups, our results must be viewed cautiously; however, the trends are appreciable and suggest that pathology is an important factor in determining cognitive outcome in epilepsy.

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T. HERSHEY, R. LILLIE, M. SADLER, & N. WHITE. Prospective Report of Severe Hypoglycemia Explains Changes in Delayed Response.

Previous reports indicate that children with Type 1 diabetes at higher risk for severe hypoglycemia show selective deficits in delayed declarative memory. In this study, we tested the hypothesis that severe hypoglycemia, measured prospectively, would reduce performance on long delays of a spatial delayed response (SDR) task. Diabetic children ($n = 30$; M age = 11.6; M age of onset = 6.4) were recruited from a larger treatment study and were tested at baseline and after approximately 1 year of treatment ($M = 13.5$ months, $SD = 4.5$ months) on an SDR task with short (5 s) and long (120 s) delays. Severe hypoglycemia was measured prospectively and was defined as any event that required assistance for treatment (i.e., seizure, loss of consciousness, glucagon shot, medical assistance, etc.). Data were analyzed using a hierarchical linear regression procedure with long delay performance at the 2nd testing session as the dependent variable and performance at Testing Session 1, age, age of onset, and reports of severe hypoglycemia between testing sessions as independent variables. After controlling for performance at Testing Session 1, age, and age of onset, severe hypoglycemia accounted for a unique and significant portion of the variance ($p < .01$) in long-delay performance. Further analysis revealed that children who had experienced severe hypoglycemia between sessions did not show the same level of improvement as children who had not experienced severe hypoglycemia. We conclude that severe hypoglycemia, measured prospectively, may interfere with diabetic children's ability to benefit from practice or developmental gains on a measure of delayed declarative memory.

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ENDOCRINE DYSFUNCTION

J. GILES, B. GIORDANI, K. RYAN, S. BERENT, E. SCHEINGART, A. SCHULTZ, M. KAUSZLER, S. GEBARSKI, & M. STARKMAN. Hippocampal, Glucocorticoid, and Cognitive Changes in Treated Cushing's Disease.

Cushing's disease (CD) presents an interesting model to study the effects of glucocorticoid steroids on cognition. Chronic, high levels of cortisol, as present in CD, have been associated with a decrease in hippocampal volume and memory deficits. A recent study by our group demonstrated reversibility of hippocampal atrophy in successfully treated CD patients. Therefore, it can be hypothesized that improvement in cognitive function also will occur following remission of CD. However, the timeframe in which cognition improves is unclear. In order to elucidate the relationship between decreased cortisol levels and cognitive improvement, this study compared the pretreatment and post-treatment performances of 23 CD patients (3 males, 20 females; M age = 36.78 ± 14.48) on tests of word-list learning, digit recall, and verbal fluency. Following a presurgical assessment,

tests were readministered postsurgically at 3–5, 6–12, and 13–18 months. MRI scans were completed presurgically and after 1 year. Cortisol levels were measured at each assessment. Although cortisol levels significantly decreased immediately post surgery, significant improvement in word-list learning was evident only between the pretreatment and final retest ($p < .0001$). Fluency, however, improved at both of the last 2 retest intervals ($p < .001$, $p < .0001$). Significant improvements in learning were significantly correlated with improvements in hippocampal volume and cortisol levels. Although cortisol levels drop rapidly following surgery, cognitive improvements may not be evident immediately and the cognitive recovery rate may vary with the particular aspect of cognition assessed.

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H.N. BAWDEN, G. ESKEES, R. MOREHOUSE, & S. SALISBURY. Long-Term Neuropsychological Outcome Following Craniopharyngioma Removal.

Obesity and endocrine deficits are frequent sequelae following removal of craniopharyngioma brain tumors. Executive functioning deficits may occur as a consequence of the surgical approach used to access the tumor. We compared the long-term neuropsychological outcome of craniopharyngioma patients, an endocrine control group comprised of patients with non-tumor hypopituitarism, an obese control group, and a normal control group. Groups were comparable in terms of age and gender composition. The craniopharyngioma and hypopituitarism groups did not differ in height, but the craniopharyngioma group weighed significantly more, averaging about +2 standard deviations above the norms for their age and gender. There were no group differences on measures of executive functioning including tests of nonverbal problem solving ability, attention, verbal and figural fluency, concept identification and ability to switch set, and ability to copy a complex geometric figure. The groups were comparable in terms of their performance on measures of verbal and visual-spatial memory. The craniopharyngioma and hypopituitarism groups had significantly lower Full Scale IQs as a result of lower Performance IQs than the normal control group. There were no differences in Verbal IQ. Mean IQ values for all groups were in the Average range. Despite significant medical morbidity resulting from hypothalamic dysfunction following tumor removal, the executive functioning abilities of craniopharyngioma patients appear intact and are comparable to controls.

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M. BOOTH-JONES, H.G. BELANGER, & M.A. WEITZNER. Neuropsychological, Psychological, and Quality-of-Life Improvements in Patients Diagnosed With Pituitary Disease Following Ritalin Treatment.

Previous research has demonstrated that pituitary disease results in various neuropsychological and psychological deficits, including memory disturbance, executive dysfunction, and depression. Twenty consecutive patients with pituitary disease were evaluated. Eleven patients were prescribed Ritalin (M dose = 20 mg b.i.d.) due to objective impairments in one or more of the following domains: psychomotor speed, verbal memory, attention, and executive functioning. Their mean age was 41.5, mean level of education was 15, and mean NART score was 108.8. A variety of neuropsychological and psychological instruments were used to assess the effectiveness of the Ritalin treatment. It was found that performance on measures of attention and measures of psychomotor functioning significantly improved following treatment. Specifically, performance on Digit Span improved significantly ($t = -2.98$, $p = .014$), as did performance on Trails A ($t = -2.87$, $p = .017$). In addition, performance on Digit Symbol significantly improved ($t = -3.39$, $p = .007$) as did performance with the dominant hand on Pegs ($t = -2.51$, $p = .0311$). In addition, depressive symptoms, as measured by the CES-D, were significantly reduced ($t = 2.19$, $p = .053$). Perhaps most importantly, QoL improved, as measured by the FACT-G ($t = -2.95$, $p = .019$) and the FACT-Br ($t = -2.93$, $p = .019$). These results are impressive given the small sample size and illus-

trate the potential effectiveness of stimulant medication in treating the neuropsychological sequelae of pituitary disease.

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C. WEINER & M. PRIMEAU. Androgens and Spatial Abilities in Women.

Organizational effects of androgens on the brain are believed to contribute to sex differences in cognitive abilities such that males generally perform better on spatial tasks and worse on tasks of verbal fluency and perceptual speed than females. Activational effects of androgens are postulated to account for differences as well but are harder to study and perhaps more subtle. Women with polycystic ovarian syndrome (PCOS) have abnormally elevated testosterone levels and, because the onset of this disorder is postpubertal, they offer the opportunity to examine activational effects of androgens in females. Twenty PCOS women and 32 normally cycling women (NC) were administered tasks of verbal fluency, spatial visualization, perceptual closure, mental rotation, and perceptual speed with the expectation that the pattern of performance by PCOS women would resemble that of men. Serum hormone assays showed significant differences in free testosterone (FT), total testosterone (TT) and estrogen (PCOS > NC), and no differences in progesterone between groups. When time since last menstruation (postmenses) was covaried, the groups differed significantly on spatial-task performance in the expected direction [$F(2,49) = 9.28$, $p < .01$; PCOS > NC]. Groups did not differ on the verbal or perceptual factors. Partial correlation (controlling for postmenses) demonstrated significant positive relationships between spatial skills and TT ($r = .36$), FT ($r = .26$), and progesterone ($r = .31$). No relationship with estrogen was observed. The results support the idea of activational effects of androgens, as well as progesterone, on spatial ability in women.

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D. JEWELL, S. HEPWORTH, P. ARSENEAU, & J. ROVET. Episodic and Semantic Memory Dissociation in Congenital Hypothyroidism.

In previous work on pediatric patients with amnesia, a selective memory deficit affecting episodic memory while sparing semantic memory was observed following early bilateral hippocampal damage. Children with congenital hypothyroidism (CH) who are identified by newborn screening and treated early in life have, for the most part, normal cognitive functioning. However, they show subtle neuropsychological deficits including poorer performance on certain memory tasks. Their deficits are attributed to the brief loss of thyroid hormone they experience prior to treatment onset and hormonal normalization, which typically occur during a critical period of neurodevelopment. Because the hippocampus is a brain structure where thyroid hormone receptors are localized and postnatally expressed, we hypothesized that children with CH would show a selective memory deficit affecting episodic but not semantic memory. We compared 44 children 6–12 years of age with CH and 35 normal controls in their performance on memory indices primarily from the Children's Memory Scale. Seven indices were obtained and grouped as to episodic *versus* semantic requirements. Multivariate ANOVAs indicated that the CH group performed significantly below controls on 3 of 4 indices of episodic memory ($p = .008$) but they did not differ on the 3 semantic memory indices ($p = .27$). These findings are consistent with the view that only episodic memory is fully dependent on the hippocampus, and is thus affected by early thyroid hormone deficiency. In contrast, there is no effect of this thyroid hormone loss on semantic memory, which is thought to be supported by surrounding cortical structures.

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S. PURDON, S. KLEIN, N. WOODWARD, B. REED, & P. FLOR-HENRY. Menstrual Effects on Asymmetrical Olfactory Acuity.

Gender specific discrepancies on psychometric examination have been interpreted to imply differences in cerebral hemisphere specialization, but this hypothesis has rarely been subjected to direct examination. The often

cited right hemisphere advantage in males and left hemisphere advantage in females is inferred from the subtle but reliable male spatial advantage and female verbal advantage, and the difference is interpreted to represent a neuroanatomical divergence secondary to gender-specific circulating gonadal hormones in the developing brain. Recent demonstrations of lateralized cerebral effects of transient neuroendocrine fluctuations suggest that neuroanatomical differences may represent only a partial explanation for the gender difference. The present investigation continues this line of work by measurement of prospective changes in unirhinal olfactory acuity across the menstrual cycle in eleven healthy women who agreed to blood assay of estradiol and progesterone prior to completing a modified version of the Connecticut Chemosensory Perception Exam. The CCPE detection of n-butanol showed a clear pattern of changes over the menstrual cycle marked by an asymmetry favoring the right nostril during menstruation when estradiol and progesterone levels were low, an asymmetry favoring the left nostril during ovulation when estradiol levels were high and progesterone levels were low, and an absence of asymmetry during the midluteal phase when estradiol levels decreased and progesterone levels increased. The transient fluctuations in relative cerebral hemisphere advantages in women question the validity of a pure developmental interpretation of gender-specific effects and pose a novel challenge to the over generalization of the gender-based difference in verbal and spatial tasks.

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P.A. KEENAN, W.H. EZZAT, K. GINSBURG, & G.J. MOORE. Prefrontal Cortex as the Site of Estrogen's Effect on Cognition.

It has long been presumed that the hippocampus is the primary site of action of estrogens on cognition, and that explicit memory is most vulnerable to menopausal loss of estrogen. Our data suggest instead that the prefrontal cortex and its neural circuitry are the primary moderators of estrogen's role in cognition, and that menopausal cognitive decline is secondary to executive dysfunction. We used a cross sectional design to compare the performance of 10 menopausal women on hormone replacement therapy (HRT) and 10 untreated menopausal women on tests of memory and executive functioning. Unlike most previous studies we used the CVLT rather than paragraph recall, thus isolating spared and impaired cognitive processes. Despite comparable free recall on the CVLT, untreated women were relatively impaired in distinguishing words previously learned from items not on the list (discriminability index: $t = 1.83, p = .08$). They also had difficulty inhibiting inappropriate responses in the form of perseverative errors ($t = -2.1, p < .05$). Clinically significant impairments were noted for both perseverative responses and performance on Trails B for the untreated women. They also performed worse on the *N*-Back test of working memory ($t = 2.9, p = .01$). The data are possibly supported by results of $^1\text{H-MR}$ spectroscopy, which indicated a lower creatine (CR) to n-acetyl-aspartate (NAA) ratio in the dorsolateral prefrontal cortex in the untreated women ($t = -2.9, p = .02$). In conclusion, this study provides compelling evidence for executive dysfunction in untreated menopausal women. Women with HRT tended to outperform women without HRT on tests requiring directed attention, inhibition of inappropriate responses, and cognitive set switching.

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EMOTION

L. DE SONNEVILLE, C. VERSCHOOR, C. NJIOKIKTIJEN, V. OP HET VELD, N. TOORENAAR, & M. VRANKEN. Speed and Accuracy of Processing Facial Information.

As yet, nearly all studies in face and facial affect recognition typically provide only data on the accuracy of processing, invariably also in the absence of reference data on processing of abstract information. In this study, accuracy and speed of processing abstract visuospatial patterns, neutral facial information (face recognition), and facial emotions recognition

were investigated in 106 normal school children (7–10 years) and 26 adults (25 ± 4 years). All stimuli (visuospatial patterns, faces with a neutral or an emotional expression) were presented on a computer screen. In addition to 'stills' as stimuli, the subjects also processed digitized video segments of facial transitions—from neutral to an emotion. In children of 7–10 years, accuracy of facial processing increased hardly, while speed did substantially increase with age. Adults were considerably more accurate and faster than children. Analyses within and across tasks clarified the extent to which the tasks tap separate or similar processing skills. Differences, in relation to age, concerning the processing of facial and abstract information, face and facial emotion recognition, and the processing of dynamic facial information are extensively discussed. Preliminary results suggest that this approach might successfully be used in assessing clinical deficits.

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B. SHENAL & D. HARRISON. Cardiovascular Correlates of Hostility, Stress, and Affective Learning.

The purpose of this experiment was to compare the cardiovascular regulation of high- and low-hostiles to affective learning in stress and no-stress conditions. Additionally, this experiment tested hypotheses linking the right cerebral regulation of hostility and cardiovascular reactivity. Past research has shown that high-hostile individuals evidence heightened cardiovascular reactivity. This experiment extends this literature by examining cardiovascular reactivity to affective list learning and stress. Also, this experiment expands a line of research with the negative and positive lists of the Affective Auditory Verbal Learning Test (AAVLT). High- and low-hostile participants ($N = 64$) were identified using the Cook-Medley Hostility Scale. Right-handed, male, college students with no remarkable medical history were included. High-hostiles typically demonstrate heightened right cerebrum activation, relative to low-hostiles. It was hypothesized that heightened right cerebral activation would interfere with cardiovascular regulation among the high-hostile participants. All participants completed the cold-pressor condition or the no-stress condition as well as the negative list and the positive list from the AAVLT. Analysis of variance (ANOVA) demonstrated a significant Group \times Condition \times Valence interaction [$F(1, 60) = 6.87, p \leq .05$]. Results demonstrated that mean arterial pressure (MAP) was elevated for high-hostiles regardless of the valence of the learning task. In contrast, low-hostiles' cardiovascular reactivity was valence dependent with elevated MAP to both the positive list with stress and to the negative list with no stress. These findings are consistent with the *a priori* hypothesis and support previous related findings. Results are discussed with respect to potential asymmetrical cerebral activation patterns.

Correspondence: David W. Harrison, Ph.D., *Department of Psychology, Virginia Tech, Blacksburg, VA 24061-0436.*

B. SHENAL & D. HARRISON. Neuropsychological Differences in the Learning of Positive and Negative Words.

The purpose of the present experiment was to compare learning performances on affectively valenced word lists. Past research has demonstrated that the learning of positive and negative words produces differential patterns of acquisition. The present experiment provides an extension to this literature examining the accuracy of emotional learning and expands a previous line of research with the Affective Auditory Verbal Learning Test (AAVLT). The recently developed AAVLT consists of lists of positively and negatively valenced words. The negative and positive emotional lists were designed to be analogous to those on the Rey Auditory Verbal Learning Test (RAVL) but to vary on the affect dimension. Right-handed, male, college students ($n = 64$) with no remarkable medical history were included in the experiment. All participants completed the negative affective list and the positive affective list from the AAVLT. Analysis of variance (ANOVA) demonstrated a significant Valence \times Trial interaction, [$F(2, 120) = 12.68, p \leq .5$]. Analyses revealed a significant primacy effect (proactive interference) for the negative affective list and a significant recency effect (retroactive interference) for the positive affective list. Also, overall results of this experiment demonstrated that more negative words

were recalled than positive words. These findings are consistent with the *a priori* hypothesis and support previous related findings. Results are discussed with respect to potential asymmetrical cerebral activation patterns between positive affective learning and negative affective learning. These results successfully expand the literature of neuropsychological patterns of acquisition for emotional learning and support the utility of the AAVLT. Correspondence: David W. Harrison, Ph.D., Department of Psychology, Virginia Tech, Blacksburg, VA 24061-0436.

C. NEUMANN, P. JOSEPH, K. HILLIARD, E. ROSS, & J. TESTA. Comparison of 2 Measures of Affective–Prosodic Comprehension in Alzheimer’s Disease.

This study investigated the sensitivity of the Florida Affect Battery (FAB), and the Aprosodia Battery. Both tests were developed, in part, to assess an individual’s ability to comprehend and discriminate affective prosody in speech. The Aprosodia Battery differs from the FAB in several ways: the samples are spoken by a male rather than a female, there are more examples of emotions (6 vs. 5), and the discrimination samples are filtered to preserve prosodic information while markedly reducing phonetic information. It was hypothesized that these differences would result in a more sensitive measure of affective-prosodic comprehension and discrimination in neurologically impaired populations. In order to test this hypothesis, a sample of mildly impaired patients with Alzheimer’s disease (AD; MMSE > 20) were compared to normal healthy elderly. In comparison to controls, AD patients were impaired on Aprosodia Battery discrimination ($p < .05$) but had a normal performance on FAB discrimination. AD patients were significantly more impaired on the Aprosodia Battery comprehension subtest ($F = 38.6, p < .001$) than on the comparable FAB subtest ($F = 5.5, p < .05$). In conclusion, the Aprosodia Battery appears to be a more sensitive measure of affective-prosodic comprehension and discrimination when used with mildly demented AD patients. However, because the FAB has a greater ceiling effect, it may be more useful in patients with more severe AD.

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D. HIGGINS & D. HARRISON. QEEG Imaging Brain Laterality of Visualized Positive and Negative Emotions.

Research supporting the idea of lateralized processing of emotional valences (with positive emotions being processed primarily in the left hemisphere and negative emotions in the right hemisphere) has continued to surface. This study utilized Quantitative Electroencephalography (QEEG) as an imaging tool to map two self-induced (visualized) emotional states. QEEG has proven to be a useful instrument as part of a neuropsychological assessment, as an objective method for supporting hypotheses generated from neuropsychological evaluations. Nevertheless, it can also be useful as a functional brain imaging procedure. Baseline QEEG data were first collected as the patient relaxed, with eyes closed. For the first induction procedure, the patient was asked to visualize a positive/happy, real-life emotional experience. Accordingly, state-dependent data were collected. For the second induction procedure, the patient was asked to visualize a negative/sad, real-life emotional experience. Analyses included a within-subject statistical approach to analyze interhemispheric comparisons (i.e., left vs. right), specific site comparisons (e.g., frontal vs. occipital), and state comparisons (e.g., baseline vs. emotion inductions). Relative lateralized activity was recorded in the left temporal and occipital areas during positive emotion visualization, while lateralized activity was recorded in the right temporal and occipital areas during negative emotion visualization. This study illustrates the utility of QEEG in imaging lateralized cerebral activity during emotion induction states. In addition, occipital areas were noted to be involved in the processing of induction states when the patient was asked to visualize an emotional experience, rather than to simply recall an emotional experience.

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D.E. EVERHART, D.W. SHUCARD, & J.L. SHUCARD. ERP Differences in Facial Affect Perception.

In this experiment, we investigated the relative contribution of the right and left hemispheres to the processing of differing facial emotions. Visual event-related potentials (ERPs) were recorded from 17 college-aged (11 women, 6 men) participants across 8 scalp sites (F3, F4, T3, T4, C3, C4, P3, P4) while they performed an Affect Identification Task (AIT) developed in our laboratory. During the AIT, 5 facial affects (*happy, sad, fear, angry, neutral*) selected from Ekman’s Pictures of Facial Affect were presented (350 ms), and measures of reaction time, accuracy, and perceived emotional intensity were obtained for each affective stimulus. ANOVA performed for behavioral measures revealed that happy affect was identified more accurately [$F(4, 12) = 11.02, p < .001$] and more quickly [$F(4, 12) = 17.58, p < .001$] than other affects. In addition, subjects rated happy and fear affects as more intense [$F(4, 12) = 9.16, p < .001$] than other affects. With respect to the ERPs, ANOVA performed for the peak-to-peak amplitude measures for Peak 3 (P2–N2) and Peak 4 (N2–P3) revealed a significant Affect \times Hemisphere interaction for P3. *Post hoc* comparisons of this interaction revealed higher right versus left hemisphere amplitude ($p < .01$) for fear only. The behavioral data are consistent with previous studies, in that happy faces were identified more accurately than other affects. The ERP data suggest that the perception of emotional faces, particularly fear, relies on specific neuronal systems, in that perception of fear involves more right versus left hemisphere resources.

Correspondence: D. Erik Everhart, Behavioral Neurosciences, Department of Neurology, 100 High Street (D-6), Buffalo, NY 14203.

J. DEMERY, M. HAMBY, & D. BOWERS. Affect Modulation of the Acoustic Startle Response by Semantic Representation.

Rationale: Past research has demonstrated that the magnitude of startle eyeblinks is greater when subjects view unpleasant versus pleasant pictures. We attempted to determine if the acoustic startle response (ASR), as measured by startle eyeblink magnitude, could be modulated following the presentation of photographs of famous people who were rated as negative, neutral, or positive based on the rater’s independent knowledge about the person. *Methods:* Thirteen participants (7 males/6 females) rated a series of photographs of famous people on recognition, degree of familiarity, and valence dimensions. Photographs were then counterbalanced by valence and organized into a computerized “slide-show” for observation. Startle eyeblink magnitude data were collected on all subjects. *Results:* ANOVA between conditions (e.g., negative, neutral, positive) was significant, and pairwise comparisons with Bonferroni adjustment demonstrated significant differences in startle magnitude between photographs of people who were perceived as semantically negative (e.g., Adolf Hitler) versus semantically positive (e.g., Mother Theresa). However, no differences were observed between photographs of people who were perceived as semantically neutral (e.g., Mikhail Gorbachev) versus semantically negative or positive. *Conclusions:* These data provide support for the hypothesis that faces which connote semantic knowledge may affectively modulate the ASR and suggest a role for semantic stimuli in future studies of emotion. Correspondence: Jason A. Demery, M.A., University of Florida Health Sciences Center, Department of Clinical and Health Psychology, P.O. Box 100165, Gainesville, FL 32610-0165.

J.C. BOROD & A.M. BRICKMAN. Emotional Processing Deficits in Parkinson’s Disease: A Review of the Literature.

In addition to the depression that is commonly observed in Parkinson’s disease (PD), recent literature has suggested that specific emotional processing deficits can also exist. We identified 23 pertinent studies in this area, organized them by processing mode and communication channel (which yielded 35 observations), and characterized the prevalence of significant emotional deficits in PDs relative to normal controls (NCs) for each study. Fifty-five percent of the observations involved expression; 39%, perception; and 6%, experience. Furthermore, 54% of the studies involved faces; 29%, prosody; 11%, gesture and posture; and 6%, other. For expression, 100% of the studies reported that PDs were significantly impaired

relative to NCs for prosody, 100% for gesture and posture, and 57% for face. For perception, deficits have been less prominent, with 55% of the studies for the prosodic channel showing significant deficits in PDs compared to NCs, 50% for face, and 33% for other. For all studies involving emotional experience, PDs did not differ significantly from NCs. In summary, the PD emotion literature reviewed demonstrates significant expression deficits, equivocal findings for perception, and the absence of experiential deficits. While it appears that at least some emotional deficit exists in PD, the etiology of this deficit remains to be elucidated. Specifically, the emotion deficit in PD may be the result of general impairment in emotional processing or secondary to motor/cognitive symptoms seen in PD. Further, inconsistent findings may be the result of methodological factors, such as heterogeneity in participant selection and procedures employed to study emotional processing.

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J. SPIELMAN, L. RAMIG, & J. BOROD. Preliminary Effects of Voice Therapy on Facial Expression in Parkinson's Disease.

Recent advances in speech therapy for Parkinson's disease (PD) have documented that short-term, intensive voice therapy produces significant and lasting improvements of voice and speech disorders, and may positively impact other behaviors affected by PD. One such deficit that anecdotally appears to benefit from intensive voice therapy is diminished facial expression, a hallmark sign of PD which rarely receives treatment despite its negative impact on social interaction. The purpose of this preliminary study was to examine the effects of the LSVT on facial expression in PD. Thirty-six individuals with PD were videotaped before and after receiving 1 month of respiratory (RT; $n = 14$) or voice treatment (LSVT; $n = 22$) while speaking spontaneously on a neutral topic. Pre- and post-treatment video samples (20 s in duration) were paired, randomized, and presented on videotape without sound to 15 naive female observers who were asked to choose the more expressive segment from each pair. *Expressive* was defined as "meaningful" and "communicative" facial movement. For RT, 7/14 (50%) individuals were more expressive pre treatment, and 7/14 (50%) were more expressive post treatment. For LSVT, 7/22 (32%) individuals were more expressive pre treatment and 15/22 (68%) were more expressive post treatment. The positive trend following voice therapy (binomial test, $p = .067$) suggests that phonation-based treatment may have a clinical impact on expressive output in general. Findings are discussed as they relate to theories of connectivity between vocalization and facial expression.

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M-S. HUA, Y-C. CHU, S-T. CHEN, & C-S. LU. Depression in Taiwanese Patients With Subcortical Lesions.

Emotional disturbances, especially depression, have often been noted in brain-damaged patients. The implied clinical and economic impacts of the problems on the patients are remarkable and multifold. Depression has been reported in the patients with subcortical lesions. The literature in this area, particularly in Taiwan, however, is less extensive than that of patients with cortical lesions. The aim of this study, thus, was to explore the prevalence of depression in patients with subcortical lesions, and also to examine the issue of the relationship between depression and cognitive impairments in these patients. Two adult patient groups participated in the study. One group included 25 patients with subcortical stroke (12 left and 13 right subcortical stroke), and another consisted of 133 parkinsonian patients. Each received a battery of neuropsychological tests, and measures of emotional status. Compared to age-corrected norms, 20% (5/25) of our patients with subcortical stroke, and about 38% (50/133) of Parkinsonian patients had depression. Of 5 depressed patients with subcortical stroke, 3 involved in the left subcortical region and 2 in the right. For the patients with stroke, 20% (5/25) of them were aphasic, but none were depressed. For the Parkinsonian patients with depression, 58% (29/50) of them were demented. On the basis of our preliminary results, it appears that the prevalence of depression in our Taiwanese patients with subcortical lesions is compati-

ble with the literature. Meanwhile, our findings also partially support the earlier observation that there is a significant association between depression and dementia in Parkinsonian patients.

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D. ZGALJARDIC & J. BOROD. Recovery of Emotion Perception in Stroke Patients Across Communication Channels.

Despite an ever-increasing literature on the recovery of language and cognitive functions after brain injury, there are relatively few investigations concerning the recovery of emotional processing. The purpose of this study was to examine the recovery of emotional perception as a function of time across 3 communication channels (facial, prosodic/intonational, and lexical/verbal) in unilateral stroke patients. Additional aims of the current study were to examine instrument stability and interrelationships among the 3 communication channels. The New York Emotion Battery was administered to 23 participants in 3 groups: 9 right brain-damaged patients (RBDs; M age = 63.2 years), 7 left brain-damaged patients (LBDs; $M = 59.7$), and 7 normal controls (NCs; $M = 58.7$ years). Participants were right-handed, fluent English speakers; groups were matched on demographic and clinical variables. Emotional perception was examined at two separate testing periods with a median test-retest interval of 25 months. Overall, there was no evidence of recovery in emotional perception among the brain-damaged patients. Importantly, task performance was stable across time for LBDs ($MDN r = .73$) and NCS ($MDN r = .85$). The lack of stability for the RBDs may be related to impairments specific to that group (e.g., deficits in arousal and attention). Consistent with previous research, significant correlations were found for the facial channel *versus* the prosodic channel (67%) but not for the lexical channel *versus* the nonverbal channels (25%). It can be argued that facial and prosodic perception subserve a general emotional processor.

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S. BORGARO & G. PRIGATANO. Early Cognitive and Affective Sequelae of Traumatic Brain Injury.

Fifty adult patients with moderate ($n = 22$) or severe ($n = 28$) traumatic brain injury (TBI), as determined by admitting Glasgow Coma Scale scores and neuroimaging findings, were administered the BNIS of Higher Cerebral Functions within 90 days of their injury. Performances were compared to 28 normal controls. The BNIS is a neuropsychological screen that consists of seven subtests designed to assess both cognitive and affective functions. Cognitive performance was assessed on subtests of speech/language, orientation, attention/concentration, visuospatial problem solving, and learning and memory. The affect subtest consists of items designed to assess one's ability to verbally express affective tone, perceive facial affect, control affect, and generate spontaneous affect. An awareness subtest compared a subject's actual memory performance to their predicted performance. Statistical analyses employed ANOVAs, followed by ANCOVAs to control for significant education differences. Results revealed significantly better performances on all of the BNIS subtests for controls compared to the TBI groups (all $ps < .001$). The 2 subgroups of TBI patients did not statistically differ from each other on the seven subtest scales, although a trend in performance was observed, with controls > moderate > severe. Stepwise multiple regression analyses identified lower scores on subtests of affect and awareness as most associated with the classification of severe TBI ($p < .001$). Moderate patients were best predicted by poor language and memory scores ($p < .001$). These findings suggest that both cognitive and affective functions are impaired during the acute stage of TBI. Assessing both domains has implications for early cognitive rehabilitation and treatment planning.

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G.E. GETZ, P.K. SHEAR, & S.M. STRAKOWSKI. Facial Affect Recognition Deficits in Bipolar Disorder.

Patients with bipolar disorder (BPD), by definition, have problems with emotional regulation. However, it is uncertain whether these patients are also deficient at processing other people's emotions, particularly while in the manic state. The present study examined the ability of 11 hospitalized manic patients (6 female; 5 male) and 22 healthy participants (14 females; 8 males) to recognize facial affect at three different stimulus durations: 500 ms, 750 ms, and 1000 ms. BPD and control groups did not differ in terms of age (27 + 9 and 24 + 4), education (12 + 2 and 12 + 2), or ANART-estimated verbal IQ (104 + 8 and 109 + 5). At the time of the testing, patients had an average Young Mania Rating Scale (YMRS) score of 29 + 10, indicating that they were experiencing manic symptoms. In terms of facial recognition, the two groups did not differ significantly on either a novel computerized facial recognition task or on the Benton Facial Recognition Test. In contrast, the BPD group performed significantly more poorly than did the comparison group on a computerized facial affect matching task at the 500-ms interval ($p < .01$) and a facial affect discrimination task at the 500-ms interval ($p < .03$). Facial affect processing was not impaired at the longer time intervals. This study indicates that patients with BPD may need more time to process facial affect, but they exhibit a normal ability to recognize faces.

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A. DESAI, D. GÖKÇAY, C. RICHARDSON, M. HAMBY, & D. BOWERS. Digitizing the Moving Face During Emotion Displays: Movement Asymmetries and Gender.

Rationale: Facial expressions are complex signals caused by rapid changes in facial muscle activity that are brief and last only a few seconds. In this study, we used a novel computer imaging approach to digitize dynamic facial expressions to learn (1) whether movement asymmetries occurred across the 2 sides of the face during emotional expressions; and (2) whether gender differences existed. *Methods:* Forty-eight dextral adults (25 M, 23 F) were video-recorded while they produced voluntary expressions. For each expression, a 900-ms video segment was digitized, on a frame-by-frame basis, and analyzed for changes in signal value (pixel intensity) over consecutive frames using semiautomated custom software. Each frame (30.5 ms) consisted of a 640 × 480 pixel array at 256 levels of grey scale. Upper and lower face regions were analyzed separately due to differences in cortical innervation of the upper (bilateral) versus lower face muscles (contralateral). *Results:* Certain emotions were associated with more overall movement than others [surprise > happy > fear > (angry-neutral)], regardless of gender. In males, movement asymmetries favoring the left occurred in the lower face for most emotions, replicating a previous report from our laboratory. Females displayed no movement asymmetries. *Conclusions:* These findings suggest gender differences in facial movement asymmetries during voluntary displays of emotion. In males, the lower left movement asymmetry may reflect emotional priming by right hemisphere systems, whereas emotional priming in females may involve more widely distributed systems. Alternatives to the emotional priming hypothesis will be discussed.

Correspondence: *Dawn Bowers, Department of Clinical & Health Psychology and University of Florida Brain Institute, P.O. Box 100165, Gainesville, FL 32610.*

J. MURPHY, A. GREGORY, M. SEMRUD-CLIKEMAN, K. HIGGINS, J. LANCASTER, & D. TUCKER. A Double Dissociation of Facial Emotion Recognition: The Amygdala and Hippocampus.

The amygdala has been associated with recognition of facial emotion in human lesion and PET studies. A specificity of response to fearful facial expressions has been found, with left amygdala being more responsive to fear and bilateral damage associated with both fear and surprise deficits. The hippocampus, in contrast, is believed to be involved in the consolidation and storage of neutral memory. The present study evaluates the relationship between the amygdala and hippocampus and recognition of emotion

in faces among a male antisocial adolescent sample and matched controls ($N = 33$). Hare's adolescent Psychopathy Checklist quantified antisocial behavior and personality traits (e.g., empathy, remorse). Recognition of facial affect was measured with Nowickie's affective faces, which yielded indices (no. of errors) of ability to identify fear, anger, happiness, and sadness. MRI volumes were calculated with contiguous coronal 1.0-mm slices for each structure. A double dissociation was established, with amygdala asymmetry being correlated with happiness ($r = -.32, p < .04$) but unrelated to recognition of any other emotion. Hippocampal asymmetry, in contrast, was correlated with recognition of fear ($r = -.34, p < .02$) yet unrelated to recognition of any other emotion. Greater asymmetry (right structure > left) was therefore associated with greater accuracy for happiness in the amygdala and for fear in the hippocampus. Left hippocampal volume was also associated with deficits in detecting anger ($r = .33, p = .03$). These data suggest that limbic structural symmetry may be related to the processing of affective visual stimuli, and that the amygdala and hippocampus may play unique roles in processing of different emotions.

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K. BURTON & A. KASZNAK. Emotional Experience, Facial Expression, and Startle Modulation in Dementia of the Alzheimer Type.

The aim of the present study was to investigate possible changes in emotion processing in individuals with mild dementia of the Alzheimer type (DAT) as evidenced by psychophysiological and subjective responses to emotional stimuli. It was hypothesized that DAT subjects would show decreased modulation of psychophysiological responses compared to age-matched control subjects, but would not show differences in their subjective ratings of the emotional stimuli. DAT ($n = 11$) and age-matched controls ($n = 21$) viewed 36 valenced emotional stimuli (slides depicting positive, neutral, and negative scenes) for 6 s each, during which psychophysiological measures of emotion processing were gathered. The psychophysiological measures included corrugator and zygomatic muscle activity and eye-blink startle responses to an auditory probe (50 ms exposure to 95 db white noise). Subjective ratings of happiness/sadness and arousal/relaxation were gathered after viewing each of the slides. The DAT group showed no significant differences from controls on the measures of corrugator activity, startle response, and subjective ratings. The DAT group demonstrated significantly less zygomatic activity than the control group in response to positive stimuli. These preliminary results suggest that facial expression of positive emotions may be reduced early in the course of DAT.

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Symposium 9/9:00–10:45 a.m.

VISUAL PERCEPTION IN INFANTS, CHILDREN, AND YOUNG ADULTS WITH SPINA BIFIDA

Organizer and Chair: Maureen Dennis

M. DENNIS & J.M. FLETCHER. Visual Perception in Infants, Children, and Young Adults With Spina Bifida.

Spina bifida with hydrocephalus (SBH) is a neurodevelopmental disorder that affects the brain and spinal cord. One of the signature deficits of SBH in school-aged children is impaired visual perception. Many features of this deficit are poorly understood, such as: life span developmental course, cognitive architecture, brain correlates, and relation to academic competence. This symposium presents current information about some understudied issues related to visual perception deficits in SBH: developmental origin in infants and pre-schoolers, behavioral and neuroanatomical expression in childhood, role in academic competencies, and developmental continuity into young adult life. *Landry* addresses the early manifestations of visual perception and related neuropsychological deficits in infants and preschoolers with SBH. *Dennis* considers the nature of visual perception

impairments by comparing school-aged children with SBH and controls on tests of visual object identification, egocentric spatial representation, and visually guided movement. *Fletcher* relates motor and visual perception skills to regional morphometric segmentation of MR images of the brain in school-aged children with SBH. *Barnes* presents data on arithmetic computation, geometry, estimation, and problem solving in school-aged good readers with SBH and relates arithmetic processing to visuospatial and other cognitive skills. *Hetherington* presents data on nonverbal intelligence and visual perception in young adult survivors of SBH. The material in the symposium constitutes the beginning of a life span perceptiveness on visual perception, one of the signature cognitive deficits in SBH, a major neurodevelopmental disorder.

Correspondence: *M. Dennis, Department of Psychology, The Hospital for Sick Children, 555 University Avenue, Toronto, ON M5G 1X8, Canada.*

S.H. LANDRY, L. STEELMAN, M. ASSEL, & M. BARNES. Early Cognitive Skills in Young Children With Spina Bifida/Hydrocephalus: A Longitudinal Study.

This study will address the early manifestations of the neuropsychological problems associated with spina bifida and hydrocephalus (SBH). The association between SBH and deficiencies in cognitive areas by school age, particularly motor, spatial skills, and executive function, are well documented. However, their developmental origins are not well understood since to date few studies of SBH have examined cognitive development in the infancy and preschool periods. Children with SBH have specific deficits in areas of spatial cognition, attention, behavioral regulation, rule-based learning, and organizing and initiating behavioral responses. Since deficits in these neuropsychological skills may underlie some of the more general problems that school-age children with SBH exhibit, we have examined the origin of these skills in the infancy and preschool period. We will describe SBH children's early development of four abilities, including contingency learning skills, goal-directed play, social initiative, and social responsiveness. We will also describe how core deficits associated with SBH, early abilities, and specific brain anomalies influence the development of these skills. The relation between core deficits and motor exploration, motor timing, and attention shifting with deficits in motor contingencies, spatial learning, and joint attention will be presented. Given the link of these skills to the development of daily living skills, social relationships, and academic performance, it is important to understand the origins of these skills and their implications for children with SBH.

Correspondence: *Susan H. Landry, University of Texas–Houston, 7000 Fannin, UCT 2401, Houston, TX 77030.*

M. DENNIS, J.M. FLETCHER, T. ROGERS, & R. HETHERINGTON. Object-Based and Action-Based Visual Perception in Children With Spina Bifida.

Visual perception allows the individual to identify objects and to act overtly or symbolically on the visual environment. Object-based identification permits detection of features like contour, shape, size, and orientation. Action-based visual perception permits visually guided, goal directed action, and requires the representation of visual space in egocentric coordinates and the coupling of these coordinates to movement. Children with spina bifida and hydrocephalus (SBH) have long been known to have difficulties with visual perception. We studied how children with SBH perform visual perception tasks requiring either object identification or visually guided movement. Four tasks required object-based processing (visual constancy illusions, face recognition, visual recognition of fragmented objects, and line orientation). Eight tasks required action-based processing, either the representation of visual space in egocentric coordinates (stereopsis, visual figure-ground identification, perception of multistable figures, egocentric mental rotation) or the coupling of these coordinates to movement (visual pursuit, figure drawing, visually-guided route finding, visually guided route planning). Effect sizes measured the magnitude of the difference between SBH children and their age and geographically matched controls. Effect sizes were consistently larger for action-based than object-based visual perception tasks. Within action-based tasks, effect sizes were greater for tasks requiring the representation of space in egocentric coordinates than for

tasks explicitly related to overt action. The data are discussed in terms of the physical and brain problems of children with SBH that limit their ability to build situation models of space and of language.

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J.M. FLETCHER, M.E. BRANDT, D. STRITE, K.C. DAVIDSON, & J.M. SLOPIS. Regional Morphometric Segmentation of the Hydrocephalic Brain: Relationships With Motor and Spatial Skills.

Morphometric analysis of the hydrocephalic brain has shown reductions in both gray matter and white matter, and the expected increases in CSF. However, these analyses have been restricted to area measurements of specific MRI slices and have not involved whole brain segmentation. In this study, MRIs from 29 children with early shunted hydrocephalus (SH) and 14 age-matched controls (C) were subjected to whole brain and regional segmentation in which volumes of white matter, gray matter, and CSF were estimated using a fuzzy clustering algorithm. These volumes were correlated with neuropsychological measures of verbal and spatial cognition, problem solving, and fine motor skills. The results revealed a significant Group \times Region \times Tissue interaction [$F(4,38) = 3.07, p < .03$]. Follow-up tests showed that relative to controls, the group with SH had significantly more CSF and less gray and white matter in posterior brain regions bilaterally, but not in anterior brain regions. There were significant correlations of regional CSF volumes with measures of spatial cognition and fine motor skills, but not verbal or problem-solving skills. Children with more posterior than anterior thinning had poorer development of motor and spatial skills relative to children with symmetrical thinning. These results are consistent with animal models of hydrocephalus in which tissue loss involves both gray and white matter. Within children with SH, variations in the development of motor and spatial skills are inversely correlated with indices of tissue loss.

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M. BARNES, S. PENGELLY, & M. DENNIS. Arithmetic Processing in Good Readers With Spina Bifida and Hydrocephalus.

Children with spina bifida and hydrocephalus (SBH) have a modal academic profile that includes stronger word decoding than math skills. It has been hypothesized that computational difficulties in this group are related to one of the signature cognitive deficits of SBH, visuospatial impairment. There is little direct evidence, however, to support this view. We present data from studies of arithmetic processing in good readers with SBH using measures derived from research on normal arithmetic development. One important component of arithmetic processing involves math fact retrieval. Children with SBH were as accurate and as fast as age-matched controls in single digit addition, suggesting that math fact retrieval processes are intact in SBH. We also investigated procedural and visual-spatial aspects of arithmetic performance by comparing written subtraction errors in 24 good readers with SBH, 24 typically developing good readers of the same age, and 24 younger children matched for math level to the children with SBH. The SBH group made more procedural errors (e.g., errors borrowing across zero), but not more fact retrieval or visual-spatial errors, than age-matched controls. They made the same number and types of errors as younger, math-level matched children. Computation deficits in children with hydrocephalus appear to reflect delayed development of procedural knowledge. Results are discussed in relation to models of arithmetic disability and to the role that visuospatial processing deficits in SBH might play in the early acquisition of informal arithmetic skills and in the later development of other math skills such as geometry and estimation.

Correspondence: *Marcia Barnes, Department of Psychology, The Hospital for Sick Children, Toronto, ON M5G 1X8, Canada.*

R. HETHERINGTON & M. DENNIS. Visual Perception in Young Adult Survivors of Spina Bifida and Hydrocephalus.

Children with spina bifida and hydrocephalus (SBH) have poor visual perception skills. It is not known whether this signature cognitive deficit is stable into adulthood; that is, whether adults with SBH show visual per-

ception impairments relative to their other cognitive skills in comparison to age norms. We studied nonverbal intelligence and visual perception skills in 27 young adults (M age 26.8 years) who had been diagnosed with spina bifida at birth and treated with shunts to control hydrocephalus. Five measures were used: (1) nonverbal intelligence (PIQ, WAIS-R); (2) spatial processing domain score from Microcog®, which does not involve motor or constructional components; (3) *Tic Tac*, in which participants replicate the spatial configuration of visual patterns; (4) *Clocks*, in which participants choose a time setting from clocks with hand configuration but no numbers; and (5) the Map Search subtest of the Test of Everyday Attention, a timed task requiring selection of particular symbols on a map of Philadelphia. Mean nonverbal intelligence was significantly worse than verbal intelligence. Forty-one percent of the sample were below average on the Spatial Processing domain of Microcog®. Performance was slow but intact on the time setting task; however, 44% of the sample were below average on the spatial configuration task. The group's worst performance was on the second part of the Map Search task, where 41% were impaired. Results will be discussed in the context of the developmental stability of the cognitive profile in spina bifida.

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Paper Session 12/11:00 a.m.–12:45 p.m.

AGING

H. BENEFIELD, D. DEDE, C. GARVAN, & T. MONK. The Association of Postoperative Cognitive Dysfunction With Anxiety and Depression.

Postoperative cognitive dysfunction (POCD) threatens surgical patients' independence and quality of recovery, while increasing caregiver burden. POCD has been operationalized as $\geq 20\%$ decline from baseline on ≥ 2 tests of cognitive function. A study of surgical patients age ≥ 60 years found POCD in 26% at 1 week and 10% at 3 months. The authors concluded that the interaction of increased age, anesthesia, and the surgical process caused POCD. Better understanding of patterns of risk for this multidimensional problem holds hope of successful interventions. As part of the largest, most comprehensive POCD study to date, we examined the relationship of affective distress and select demographic variables to POCD. Volunteers provided medical and demographic information and were screened for altered mental status preoperatively. Exclusions were based on MMSE scores < 24 , presence of neurological/psychiatric disorder, and high risk surgical procedures. Participants were assessed immediately before surgery, 1 week and 3 months after surgery. Neuropsychological tests of cognitive functioning (verbal learning/memory, executive functioning, attention/concentration, psychomotor processing) and affective distress (anxiety and depression) were administered at all 3 time points. Preliminary results presented here ($N = 610$) suggest preoperative and concurrent affective distress are risk factors for POCD (particularly reduced executive functioning) at 1 week. Cognitive decline increased with age. Initial memory dysfunction was predicted by anxiety whereas memory dysfunction at 3 months was better predicted by depression at that time. Relative contributions of various factors were examined through statistical modeling.

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S. LEACH, R. ARIAS, M. MORAN, M. HAUT, & H. KUWABARA. Age-Related Differences in Neural Activation During Number–Letter Sequencing.

Consistent with frontal/executive dysfunction, age-related changes in working memory (WM) have been widely reported. This study examined age-related patterns of neural activation, using [^{15}O] water positron emission tomography during WM. The Number-Letter Sequencing task adapted from the Wechsler scales was used as a WM task. We studied 7 young, healthy

participants (M age = 23.5, M education = 16.6) and 7 older healthy subjects (M age = 71.3, M education = 18.4). Participants completed a number-letter sequencing task. They heard five numbers and letters and then repeated the numbers first in ascending order followed by the letters in alphabetical order (e.g., 5–J–3–C–8 \rightarrow 3–5–8–C–J). A number–letter span task was used as a subtraction control (e.g., 5–J–3–C–8 \rightarrow 5–J–3–C–8). The young group demonstrated the typical peaks of activation associated with WM including the dorsolateral prefrontal cortex, orbital frontal cortex, posterior premotor cortex, and the posterior parietal cortex. The predominance of right hemisphere activation in the young participants suggests they used a visualization strategy. In contrast, the older participants demonstrated significantly less activation in the right dorsolateral prefrontal and orbital frontal cortex, and significantly greater activation in the left precuneus. The observation of age-related decreases and increases in activation during WM suggests the use of an alternative strategy and/or neural compensation for dysfunctional cortex in the aging brain.

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A. BRICKMAN, E. HAZLETT, L. SHIHABUDDIN, R. MOHS, & M. BUCHSBAUM. Striatal Size, Glucose Metabolic Rate, and Verbal Memory in Normal Aging.

Studies have suggested decreases in striatal function associated with age. The striatum has recently received attention as an area that may mediate cognitive decline associated with age via diminution of dopamine binding. In this study, we assessed 70 healthy right-handed normal participants with [^{18}F]-deoxyglucose PET to characterize striatal function during a memory task. Participants ranged in age from 20 to 87 ($M \pm SD = 54.0 \pm 20.4$); 35 males, 35 females. During tracer uptake, participants performed a serial verbal learning task (SVLT). For each participant, PET images were coregistered to high-resolution MRI. Caudate and putamen were traced on individual MRIs at 2 standard levels. Effect of aging on glucose metabolic rate (GMR) and size was assessed with 2 repeated-measures ANOVAs ($2 \times 2 \times 2 \times 2 \times 7$), with decade (20–80) and gender (male/female) as between-subjects factors, and region (caudate/putamen), level (dorsal/ventral), and hemisphere (left/right) as within-subjects factors. As decade increased, GMR increased in putamen and decreased in the caudate (Region \times Decade; $p < .001$). Females had lower activation than males in the caudate, but equal in putamen (Region \times Gender; $p = .011$). At the ventral level, putamen GMR increased with age and decreased in the caudate (Level \times Region \times Decade; $p = .026$). For striatal size, there was a significant Decade \times Gender interaction ($p = .03$). Exploratory correlational analyses were performed to examine relationship between striatal glucose and memory performance. Greater dorsal caudate activity was associated with more words recalled ($r = .316, p < .01$). Number of intrusions was inversely related to total striatal activity ($r = -.323, p < .01$). These findings are consistent with the view that dopamine loss occurs in normal aging and further suggest a role of the striatum in cognition.

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N. WEST, J. TSCHANZ, K. WELSH-BOHMER, C. CORCORAN, B. WYSE, C. WEIGHT, & J. BREITNER. Genetic and Nongenetic Risk Factors for Cognitive Decline in the Normal Elderly.

The $\epsilon 4$ allele of the Apolipoprotein E gene and a family history of Alzheimer's disease (FHAD) are known risk factors for Alzheimer's disease (AD). However, their combined effects on cognitive decline in normal elderly are relatively unexplored. We examined the association of APOE $\epsilon 4$ and FHAD with cognitive decline in 2,886 nondemented community-dwelling elders who had been stratified into groups presently aged 67–76, 77–87, 88+. We estimated cognitive decline by difference scores of an adapted version of the Modified Mini-Mental State Examination (3MS) obtained at baseline and again after 3 years. The effects of $\epsilon 4$, FHAD, and age group were examined in a 3-way analysis of covariance (ANCOVA) using education, gender, health status, and a history of cardiovascular and central nervous system disorders as covariates. The results suggested a significant 3-way interaction between presence of $\epsilon 4$, FHAD, and increasing age

[$F(1,2793) = 8.218, p < .001$]. We therefore stratified by age group and $\epsilon 4$ and ran *post-hoc* ANCOVAs. This approach revealed a significant effect for FHAD in individuals who had $\epsilon 4$ in the oldest age group [$F(1,28) = 5.941, p = .021$]. Surprisingly, FHAD had no effect on cognitive decline in the younger age groups nor in normal elderly without the $\epsilon 4$ allele. Our results suggest that in the presence of the $\epsilon 4$ allele, FHAD predicts even greater cognitive decline in the oldest-old. The changes identified suggest the possibility of preclinical AD detection and support the enrichment of study samples on these variables (older age, APOE $\epsilon 4$, and FHAD).

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M. JACOBSON, D.C. DELIS, S. JERKINS, M. BONDI, & D.P. SALMON. Auditory and Spatial Attention in Normal Elderly With the ApoE- $\epsilon 4$ Allele.

Recent neuroimaging studies suggest that elderly individuals with the ApoE- $\epsilon 4$ allele ($\epsilon 4$) at risk for Alzheimer's disease (AD) show atypical hemispheric asymmetries. Asymmetric cognitive changes, similar to deficits noted in early AD patients, have also been found in elderly $\epsilon 4$ individuals with mild cognitive impairment. We investigated whether nondemented, elderly $\epsilon 4$ individuals would demonstrate cognitive asymmetries on attention tasks. Given previous findings of asymmetric cognitive profiles, we hypothesized that the $\epsilon 4$ group would show larger discrepancies between auditory and spatial attention span compared to non- $\epsilon 4$ subjects. To test this hypothesis, we compared 14 normal, elderly $\epsilon 4$ individuals with 14 non- $\epsilon 4$ individuals matched on age, education, and cognitive ability (total DRS score). We administered the WAIS-R Digit Span and the WMS-R Spatial Span subtests. *T* tests showed that the groups did *not* differ significantly ($p > .1$) on the tests of auditory and visual attention. We then calculated a difference score (Digit Span *z* score minus Spatial Span *z* score) to measure auditory/visual attention asymmetry. The groups were significantly different ($t = -2.2; p < .05$) using the asymmetry score [*z* score difference Mean (*SD*): $\epsilon 4$ group = 1.41 (1.07); non- $\epsilon 4$ group = .718 (.64)]. These results show that, despite comparable mean performances on digit span and spatial span tests, the within-subject difference scores revealed greater asymmetry in the $\epsilon 4$ group's attentional skills. This difference may represent a decline in auditory relative to visual attention (and *vice versa*), and may signal a preclinical phase of cognitive changes in the $\epsilon 4$ group. Correspondence: Mark Jacobson, V.A.M.C.—San Diego, 3350 La Jolla Village Drive, #116B, San Diego, CA 92161.

Poster Session 9/11:00 a.m.—12:45 p.m.

MOTOR FUNCTION, APRAXIA, AND CEREBELLAR FUNCTIONS

J.I. TRACY, S.S. FARO, F. MOHAMMED, A. PINUS, H. CHRISTIANSON, & D. BURKLAND. Early- Versus Late-Stage Brain Activity During Practice of a Motor Task.

Does the neural circuit implementing a motor task undergo change as a function of even limited practice? To detect potential neural changes associated with limited practice we compared brain activation at the early and late stages of motor performance on a simple task over one brief session. Single-finger opposition served as cognitive stimulation during collection of BOLD signal. We predicted prefrontal cortex activation would be prominent early, with basal ganglia activation prominent during late stage performance. All 5 participants were healthy normal, right-handed, college-educated adults. Whole brain imaging was conducted at 1.5 T. Each participated in 5 fMRI series consisting of 78 acquisitions and 22.65 minutes of motor activity. An "early" contrast tested for the difference between the first and last two epochs of activation; a "late" contrast tested the reverse. All areas of activation were significant at the $p < .00001$ level ($k = 14$). Results revealed both early and late performance involved cerebellar, prefrontal, midtemporal, extrastriate, and parietal cortices, but that the regions active within these broad areas differed for the 2 points of performance. The general hypothesis of the study was not supported. The stron-

gest dissociation between early and late performance involved the corpus striatum, thalamus, and cingulate gyrus. Bilateral cerebellar activation throughout the task argued against an "ipsilateral" view of this structure's role in motor output and pointed to its involvement in nonmotor components of the task. Results support the growing literature showing that level of task exposure at the time of brain imaging is a crucial determinant of activation.

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A.M. RAYMER & L.M. MAHER. Effects of Verbal Plus Gestural Training on Limb Apraxia: A Case Study.

Some individuals with significant impairments of verbal production benefit from verbal plus gestural (V+G) training, which applies Luria's notion of intersystemic reorganization to mediate language abilities through an alternative gestural modality. One problem with V+G training is that clinicians often overlook limb apraxia that may co-occur in precisely those patients for whom gesture is a necessary compensatory means of communication. Seldom have V+G studies examined the types of responses, nouns or verbs, that are likely to be assisted using a gestural form of communication. We describe a single subject treatment study incorporating V+G training in a patient, D.R., who had significantly limited verbal output and severe limb apraxia following 2 left hemisphere strokes. The gestural training emphasized critical elements of the gesture: hand configuration, coordination of joints and trajectory of movement, and external spatial location. Once elicited, the gesture was paired with the verbal target for practice in naming pictures. We trained picture naming and gesture production for 20 nouns and 20 verbs. In daily probes, we found no improvement in naming either noun or verb pictures. We noted significant improvements in gesture production of trained gestures, from unrecognizable gestures in baseline sessions to imprecise, recognizable gestures following treatment. Effects were greater for gestures paired with verbs as compared to nouns. Generalized improvement was evident on gesture to command. Positive effects of V+G training suggest that D.R.'s severe limb apraxia represented an ideomotor apraxia that could be modified with training to allow functional use of gesture as a communication strategy.

Correspondence: Stacie Raymer, Child Study Center, Old Dominion University, Norfolk, VA 23529.

B. HANNA-PLADDY, K.M. HEILMAN, & A.L. FOUNDAS. Ecological Implications of Apraxia: Evidence From Activities of Daily Living.

When performing pantomimes or imitating, patients with ideomotor apraxia (apraxia) make spatial and temporal errors. To learn if apraxia adversely influences activities of daily living (ADL), the relationship between apraxia and the ability to perform ADLs was investigated in 10 unilateral left hemisphere damaged stroke patients and 10 matched controls. Even when we controlled for stroke-test interval, lesion size, elementary motor impairments, and motor sequencing deficits, there was a significant positive relationship between apraxia severity, based on scores from a verbal gesture-to-command (pantomime) task, and dependency score as defined by increased caregiver assistance from the Physical Self-Maintenance Scale (PSMS). Analysis of the categories comprising the PSMS revealed that the patients with apraxia had increased dependency in grooming, bathing, and toileting, but relative independence for feeding, ambulating, and dressing. These findings emphasize the ecological implications of ideomotor apraxia, and the need for rehabilitation strategies to improve the execution and efficiency of coordinated skilled movements in left-hemisphere-damaged stroke patients.

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T. ZAWACKI, J. GRACE, J. FRIEDMAN, & L. SUDARSKY. Impaired Executive Abilities in 6 Patients With Machado-Joseph Disease. Machado-Joseph disease (MJD) is an autosomal dominant spinocerebellar ataxia. Only two studies have examined the neuropsychological and neuro-

behavioral profiles of patients with MJD. Maruff et al. found slow processing of visual information with high task demands and deficits in shifting of visual attention on a computerized neuropsychological testing system administered to 6 MJD patients of Australian aboriginal descent. Radvany et al. reported visual memory impairment and perseveration, suggesting executive compromise in Brazilian MJD patients. This study builds upon previous research by extending assessment to English speaking individuals and utilizing normed clinical neuropsychological measures for the first time. Six individuals with MJD with significant ataxia symptoms (Stages 3–5) revealed relative impairments on effortful timed verbal attention tasks and verbal fluency (Stroop, Oral Symbol Digit Modalities, and Controlled Oral Word Association Test). These executive impairments also were seen on the Wisconsin Card Sorting Test, independent of motor dysfunction severity. Moderate to severe levels of depressive symptoms on the Beck Depression Inventory-II also were endorsed by 4 of the 6 patients. General cognitive abilities, language, list learning, story recall, and untimed tasks of attention were not significantly different from normative data or from the respective patients' overall cognitive performance. Disruption of executive abilities in MJD patients is consistent with neuropathology studies that describe affected afferent and efferent cerebellar tracts and the striatum with disruption of frontal-subcortical systems.

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L. SHEPARD & S. PIGOTT. Opsoclonus-Myoclonus Syndrome: Neuropsychological Functioning of 2 Children.

Opsoclonus-myoclonus syndrome (OMS) is a rare movement disorder characterized by multidirectional, chaotic eye movements, myoclonus, ataxia, and delays in cognitive and adaptive function. It typically affects preschool-aged children but the associated deficits may be longstanding. OMS may occur in association with neuroblastoma outside of the central nervous system, viral infection, or have no known etiology. It has been suggested that OMS results from an immunologically mediated degeneration of cerebellar Purkinje cells, but other investigators have hypothesized additional involvement of the brainstem and the cerebrum. Little is known about the precise neuropsychological sequelae of OMS in young children. Detailed neuropsychological data on two 5-1/2-year-old boys with OMS are reported. The cases are matched for age of onset but differ in etiology; the etiology in Case 1 is unknown but is presumed to be viral, whereas Case 2 had a neuroblastoma. MRI and CT scans are normal. Case 1 is experiencing significant delays in verbal, visuoperceptual, visuomotor, and adaptive function (WPSI-R Verbal IQ = 53, Performance IQ = 51, Vineland Adaptive Behaviour Composite = 62). Case 2 is less severely impaired (WPSI-R Verbal IQ = 91, Performance IQ = 82, Vineland Adaptive Behaviour Scale = 68). This discrepancy is consistent with a previous investigation suggesting that neurologic outcome is worse in children with an associated neuroblastoma. Both cases showed relatively intact memory performance but were impaired in many other domains. Overall, these findings contribute to the newly emerging literature suggesting that the cerebellum and its connections play an important role in some higher-order cognitive and motor skills.

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J. HUBER, M. DENNIS, J. BRETTSCHEIDER, & B. J. SPIEGLER. Motor Speech Deficits in Children and Adults With Spina Bifida and Hydrocephalus.

Spina bifida and hydrocephalus (SBH) is a neurodevelopmental disorder with prominent and bilateral dysmorphologies of the cerebellum. Acquired bilateral lesions of the cerebellum produce motor speech deficits, including an ataxic dysarthria profile of dysfluent speech, articulatory inaccuracy, prosodic excess, phonatory-prosodic insufficiency, and slowed speech rate. It is not known whether individuals with congenital cerebellar dysmorphologies, such as those with SBH, exhibit these deficits. We studied motor speech in 4 groups, each of 20 individuals: SBH children (*M* age 12.5 years); control children (*M* age 12.2 years); SBH adults (*M* age 24.9

years); and control adults (*M* age 28.4 years). Speech characteristics were coded from videotapes of speech samples from a picture-prompted narrative task. Two speech-language pathologists agreed after rating independently. *Percent dysfluency* (number of dysfluent words per total number of words, including blocks, prolongations, repetitions, and revisions) was higher in individuals with SBH, especially SBH adults. *Articulatory inaccuracy* included imprecise consonants, irregular articulatory breakdowns, distorted vowels, and repeated phonemes. *Prosodic excess* included excess and equal stress, prolonged phonemes and intervals, slow rate, and short phrases. *Phonatory-prosodic insufficiency* included harsh/strained-strangled voice, monopitch, and monoloudness. *Speech rate* was words per min of total speaking time. SBH adults had significantly more articulatory inaccuracy, more prosodic excess, greater phonatory-prosodic insufficiency, and slower speech rate. Young adults with SBH exhibit significantly more ataxic dysarthric characteristics and dysfluent speech than age peers. The results are discussed in terms of how the effects of congenital cerebellar dysmorphologies on motor speech vary with maturation and brain development.

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G. ALLEN & E. COURCHESNE. Functional Magnetic Resonance Imaging of the Cerebellum in Autism.

The cerebellum is one of the most consistent sites of neuroanatomic abnormality in autism. Ninety-five percent of autistic cerebella show Purkinje cell abnormalities, typically a reduction in the number of these cells, the only source of output from cerebellar cortex. A crucial question is how this reduction impacts cerebellar function. In the normal cerebellum, we previously demonstrated a dissociation between regions involved in attention and those involved in a simple motor task, with motor activation localized to anterior cerebellum and attention activation localized to superior posterior cerebellum. The present investigation examined activation in the cerebella of 8 autistic patients and 8 normal controls (ages 14–39 years) performing the same tasks from our original study of cerebellar function. *Motor*: Participants pressed a button at a comfortable pace, and activation was compared to rest. *Attention*: Visual stimuli were presented 1 at a time at fixation, and participants pressed a button to every target. Activation was compared to passive visual stimulation. Autistic individuals showed significantly increased motor activation and significantly decreased attention activation. Cerebellar activation typically reflects task familiarity; activation decreases as learning progresses. The motor task is amenable to learning, but will be learned slower when Purkinje cells are reduced. Thus, motor activation was greater in autism. On the other hand, randomly presented stimuli constrain learning of the attention task. Activation differences therefore reflect differences in viable cerebellar tissue, which is reduced in autism.

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MEMORY

S. RASKIN & C. BUCKHEIT. Prospective Memory Functioning After Brain Injury.

One of the most frequent, and least studied, sequelae of brain injury (BI) is failure of prospective memory. Successful completion of a prospective memory task requires the ability to monitor time, initiate an action, keep the action to be performed periodically in awareness, and remember the task to be performed. Although prospective memory has been shown to be a common difficulty after BI, it is unknown which part of successful performance is impaired or which prospective memory task variables might influence performance in these individuals. In this study, a novel test of prospective memory was used. This standard test, the Assessment of Intentional Memory (AIM) allows for analyses of differences based on time until completion of the task, difficulty of the distractor performed while waiting, whether the task is an action or is verbal, and whether the cue to

perform the task is the passing of a particular amount of time or is an external cue. Individuals with BI performed significantly more poorly than normal controls on most but not all aspects of this test. Notably, both groups showed a superiority for event-based cues, but subjects with BI did not show a superiority for action responses or any difference based on difficulty of distraction. Performance on this test was also compared to a battery of standard neuropsychological measures and to self-report measures of prospective memory functioning. Performance was significantly correlated with tests chosen *a priori* to measure frontal functions but did not correlate with self-report measures.

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C. ALLEN & M. ROBARDS. Frequency of Neuropsychological Impairment in Railroad Workers With Long-Term Exposure to Organic Solvents.

Frequency of neuropsychological impairment was analyzed in a sample of 39 railroad workers referred for neuropsychological testing secondary to long term exposure to organic solvents. The patients ranged in age from 35 to 65, and in years of education from 6 to 15. Solvent exposure varied from 1 to 35 years. Raw scores for tests of attention and concentration, memory, motor dexterity, and divergent reasoning were converted to standard scores using published norms. The sample was then divided into impaired and nonimpaired groups for each measure according to standard score values for each test. Workers with scores falling at or below the 5th percentile rank were classified as impaired, whereas those with scores falling above the 5th percentile rank were deemed nonimpaired. A binomial test was then calculated for each measure to determine whether the resulting frequency of impairment was greater than expected by chance alone (i.e., greater than 5%). The frequency of impaired scores on the neuropsychological tests ranged from 14% to 54%. The results indicate that frequency of impairment significantly exceeded chance on all measures, with the highest frequency of impaired scores on tests of immediate attention (letter and block span), working memory (letter and block span with 20-s delay) and motor dexterity (Grooved Pegboard). It is concluded that this sample of solvent-exposed, workers exhibits neuropsychological impairments at a frequency which is significantly greater than expected by chance. A hypothesized relationship between long-term exposure to organic solvents and cerebral dysfunction is supported by these results.

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J.B. RICH & N.W. PARK. Differential Encoding Effects on Implicit and Explicit Memory in Amnesic Patients.

This study examined the effects of encoding manipulations on implicit and explicit memory in 19 amnesic patients of diverse etiologies (M age = 63.1; M education = 14.7) and 19 healthy individuals (M age = 66.1; M education = 13.0). Study conditions involved reading words, naming pictures, and generating best-fit endings for high-cloze sentence frames (e.g., "Ron swept the floor with a _"). Implicit memory was subsequently assessed by word-stem completion (WSC), in which participants completed three-letter stems with the first word that came to mind (e.g., "bro_"), and picture-fragment identification (PFI), in which they attempted to identify perceptually degraded pictures. Explicit memory was tested by yes/no recognition of studied items and distractors. Priming on the implicit memory tasks was equivalent for the 2 groups and was best explained by transfer-appropriate processing. Specifically, WSC priming was observed only for items that had been read at study, and PFI priming was associated with the picture naming study condition only. Although the patients had significantly poorer recognition memory overall, as expected, both groups showed better memory for items initially presented as pictures relative to the other 2 study conditions. The control group showed better memory for items generated as sentence endings than items read in isolation, whereas the patients showed equally poor recognition of generated and read items. Overall, this study revealed intact lexical and pictorial implicit memory as well

as a preserved picture-superiority effect despite the absence of a generation effect on recognition memory in amnesia.

Correspondence: Jill B. Rich, Department of Psychology, York University, 4700 Keele Street, Toronto, ON M3J 1P3, Canada.

B.A. WILSON, G. CARTER, D. NORRIS, & M. PAGE. Does Errorless Learning Work Through Implicit or Explicit Memory?

Errorless learning is a teaching technique whereby trial-and-error learning is avoided as far as possible. Both errorless discrimination learning from behavioral psychology and implicit learning from cognitive neuropsychology have provided the theoretical impetus for studies employing errorless learning with people who have severe memory deficits. The first study in this area suggested that errorless learning worked with this group by capitalizing on "intact" implicit learning. A later study argued that errorless learning worked by strengthening residual explicit memory. We tested both hypotheses by administering 4 stem completion tasks to 24 people with stable memory impairments. Conditions included (1) errorless implicit learning, (2) errorless explicit learning, (3) errorful implicit learning, (4) errorful explicit learning. The order of conditions was counterbalanced. Half the participants had severe memory impairment (zero on delayed recall of prose passages), the remainder had moderate memory impairment (delayed recall less than 50% of immediate recall). We predicted that (1) if errorless learning was responsible both memory groups would benefit from the implicit-errorless condition as both could use implicit memory, (2) if explicit memory was responsible then the moderately impaired group (with some explicit memory) would show greater benefit from the explicit-errorless learning condition than the severely impaired group, and (3) if both explanations were correct then the severely impaired group would benefit from errorless learning only under the errorless-implicit condition whereas the moderately impaired group would benefit from both errorless learning conditions. Results suggested that errorless learning can work by capitalizing on both implicit and explicit memory.

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S. DEVINE, M. WELSH, P. RETZLAFF, M. YOH, & C. ADAMS. Explicit and Implicit Cognitive Processes Underlying Tower of Hanoi Performance.

The degree to which implicit and explicit cognitive processes mediate performance on the Tower of Hanoi (TOH-R) was investigated. A sample of 73 male and female college students were randomly assigned to two groups representing two versions of the TOH-R: a 22-item, single-trial version and a 4-item, multiple-trial version. Both groups also were administered two explicit cognitive tasks (Matrix Reasoning and Gama), and 2 implicit cognitive tasks (Mirror Tracing and Boxes & Balls). Performance on the traditional, single-trial version was predicted by scores from the Gama ($r = .45$) and Mirror Tracing ($r = .51$). There were no significant predictors of the multiple-trial version of the TOH-R. The two explicit tasks, Matrix Reasoning and the Gama, significantly intercorrelated ($r = .37$); however, the two implicit tasks, Mirror Tracing and Boxes & Balls, were not significantly associated. These results suggest that both explicit reasoning and implicit or procedural learning processes contribute to performance on the TOH-R. The findings also demonstrate that the administration of the TOH, which varies widely across studies, has important implications for the cognitive processes tapped by this task.

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W.D.S. KILLGORE & D.A. YURGELUN-TODD. Amygdala but Not Hippocampal Size Predicts Verbal Memory Performance in Bipolar Disorder.

Bipolar patients often show deficits in memory performance, especially for verbally encoded material. Because verbal memory is highly dependent on the integrity of left medial temporal lobe structures, deficits suggest a possible involvement of these structures in the pathogenesis of bipolar disorder. Most studies that have evaluated cognitive deficits or volumetric

changes in bipolar illness have not controlled for the duration of illness or number of prior affective episodes. In the present study, we controlled for these confounds by evaluating bipolar patients at the time of their 1st clinically documented affective episode. We explored whether left hippocampal or amygdalar volumetric differences are associated with level of verbal memory performance. Eleven patients diagnosed with their 1st episode of bipolar disorder and 20 healthy controls underwent structural magnetic resonance imaging (MRI) and neuropsychological assessment with the California Verbal Learning Test (CVLT) and Prose Memory passages on the Wechsler Memory Scale (WMS). Morphometric volume analysis was conducted on the left amygdala and hippocampus for each. Volumes were correlated with recall measures within each diagnostic group. The results showed a clear dissociation between the pattern of correlations for the 2 groups. Hippocampal but not amygdala volume was associated with immediate verbal memory in health participants but not patients, whereas amygdala but not hippocampal volume was associated with delayed memory in patients but not controls. Bipolar illness is associated with reduced amygdala volume and verbal memory deficits, suggesting that a left medial temporal dysfunction may be involved in the early pathogenesis of the disorder.

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N. DONOFRIO & J. DELUCA. The Generation Effect in Multiple Sclerosis: A Means for Improving New Learning?

The generation effect, the observation that items generated by subjects are better remembered than items simply read, has been shown to be robust within a healthy population. However, the utility of the generation effect with neurologically impaired individuals has not yet been adequately examined, despite the fact that neurologically impaired individuals often require the assistance of memory aids. This study examined the generation effect in 17 participants with multiple sclerosis (MS) and 11 healthy controls (HC), matched for age and education. Participants completed measures of attention/concentration, language skills, executive control, verbal memory, and emotional symptoms, as well as a protocol specifically designed to evaluate the generation effect. No significant differences were noted between MS and HC groups in age, education, or estimated premorbid VIQ. In both MS and HC participants, recall and recognition performance was better for words that were generated than words that were read, after varying delay periods (immediately, 30 min, and 1 week). There was no difference in generation-effect performance noted between the groups. These findings indicate that in both healthy and MS participants, generating to-be-remembered information, rather than simply reading such information, significantly improves one's ability to recall and recognize that information up to 1 week following initial presentation. This finding has significant implications for rehabilitation strategies in persons with MS. For example, teaching an MS patient to generate information that he or she may need later increases the probability that the patient will be able to remember that information when needed.

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M. HAUT, S. LEACH, M. MORAN, & H. KUWABARA. Neural Activation Associated With Increased Working Memory Load.

The neural correlates of working memory have been widely examined using functional imaging activation technology. The typical areas of activation associated with working memory performance include the dorsolateral prefrontal cortex, the anterior cingulate gyrus, the posterior premotor cortex, and the posterior parietal cortex. Increasing working memory load has been associated with increased activation of the prefrontal cortex. This study examined the effects of increased working memory load on neural activation using [¹⁵O] water positron emission tomography. As opposed to previous studies, we exceed working memory capacity. Seven young, healthy individuals (4 males) served as participants (M age = 24.3, SD = 2.8, M education = 16.1, SD = 1.3). Participants listened to the examiner say

aloud the numbers 1–6 and 1–10. The numbers were presented in a random order with 1 number omitted (e.g., 5–4–1–2–6). Participants then reported the missing number. We subtracted activation on the 6-number task from the 10-number task to examine the effects of exceeding working memory capacity. The results demonstrated activation in the hippocampal gyrus, the orbital frontal lobe, and the posterior parietal cortex, all in the left hemisphere. This suggests that when working memory load exceeds capacity, the hippocampus is activated for temporary storage of the information using the episodic memory system beyond the use of the limited storage system of working memory (i.e., posterior parietal cortex). This study demonstrates an interaction between the working memory system and the episodic memory system when working memory capacity is exceeded.

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J. LENGENFELDER, L.A. KEMENOFF, & J.H. KRAMER. Verbal Learning and Memory in Alzheimer's Disease, Mild Cognitive Impairment, and Controls.

Previous studies examining memory in Alzheimer's disease have documented significant forgetting of newly learned information. In an effort to identify patterns of memory difficulties as early markers for Alzheimer's disease, verbal learning and memory were explored in 10 individuals with early Alzheimer's disease (AD; M MMSE = 26.9, range 24–30), 14 individuals with mild cognitive impairment (MCI; M MMSE = 28.54, range 25–30), and 11 healthy controls. The California Verbal Learning Test-II (CVLT-II) was administered according to standardized procedures. Although the normal controls had higher recall levels, no significant group differences were found for the learning slope over the 5 learning trials. The difference in retention over a delay was assessed using a repeated measures ANOVA with Trial 5 versus Long Delay Recall as the within-subject factor. The Group \times Trial interaction was significant ($p < .01$). *Post-hoc* analyses indicated no significant difference in patterns of retention for the AD and MCI groups over the delay period. In contrast, both the AD and the MCI groups differed from the controls in their patterns of retention (AD vs. control, $p = .001$; MCI vs. control, $p = .010$). Results indicate that the MCI and AD groups demonstrated greater losses of information over the delay than the control group. These results suggest that rate of forgetting patterns in MCI more closely resembles that of early AD than it does normal aging, and may be an early marker for incipient dementia.

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D. KNIGHT, C. SMITH, D. CHENG, E. STEIN, & F. HELMSTETTER. Functional MRI of Neural Substrates of Awareness During Human Fear Conditioning.

The present study used fMRI to examine the relationship of awareness and human brain activity during a difficult Pavlovian discrimination and reversal conditioning paradigm in healthy volunteers. Participants were exposed to a series of 12-s visual CSs and brief (0.5-s) electrical stimulation (UCS) over 6 trial blocks. One CS was always followed by the UCS (CS+), one was never followed by the UCS (CS-), while other stimuli were assigned intermediate probabilities of predicting shock. GSR and the participants' subjective estimate of the probability of UCS delivery (shock expectancy) were recorded throughout. During the reversal phase (Blocks 4–6) the stimulus used as CS+ was now never followed by shock, and the original CS- was always followed by shock. Whole brain imaging was performed (1.5T, TR = 3, TE = 40 ms, FOV = 24 cm, Flip Angle = 90°) throughout the 6 blocks (3 *discrimination* and 3 *reversal*) of stimulus presentations. Activated regions were identified based on cross-correlation with phase-shifted canonicals representing the temporal pattern of visual stimulation. Participants were separated, based on their shock expectancy, into 2 groups that were either aware or unaware of the CS–UCS relationship. Large learning-related changes in activity developed within a number of regions including the anterior cingulate, medial thalamus, and caudate nucleus that were unrelated to the participants' awareness of stimulus re-

relationships. However, CS-related and trial-dependent changes in hippocampal activation were only observed in subjects that demonstrated awareness of CS-UCS contingencies. These results suggest awareness is dependent upon hippocampal function.

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A. SHAPIRO, M. ALT, & R. BENEDICT. Development and Validation of a New Test of Remote Memory.

Tests of remote memory lack sensitivity to temporally limited impairments (e.g., Boston Remote Memory Battery) and/or assume knowledge of specific topics (e.g., Famous Tunes). This paper describes the development and initial validation of the North American Remote Memory Test (NARMT), a public events test that employs an annual time interval. The NARMT consists of 28 cards, each containing a list of 3 events that occurred within a given year and the name of the top grossing movie for that year. Participants are instructed to provide the year during which the events and movie occurred. The NARMT was administered to 40 healthy participants ages 45 and above, along with a battery of other neuropsychological tests. Mean error scores were calculated for each year, 3-year period, and hemidecade. As expected, all participants demonstrated superior recall for recent events relative to remote events ($p < .001$), with error scores ranging from 5.0 for the early 1970s to nearly 0.0 for the late 1990s. The effects of age and gender on NARMT performance were also examined. Analyses of variance revealed no effect of gender but an interaction between age and hemidecade score ($p < .05$), with the oldest participants performing significantly worse than younger participants on the most remote years. NARMT scores were found to correlate most strongly with the autobiographical memory ($r = .64$) and semantic memory ($r = .53$) indices of the Autobiographical Memory Interview. NARMT scores were modestly correlated with HVLt-R, WCST, and VIQ. Case examples of patients with neuropsychiatric disease will be presented.

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A. POREH, G. WINOCUR, Z. RAM, M. BACKON, E. GOSHEN, P. GOLDHAMER, M. MOSCOVITCH, & M. HADANI. Retrograde Temporal Order Amnesia Resulting From Circumscribed Damage to the Left Anterior Forniceal Column.

A patient who developed a severe memory disorder following an apparently uncomplicated transcortical removal of a colloid cyst is described. Damage to the left anterior column of the fornix and the left anterior commissure is demonstrated on T2 MRI no gap scans, while other memory related structures appear entirely normal. A SPECT scan using an Elcint XZ122 was interpreted as showing a significant bilateral hypoperfusion of the mesial temporal regions. Repeated neuropsychological evaluations revealed that 6 months postoperatively both the verbal and visual spatial anterograde memory remained persistently impaired. Retrograde amnesia, as measured via a battery of formal tests, was also documented. The quality of this amnesia was characterized by memory deficits for material requiring temporal order. Memory for public events and personal semantic information remained intact. The present case is consistent with Yasuno et al. regarding the effects of anterior forniceal columns' disconnection amnesia. Specifically, that in certain cases such damage can cause retrograde amnesia for temporally ordered information, effecting both the encoding of new memories and the retrieval of old, and biographical memories. Correspondence: *Amir Poreh, Ph.D., Department of Neurosurgery, Chaim Sheba Medical, Tel Hashomers, Israel.*

M. FALK, L. COLE, & G. GLOSSER. Pseudoword and Real-Word Memory With Unilateral Temporal Lobe Dysfunction.

It is accepted that right and left medial temporal lobe (MTL) damage disrupts different aspects of declarative long-term memory, but the nature of these differences is still debated. According to the "material-specific" account, memory for linguistic information is mediated by the left MTL (LMTL), while nonverbal memory is mediated by the right MTL (RMTL). An alternative account suggests that the right hemisphere is specialized

for processing novel stimuli (both verbal and nonverbal), while the left processes information for which there are pre-existing, well-routinized codes. According to the first view, LMTL lesions should disrupt memory for both familiar (real words) and unfamiliar (pronounceable pseudowords-PWS) verbal stimuli, and damage to the RMTL should impair memory for nonverbal visuospatial stimuli (unfamiliar faces). The alternative view predicts that memory for familiar verbal stimuli should be most impaired by LMTL lesions, while memory for both linguistic and nonlinguistic unfamiliar stimuli should be disrupted by RMTL lesions. Recognition memory tests, using familiar words, PWS, and degraded photographs of unfamiliar faces were administered to 35 patients with unilateral temporal lobe epilepsy (TLE). Consistent with the material-specific hypothesis, left TLE patients were significantly worse than right TLE patients at recognizing previously shown PWS; there was a trend for worse face memory in right TLE patients; and right TLE patients showed a slight nonsignificant memory advantage for familiar words. Findings suggest that both familiar and unfamiliar linguistic stimuli are processed for memory preferentially in the LMTL, whereas unfamiliar nonverbal stimuli are processed in the RMTL.

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G. POTTER & M. HARTMAN. Neuropsychological Versus Affective Predictors of Memory Complaints.

Research on the relationship between memory complaints and memory performance among older adults has been inconsistent in finding a significant relationship between the 2. One explanation for this is that measures of memory performance used in these studies lack sensitivity and/or validity, while another is that memory complaints actually reflect underlying depression or anxiety. This exploratory study assessed 99 healthy community-dwelling older adult women on a battery of neuropsychological tests and self-report questionnaires. Measures of attention (Stroop, Trail Making A) and delayed memory (WMS-III: Logical Memory II, Word Lists II) were selected *post hoc* for their sensitivity and specificity to be included as independent variables along with measures of depression (Geriatric Depression Scale) and anxiety (Beck Anxiety Inventory) to predict memory complaints (Memory Functioning Questionnaire: General Frequency of Forgetting scale). Zero-order correlations indicated significant relationships between memory complaints and measures of attention, memory, depression, and anxiety. A series of regression analyses revealed that while attention, depression, and anxiety made independent contributions to memory complaints, memory itself did not. There was a direct effect of attention on memory, however, suggesting that attention accounts for some of the correlation between memory complaints and memory performance. Furthermore, depression also had a direct effect on attention, indicating that depression can impair attentional performance and thus has both direct and indirect contributions to memory complaints. Taken together, these results suggest that attention may be a more sensitive predictor of memory complaints than memory, but that depression and anxiety should be considered as well.

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J. MURPHY, M. SEMRUD-CLIKEMAN, A. GREGORY, J. LANCASTER, & N. RUTLEDGE. A Double Dissociation of Emotion Memory Systems: The Amygdala and Hippocampus.

A dissociation of emotional and neutral memory systems has been identified in human lesion studies, PET paradigms, and experimental animal models. The amygdala has been uniquely associated with memory for emotionally salient events while the hippocampus appears to process memory for neutral facts. The present study evaluates the relationship between the amygdala and hippocampus and memory among a male antisocial adolescent sample and matched controls ($N = 33$). Hare's adolescent Psychopathy Checklist quantified antisocial behavior and personality traits (e.g., empathy, remorse). Emotional and neutral memory was measured with Cahill's affective story, which yielded indices of free recall and recognition

of emotional and neutral memory. MRI volumes were calculated with contiguous coronal 1.0-mm slices for each structure. A double dissociation was found, with right amygdala being correlated with free recall of emotional memory ($r = -.29, p < .048$) but unrelated to recognition of emotional memory or with neutral memory. Right hippocampal volume, in contrast, was correlated with recognition of emotional memory ($r = .32, p < .03$) yet unrelated to free recall of emotional memory or with neutral memory storage. These findings are consistent with evidence that the right amygdaloid complex is involved with emotional memory, yet in this sample increased amygdalar volume is associated with the emotional memory deficits. The amygdala may be thought of as a more immediate-access memory system that is required to quickly call up emotionally salient facts. Once the information is less salient or less emotionally charged, the information may be stored in the hippocampus.

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A. FROL, D. COOPER, T. SHILLINGLAW, W. RINGE, & M.C. CULLUM. Cognitive Functions in Patients With Good Outcomes After Aneurysm Surgery.

The presence and severity of cognitive deficits after aneurysm surgery are variously described in the literature. Multiple factors likely contribute to these inconsistencies including type of surgery and complications, range of outcomes, and sensitivity of cognitive measures. This study compared a cognitive screening test (Cognistat) with a more extensive neuropsychological battery for a group of 17 patients with good outcomes on the Glasgow Outcome Scale. Performances were generally rated average for this group on the screening measure. In contrast, the cognitive battery revealed mild learning/memory deficits and slight reduction in measures of executive functions while selected measures of language, visuoconstructional, and attention were grossly intact. Compared to available norms, a list learning test showed mild impairments in learning, [$t(1, 16) = -5.19, p < .001$], and delayed recall [$t(1, 16) = -2.08, p = .054$] with intact delayed recognition [$t(1, 16) = -0.76, p = .46$]. Inspection of individual performances showed 2/17 of the patients (12%) fell in the mildly impaired range on only 1 out of 10 subtests of the screening test. However, 15/17 of the patients (88%) showed mild impairments or greater on at least 1 out of 10 cognitive measures in the larger battery. 3/17 of the patients (18%) consistently fell in the lower quartile of scores for the majority of these measures. Mild learning/memory deficits in good outcome patients were present one to three years after aneurysm surgery. These findings suggest that screening measures should be used cautiously in characterizing the cognitive profile in this population.

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J.S. KIXMILLER & R. FITZSIMMONS. Successful Memory Book Use Following Sohlberg & Mateer's Training Approach . . . in Reverse.

Two inpatients with severe memory deficits associated with Korsakoff's amnesia were taught to use memory books to facilitate their everyday memory functioning. Training followed an adapted version of Sohlberg and Mateer's memory book approach and lasted approximately 2 months and consisted of repeated, daily prompts to carry and increasingly use the notebooks. Teaching the memory books consisted of 3 phases that were in the reverse order of the authors' proposed approach. Patients were first taught to consistently carry their memory books during the daytime; they were then taught to increasingly record appointments/activities/events throughout the day; and finally, patients were encouraged to learn the purpose/verbal rationale for their notebooks. Thus, training initially stressed the procedural aspects of notebook use and de-emphasized the verbal encoding of memory books. Over time, repeatedly reinforced verbal repetition and eventual mastery of the reasons for using the memory books was internalized. After 8 weeks, patients showed dramatic improvement in memory book use. Patient 1 was recording about 85% of to-be-remembered information and was recalling 70% of scheduled meetings. Patient 2, was recording 65% to-be-recalled material, and was attending 50% of sched-

uled activities. One month follow up of both patients in outpatient residences indicated good transfer of memory book use. Results support that amnesics, given intensive training, can learn specific skills that can be adopted in new environments. Reversing the order of Sohlberg & Mateer's memory book training maximized the procedural aspects of learning to use memory books and additional encoding time to internalize the verbal justification of the benefits of notebook use.

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R. BAUER, L. FRAKEY, & K. THOMAS. Examining Temporal Lobe Contributions to Spatial Memory Using the Virtual Arena.

Cognitive mapping refers to the psychological representation of space. Past research in animals and humans has implicated the hippocampus as being a likely source for the construction and storage of cognitive maps. The Morris water maze is an effective technique for studying spatial and place learning in rodents. This maze, however, is not a practical apparatus for work with human subjects. Our study employs a computer analogue of the Morris water maze called the Virtual Arena. This program presents a first-person view of a simulated environment that mimics the conditions of the water maze. Participants use a joystick to navigate to a hidden target using distal cues. Participants are patients who underwent right (3) or left (7) anterior temporal lobectomy for relief of intractable epilepsy. We predict that patients with language-nondominant resections would show poorer performance on the Virtual Arena, as measured by increased search times and longer paths to the target, less time in the vicinity of the target, and fewer target encounters. Participants engage in 2 learning trials with visible targets, 6 trials with hidden targets, and one "probe" trial in which the target is removed entirely and search behavior is evaluated. Preliminary statistical analysis has shown significant group differences in path length and time in the SW quadrant, both suggesting impairments in patients with language-nondominant resections. Data relating individual patient performance to hippocampal pathology and volumetric data are currently being analyzed in this ongoing study.

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J. WEFEL & C. MEYERS. Qualitative Performance on the Benton Visual Retention Test in Patients With Primary Brain Tumors.

Investigations of the relationship between lesion location and performance on the BVRT are abundant in the extant literature; however, findings are equivocal and subject groups have generally consisted of mixed pathology including neoplasms, vascular lesions, traumatic brain injuries, and degenerative diseases. The literature examining neuropsychological performance in brain tumor patients has demonstrated both focal and variable cognitive sequelae, findings that appear at odds with each other. The current study examined the relationship between the qualitative error categories of the BVRT and lesion location in 184 focal primary brain tumor patients. Multiple linear regression analyses using a rigorous, *a priori* determined covariate model failed to find significant differences as a function of tumor location on nearly every qualitative error category. However, the expected hemispheric asymmetries in performance were observed when another test of visuospatial function (WAIS-R Block Design) was examined. Clearly tests used to assess for cognitive deficits are not equally sensitive to the presence of "focal" deficits. Thus the ostensible equivocal findings between studies describing "focal" cognitive deficits and those reporting more variable cognitive deficits may be related to the neuropsychological test(s) selected for each study. In fact, in this study, the BVRT did not reliably discriminate between patients with brain tumors and a group of normal controls. These findings taken together suggest the BVRT has limited value as a tool for measuring focal (e.g., right parietal vs. right frontal) or regional (e.g., right hemisphere vs. left hemisphere, frontal vs. nonfrontal) brain functioning in most patients with primary brain tumors. Correspondence: *Jeffrey S. Wefel, Department of Psychology, University of Houston, 4800 Calhoun Road, Houston, TX 77204-5341.*

A. CHAN & S.L. MOK. Category-Specific Impairment in Patients With Bilateral Temporal Lesion.

Studies of brain-damaged patients suggested a correlation between lesion site and impairment of category-specific knowledge such as animate and inanimate concepts. Some findings demonstrated that deficit of animate concepts is associated with bilateral temporal lobe lesions, but some other studies did not report such results. The inconsistent findings may be caused by that most of the studies are single-case reports, and most of them measured semantic knowledge with only 1 or 2 tasks. Thus, to further examine this issue, the present study tested 54 patients with temporal lobe lesion due to radiotherapy. Their category-specific knowledge was measured by 3 language tasks (naming, identification, sentence verification) and 3 memory tasks (free recall, cued recall, recognition). Multivariate ANOVA analyses showed that patients with bilateral lesions ($n = 34$), when compared with patients with right ($n = 9$) and left ($n = 14$) lesions and normal control subjects, were significantly impaired in animate concepts but not inanimate concepts in some tasks including naming, identification, and cued recall. Although patients with bilateral lesions, as a group, demonstrated impairment on various tests, only 12% of them ($n = 4$) demonstrated category-specific impairment across all language tasks. The magnetic resonance imaging brain scans of these 4 patients, analyzed by the NIH IMAGE program, revealed specific neuropathological involvement including lesions on bilateral superior temporal lobe, hippocampus, and amygdala. These results suggested that bilateral temporal lobe lesions would lead to category-specific impairment in some, but not all, patients.

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D. CORREA, M. RUGE, N. SCHIFF, B. BEATTIE, J. HIRSCH, L. DEANGELIS, & N. RELKIN. Memory and Executive Functions in Patients With Retrosplenial and Anterior Thalamic Lesions.

Lesions of the posterior cingulate and retrosplenial cortex have been associated with the development of anterograde amnesia. A disruption in the extensive connections that this region has with the anterior thalamic nuclei, the hippocampi, and other structures comprising Papez' circuit has been suggested to underlie the memory impairment. In order to further characterize this clinical syndrome, we studied cognitive functioning and brain metabolism in 2 patients with neoplasms involving the splenium of the corpus callosum and retrosplenial region, and one patient with bilateral lesions in the anterior thalamus. The patients displayed a combination of deficits in episodic memory, temporal memory, and markedly increased susceptibility to interference on tests of working memory. Positron emission tomography (PET) studies showed a decrease in glucose metabolism in the anterior and lateral thalamic nuclei in the patients with retrosplenial neoplasms. A mild reduction in metabolism in the retrosplenial region was found in the patient with anterior thalamic lesions. Functional MRI (fMRI) studies showed bilateral activation in the hippocampus, suggesting at least partially retained functional capacity despite the presence of memory impairment. This study provides evidence that a bilateral lesion in the posterior cingulate/retrosplenium that produces memory and executive dysfunction, is associated with a reduction in metabolism in the anterior thalamic nuclei. The findings suggest that the reciprocal connectivity between the retrosplenial region and the anterior thalamic nuclei, and their functional interactions with the ventromedial temporal lobe and dorsolateral prefrontal cortex are essential for episodic, temporal, and working memory functions.

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A. ZHELTUKHIN, J. WOODARD, K. SHANNON, & C. HERTZOG. New Approach to the Analysis of Performance on Digit Symbol Substitution Test.

The number of units successfully completed has been the primary index of performance on Digit Symbol Substitution (DSS) test. Using a computerized version of DSS, which closely emulates the conventional pen-and-paper format, we tracked performance changes during the course of the test and determined the degree of difficulty of each test unit. For each unit,

we computed motor speed (length of the strokes divided by the time spent on drawing a figure in the unit), processing speed (length of the strokes divided by the sum of the time spent on drawing a figure in the unit and the time of the preceding pause), and averages of the speed measures for the unique unit types. Our sample included 38 young healthy adults (M age = 19.8, $SD = 1.57$; M years of education = 14.2, $SD = 1.04$; 58% females; 11% left-handed). Eighty-nine percent of participants drew faster (increased motor speed) during the last 30 seconds of the task, but the increase in motor speed was significant in only 5%. Participants appeared to make shorter strokes to minimize the processing time. Most of the participants (84%) showed no increase in processing speed, which suggests that instead of relying on memorizing symbol-number pairings, they continued to look at the key. Processing speed varied between the unit types: 87% of participants were able to keep in memory (and thus process faster) figures with unique shapes (e.g., those corresponding to 6, 7, and 8). Figures with common features (e.g., 3, 4, and 5) took on average longer to process.

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VISUOSPATIAL FUNCTIONS, MENTAL ROTATIONS, AND NEGLECT

K. YOSHIZAKI, Y. HATANAKA, & H. TANAKA. The Effects of Mental Rotation on the Benefits of Bihemispheric Processing—II.

The purpose of this study was to examine the effects of mental rotation on the benefits of bihemispheric processing. Recently, one of our studies examined the effects of "functional steps" on the bihemispheric processing, using the Posner type matching tasks. Results supported the Banich's hypothesis, in which the benefits of interhemispheric interaction increased as the task was more complex. In the present study, we manipulated the rotation angle of the stimulus to change the task complexity. A pair of normal or mirror image kana letters was tachistoscopically presented in the left, right or bilateral visual fields. Both letters of each pair were rotated with 20°, 60°, or 100°. The sum of the rotation angle in each pair was 120°. That is, we set up three conditions in terms of the combination of the rotation angles: 20° and 120°, 40° and 80°, and 60° and 60°. Twenty right-handed participants were asked to make a decision if both letters were the same direction (both were normal or mirror-image) or not (one was normal, another was mirror image). The main results from the reaction times from the correct responses showed that (1) the bilateral visual field advantage (BFA) was obtained across the 3 rotation conditions, and (2) BFA in the 60–60° condition was higher than 2 other conditions. These results suggested that the benefits of bihemispheric processing could depend on the combination of rotation angles in each pair.

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J.S. MCGEE, C.D. VAN DER ZAAG, A.A. TURK, A.A. RIZZO, & J.G. BUCKWALTER. Age, Gender, and Spatial Ability in Normal Aging: An Examination of Mental Rotation.

Empirical studies have identified gender and age differences in spatial ability. With increased age, ability to perform spatial tasks typically decreases, although the nature of gender differences is less well-studied in older individuals. An interesting gender-influenced spatial ability involves mental rotation (MR), which has consistently produced a robust gender effect in favor of men. With age, men continue to perform significantly better than females despite similar global cognitive functioning. As MR ability is important in effectively carrying out many activities of daily living (e.g., driving, organizing items in space), we sought to determine if performance can be improved for both older men and women through virtual environment training (VE). Spatial ability was assessed in thirty research participants (15 men and 15 women) between the ages of 64 and 86 ($M = 73.6$). Significant differences in performance were found in favor of men on visuospatial ability (Judgment of Line Orientation; $p < .0005$), visuoconstructional ability (Block Design, $p = .006$), and spatial reasoning (Matrix Reasoning, $p = .051$). Also, there were significant differences

in favor of men on MR ability before training in a VE (Mental Rotation Task A; $p = .002$) and after training (Mental Rotation Task B; $p = .010$). Interestingly, rate of MR learning was similar for men and women. There was a nonsignificant trend ($p < .08$) for all participants to improve. These findings confirm a spatial processing advantage in elderly men, but further suggest that women are similarly capable of learning MR through VE training.

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J.S. MCGEE, A.A. TURK, C.D. VAN DER ZAAG, J.G. BUCKWALTER, & A.A. RIZZO. Cognitive Mediators for Learning Mental Rotation via Virtual Environment Training.

Traditional neuropsychological assessment and cognitive rehabilitation tools can be augmented via virtual environment technology. This could serve to enhance ecological validity, or the degree to which a test or training exercise is similar to “real world” task demands. Mental rotation (MR), a visuospatial ability described as a dynamic imagery process which involves “turning something over in one’s mind,” is important in a variety of instrumental activities of daily living requiring visualization and movement towards objects in 3-D space (e.g., driving, organizing items in space, sports). The current study examined cognitive mediators important for generalization of learning from a 3-D virtual environment MR task to a 2-D paper and pencil MR task in normal elderly participants (15 men; 15 women) between the ages of 64 and 86 ($M = 73.6$). Participants were first administered a comprehensive neuropsychological battery, including a version of the Mental Rotation Test (MRT), a paper and pencil measure of MR. They then received virtual environment MR training designed after the MRT. Finally, they received a second version of the MRT. As expected, various measures of spatial ability, as well as processing speed and working memory, were significantly correlated with baseline MR ability and with performance on the MRT after virtual environment training. Interestingly, after baseline MR ability was controlled, increased performance was significantly related to verbal ability (overall level of learning, encoding, retrieval, semantic fluency), suggesting that verbal ability may be a critical cognitive mediator for the generalization of learning of complex visuospatial skills, such as MR.

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A.M. BARRETT, M.H. KIM, G.P. CRUCIAN, & K.M. HEILMAN. Spatial Bias in Koreans Who Learned Right–Left Reading.

Background: Westerners may err leftward on coordinate computations such as line bisection, and may depict the action of a sentence by drawing the subject leftward of the object. However, a leftward orienting bias may be a learned reading habit. **Objective:** To study the visual–spatial or spatial–syntactic biases of persons who learned to read right-to-left. **Method:** We tested 30 people (M age 65.60) who learned vertical, right-to-left reading. Spatial–syntactic bias was assessed by having participants draw four sentences read by the examiner (e.g., “A woman chases her dog, who has broken his leash”). Visual–spatial bias was assessed by having participants bisect 10 lines, and draw a tree/house/person. They were not told to center their drawings; we examined how close the drawing center was to the center of the page. **Results:** Participants did not demonstrate consistent spatial–syntactic bias (14/30 drew sentence subjects left of sentence objects; 15/30 drew subjects right of objects) and only tended to err leftward on line bisection ($M = -1.70$ mm, $p = .097$). When drawing tree/house/person, however, subjects clearly centered their drawings leftward ($M = -17.44$ mm, $p < .001$). **Conclusions:** Both implicit and explicit performance conditions may be required to demonstrate spatial bias on coordinate visuospatial tasks. Our results also suggest that learned reading direction may have more influence on spatial–syntactic than on visual–spatial bias. Correspondence: *A.M. Barrett, M.D., 500 University Avenue, Neurology/H037, P.O.B. 850, Hershey, PA 17033.*

E.H.F. DE HAAN & M.J.E. VAN ZANDVOORT. Developmental Color Agnosia.

This case report concerns a right-handed man who, at the age 37 years, was referred to our department because he had suffered a cerebellar infarct in February 1998. Neuropsychological assessment in the acute phase showed, apart from residual dizziness, some mild deficits in memory functioning. At follow-up, in January 2000, no cognitive sequelae could be detected, and he did not have residual complaints. He is an intelligent, verbal man who performs in the top range on standard neuropsychological tasks. Surprisingly, he was unable to carry out the Token language perception test. It soon transpired that he was unable to name colors, while he was very proficient in color perception. He performed flawlessly on the Ishihara color plates and in the high normal range on color matching and other visual–sensory tasks. Further investigations showed that he also has good color semantic knowledge (e.g.: What color is a fire engine?), and it is not a color-naming deficit because he was not able to match color patches to color names. The patient claimed that he has always had this problem, and there is no reason to doubt this, as it is obvious that his cerebellar infarct cannot explain this deficit. Since there are no other neurological incidents in his medical past, we suggest that this is a case of developmental color agnosia. In daily life, he uses strategies to infer the color of objects. He compares the surface properties of an object with that of an object with a known color (e.g., his shirt), and he is very proficient in gauging brightness. He categorizes colors according to brightness (e.g., bright surfaces are yellow or pink and dark surfaces are red and brown) to guess the color.

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M.E. McCOURT. Cuing Effects on Spatial Attention in Visual Line Bisection.

Purpose: Numerous factors influence the leftward bias (pseudoneglect) of perceived line midpoint (p.s.e.) in normal persons in line bisection tasks. Cues are a potent factor; left and right cues promote shifts in p.s.e. to the left and right, respectively. For trapezoidal lines, p.s.e. is displaced toward the larger side. These experiments tested the hypothesis that the effect of line geometry is due to cuing effects, and measured basic properties of cuing. **Methods:** Normal right-handed participants ($N = 123$) participated in 4 experiments employing a tachistoscopic forced-choice line bisection task. Experiment 1 crossed the effect of line geometry with high contrast cues delivered to the left or right line ends. Experiments 2 and 3 measured the contrast response of the cuing effect by varying cue contrast. Experiment 4 measured the time course of the cuing effect by varying cue-line onset asynchrony. **Results:** Line geometry and cue location both significantly influence p.s.e., and produce a significant interaction. The contrast-response of the cuing effect possesses a semisaturation constant of 3.1%. Cues most influence p.s.e. at SOAs of 100 ms; their influence disappears after 2000 ms. **Conclusions:** The effect of spatial cuing interacts with line geometry, suggesting a common site of processing, supporting the conclusion that the effect of line geometry derives from asymmetric cuing. The cue contrast response function implicates a magnocellular origin for cuing effects. The time course of cuing is similar to that for the attention-induced line-motion effects, suggesting a potential connection between these effects. Correspondence: *Mark McCourt, Department of Psychology, North Dakota State University, Fargo, ND 58105-5075.*

M.E. McCOURT, C. TAHMAHKERA-STEVENSON, J. NODES, & J. HAMMES. Performance Consistency in Forced-Choice Tachistoscopic Visual Line Bisection.

Purpose: Some controversy exists concerning the reliability of leftward error (pseudoneglect) in line bisection performance. Some investigators report a relatively large incidence of normal participants who demonstrate rightward bisection errors, as opposed to the pattern of leftward error revealed by a meta-analysis of the pseudoneglect literature. An experiment was performed to assess consistency of bisection performance in a group of normal individuals. **Methods:** Normal right-handed participants ($N = 22$) participated in a tachistoscopic forced-choice line bisection task. Each

engaged in 7–16 experimental sessions separated by at least 24 hr (total bisection measurements = 317). Individual means could thus be evaluated with respect to variability measures. An eye-tracker recorded gaze position during the task in 20 participants. *Results:* A significant mean group bisection error of -0.26° was obtained (left negative); individual means ranged from -0.55° to $+0.03^\circ$. Of 317 bisection measurements, 9% (28) deviated rightward. Significant mean leftward errors occurred in 91% (20/22) of participants. Mean bisection error in 2 participants was not significantly different from zero. No participant possessed a significant rightward error. Mean gaze deviation from screen center ranged from $\pm 0.9^\circ$, and was positively correlated ($p < .05$) with bisection error. *Conclusions:* Forced-choice tachistoscopic line bisections are highly reliable; a mean correlation of $+0.87$ exists between mean error ($N = 15$ trials) and means estimated from a random sample of only 2 trials. The incidence of rightward bisection error in normal participants is estimated to be less than 5%. Correspondence: Mark McCourt, Department of Psychology, North Dakota State University, Fargo, ND 58105-5075.

P. PIMENTAL & L. BURBA. Spatial Neglect: Association With Auditory Allesthesia and Phonological Neglect?

At the 1997 INS meeting, a paper entitled *Phonological Neglect in a Patient with a Right Hemisphere Stroke* by Cibula, Anderson, Yanke, Crucian, Gonzalez-Rothi, and Heilman was presented. The present authors replicated the examination protocol with a similar research participant with right hemisphere pathology. Specifically, we studied a 70-year-old, right-handed, White male who suffered a large infarction involving the frontal, temporal, parietal, and occipital lobes and the basal ganglia of the right hemisphere. The objectives of our replication study were to determine the association of unilateral spatial neglect with auditory neglect syndromes, specifically auditory allesthesia and contralesional phonological neglect. Methods included formal neuropsychological and audiological testing and duplication of the three trial protocol from the Cibula et al. study. This involved detection of lateralized puretones delivered through headphones either monaurally or binaurally and localization of ear presentation. The patient was also presented with speech words with and without white noise masking to the non-test ear. Findings included confirmation of extinction to simultaneous auditory stimuli, absent acoustic reflexes upon ipsilateral right and contralateral left stimulation, contralesional phonological imperception (phonological neglect), and auditory allesthesia. Error analysis of false localizations will be delineated. Discussion will address: (1) association of left spatial (visual) neglect with auditory neglect in right brain injury; (2) analysis of placement of phonological errors—are they a relative of neglect dyslexia or hemialexia?; (3) attentional and hemispatial cueing systems in right hemisphere brain injury; and (4) dissociation between phonological neglect and auditory allesthesia.

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LATERALITY AND HEMISPHERIC AND CALLOSAL FUNCTION

B. HANNA-PLADDY, N.A. PENNELL, W.J. TRIGGS, & K.M. HEILMAN. Familial Handedness: Concordance Between Lateral Preference and Proficiency.

Investigations of the mechanisms underlying laterally biased behaviors, such as handedness, have included varied approaches such as studies of inheritance, performance, and preference. Given that handedness is a complex, multifactorial construct and that there are inconsistencies in the literature related to use of unitary dimensions, we investigated multiple measures of lateral preference and proficiency with a multivariate analytic technique. The results revealed that both preferred writing hand and history of familial sinistrality predicted concordance between scores on hand preference measures, ocular and foot dominance, and manual proficiency asymmetries. Subjects with a right hand writing preference (RH), without familial sinistrality, demonstrated the highest concordance between strength

of hand preference with foot dominance, manual asymmetries of motor speed and dexterity, and ocular dominance. In left hand writers (LH), a combination of familial sinistrality and strength of hand preference predicted manual asymmetries for finger tapping. Ocular dominance was the only lateral preference successfully predicted by family history of left-handedness alone. Overall, RH without history of familial sinistrality demonstrated the most marked laterality, followed by RH with familial sinistrality and familial LH with weak laterality, and then by nonfamilial LH who approached ambilaterality. The results reveal that manual dominance is indeed multifactorial and less influenced by inheritance than ocular dominance. However, our findings indicate that the concordance between proficiency and preference are, in part, influenced by a genetic component, although the expression of laterality appears to vary as a function of the specific task and preferred writing hand.

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D. HIGGINS & D. HARRISON. Sex Differences in Diastolic Blood Pressure Reactivity as a Function of Denial.

This experiment investigated sex differences in the effects of denial on cardiovascular reactivity in response to a stressor. 32 right-handed undergraduate men and women underwent physiological measurements of systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) before and after exposure to a cold pressor. Sex differences in the effects of denial (measured using the Marlowe-Crowne Social Desirability Scale) on cardiovascular reactivity were predicted. Findings indicated a Sex \times Denial \times Trial interaction effect, where high-denial men and low-denial women evidenced significant DBP increases following the stressor; whereas, low-denial men and high-denial women did not evidence such a dramatic escalation. Overall, men and women both evidenced significant SBP and DBP increases following the stressor, and a main effect of sex was found for SBP, as men were found to have higher SBP levels than women, overall. Furthermore, a main effect of denial was also found, where high-denial men and women experienced higher overall levels of DBP, compared to low-denial men and women ($M = 80$ vs. 74). Neural mechanisms involved in differential levels of SBP and DBP should be considered with other factors, such as denial. Further, systolic blood pressure and diastolic blood pressure regulation mediated by adrenal–medullary and parasympathetic systems cannot be viewed as orthogonal systems, but rather as complementary, coacting systems. These results contribute to the literature on sex differences in functional cerebral laterality (as denial can be conceptualized as a right-hemisphere deficit of awareness) and implicate denial as an important factor in cardiovascular research.

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B.S. KOPPEL, V. GHASIAN, & D. PARK. Fluctuating Visual Hallucinations With Occipital Epileptiform Activity.

A 78-year-old man was admitted for cardiac bypass surgery. Postoperatively he was noted to be confused, addressing hallucinations of relatives in the left corner of the room for several minutes but not continuously. His language testing during these phenomenon was remarkable for inattention, inability to follow three step commands, left–right confusion, and difficulty naming colors and objects. He had left hemianopsia to double simultaneous stimulation but could count fingers bilaterally. After episodes he was not tired or complaining of headaches and he remained calm during them. No convulsive activity was witnessed. MRI of the brain with MR angiography revealed increased signal on T2 images of the occipital white matter and gray matter of the occipital pole. Electroencephalography performed over several days revealed biooccipital periodic epileptiform activity with slowing (theta) in between. This resolved 2 days before the hallucinations. Repeat MRI was normal except for old ischemia. In patients with fluctuating mental status, it is useful to monitor cerebral function with electroencephalography and treat epileptiform activity. A permanent deficit does not accompany all ischemia and treatable causes should be sought. Neuroleptics should be avoided as seizure threshold is low.

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C. KELLER-LENGEN, M. REGARD, N.D. COOK, H. JOLLER, & T. LANDIS. Anomalous Brain Dominance and Immune Diseases.

Geschwind and colleagues discussed associations among immune disorders, non-right-handedness, and learning disorders. But the reports in the literature conflicting with respect to the possible associations between left-handedness and immune disorders. In this study, we directly investigated the hypothetical association between handedness/language dominance and immune disorders such as autoimmune diseases and allergies. Sixty-four healthy medical students were questioned about current or past neurological symptoms, autoimmune diseases, and other illnesses associated with the handedness hypothesis. With standard serological techniques, their sera were screened for autoantibodies, interferons, and cellular parameters. Language dominance was investigated with computerized auditory and visual lateralization tests. Data were analyzed with non-parametric methods. Left-handers had significantly lower levels of the cellular parameter CD4, a marker of allergies. Moreover, the cellular parameters associated with the development of autoimmune diseases such as CD3 (T-cell marker), CD4 (T-cell marker), CD19 (B cell marker), HLA-Dr (activated T-cell marker) and CD57 (natural killing cell) were also significantly lower in left-handers. IgE was not related to handedness. Finally, a subgroup of 22 left-handers with anomalous language dominance was additionally explored 3 circulating autoantibodies, which were found to be insignificantly increased compared to norm values.

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D.W. COLLINS. Hemispheric Specialization for Semantic Category Judgments.

The consensus in the literature concerning the contributions of the 2 cerebral hemispheres to semantic categorization is that the left hemisphere is paramount. Many such studies, however, have used lexical decision tasks in the testing procedures, and/or have confounded categorical and associative relations. The present study examined hemispheric specialization for semantic category decisions using pictorial stimuli tachistoscopically presented. Undergraduate participants decided whether two objects, presented to either the left visual field (LVF) or to the right visual field (RVF), were related in some way or not. The objects depicted in the pictures were related either by semantic category (e.g., *pear–orange*), by association only (e.g., *rabbit–carrot*), or were unrelated (e.g., *hat–bone*). The stimuli were blocked such that semantic and associative pairings were not intermixed. Results showed that overall, greater accuracy was obtained for semantic (94%) compared to associative (90%) decisions [$F(1,36) = 4.75, p = .036$]. With regard to response times, there was a significant Order \times Type interaction [$F(1,36) = 15.68, p < .05$]: semantic decisions were made faster after associative priming, but not *vice versa*. The Type \times Field interaction was not significant [$F(1,36) = 2.9, p = .09$]. These results suggest that previous reports of hemispheric differences in semantic category processing may in part be due to the superior verbal capacity of the left hemisphere. Correspondence: *David W. Collins, University of Windsor, Department of Psychology, 401 Sunset Avenue, Windsor, ON N9B 3P4, Canada.*

A. HUTCHINSON, J. ZANES, & D. WHITMAN. Interhemispheric Transfer of Information During Semantic Processing.

High- and low-associate visual half-field priming was investigated for both ipsilateral prime–target and contralateral prime–target conditions at 2 different stimulus onset asynchronies (SOAs). Sixty participants were randomly assigned to long (750 ms) or short (50 ms) SOA conditions and asked to make lexical decisions about targets projected to either the left or right visual field. Real word targets were primed by a highly associated word (e.g., CLEAN–DIRTY), a weakly associated word (e.g., CLEAN–TIDY), or an unrelated word (e.g., CLEAN–FAMILY) that was projected to either the same or opposite visual field. In the short SOA, right visual field–left hemisphere primes resulted in high associate priming regardless of target location (i.e., ipsilateral or contralateral to the prime) whereas left-visual field–right hemisphere primes produced both high and low associate priming across both target location conditions. In the long SOA, a similar pattern of interhemispheric priming was found in the contralateral

conditions, but ipsilateral priming had decayed. The results of this study demonstrate the vital contribution of interhemispheric transfer in semantic processing.

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C. NIEBAUER, J. ASELAG, & C. SCHUTTE. Handedness Predicts the Degree of a Sensory Illusion.

The 2 cerebral hemispheres may play different roles in the maintenance and updating of an individual's beliefs such that the left hemisphere (LH) forms consistent beliefs, whereas, the right hemisphere (RH) looks for anomalies in reference to those beliefs. If some threshold of anomalies are detected the RH updates the LH's belief system. Handedness may reflect the degree to which the 2 hemispheres interact such that the more strongly handed an individual is the less interhemispheric communication may take place thus attenuating this updating process. This study confronted participants with anomalous sensory information by tapping on both the participants' real hand (not visible) and a fake hand in synchrony. Participants could update their beliefs to include the fake hand as part of their body and consciously experience the fake hand as their own. It was predicted that this illusion would vary with handedness such that the more strongly handed participants should experience this illusion to a lesser degree. Also, if the anomaly detector is localized to the RH this relation should be stronger when the experiment is carried out upon the left hand. This was supported with strongly handed participants reporting lesser degrees of this experience ($r = -.29, p = .042, N = 48$). Also, the correlation between handedness and the illusion was only present under the left hand condition, $p = .020$ (right hand, $p = .717$). Handedness may be an important variable for theories making a connection between beliefs and the hemispheres.

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J. HELDIGE, P. SHULMAN, L. MARKS, K. TAYLOR, T. LENCZ, & A. RAINE. Developmental Instability and Individual Variation in Hemispheric Asymmetry.

Data from a multitask experiment were used to test 2 predictions from a developmental instability theory of individual differences in laterality (Yeo and colleagues): (1) the number of minor physical anomalies (MPAs) increases and (2) cognitive ability decreases with deviations from prototypical levels of hemispheric asymmetry. Ninety-nine participants were assessed on 7 behavioral laterality tasks, including both auditory and visual, verbal and nonverbal tasks. Brain size, corpus callosum size, sylvian fissure (SF) asymmetry and planum temporale (PT) asymmetry were computed from MRIs. For each measure, we computed the difference between the mean laterality score (an estimate of prototypical laterality for that measure) and the laterality score for each individual. The magnitude of this difference, regardless of direction, was used as a measure of atypical laterality. The resulting scores for each task or brain asymmetry measure were then correlated with MPA and IQ scores. According to the developmental instability theory, MPA scores should increase and IQ scores should decrease as the deviation from prototypical laterality increases. With respect to the MPA scores, significant correlations in the predicted direction were found only with laterality measures from a consonant-vowel dichotic listening task and with PT asymmetry. With respect to IQ scores, there were no significant correlations in the predicted direction and three in the opposite direction. However, IQ scores increased significantly with whole brain volume and with decreases in the size of the corpus callosum relative to the size of the whole brain. Support for the developmental instability theory is, at best, weak.

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S. CHRISTMAN & J. COLLINS. Handedness and Gender Differences in Humor Perception.

Humor appreciation involves 2 main processes: realizing that the punchline is unexpected and perceiving a new framework for comprehending the punchline that allows integration with the body of the joke in a meaningful

manner. The right hemisphere appears to be critical for this apprehension of coherence. Thus, humor perception requires the integration of left and right hemisphere processing; as McGhee put it, "The left cortex sets up the joke and the right gets it." The presence of behavioral and anatomic evidence for handedness and gender differences in interhemispheric integration suggests the possibility of individual differences in humor perception. Accordingly, humor perception in strong and weakly handed males and females was assessed using the 3WD Humor Test. This test measures humor perception for 3 joke types: incongruity resolution, nonsense, and sexual. A main effect of joke type indicated participants found sexual jokes to be funniest; this effect was qualified by a Joke Type \times Gender interaction, with males in particular finding sexual jokes to be funny. Critically, there was an interaction between Handedness \times Gender. Among females, mixed-handedness (defined as a score below 75 on the Edinburgh Handedness Inventory) was associated with higher levels of humor appreciation; among males, however, strong handedness was associated with higher levels of humor perception. Although this cannot be explained solely in terms of individual differences in interhemispheric interaction, the finding that mixed-handed women resemble strong-handed men, while strong-handed women resemble mixed-handed men, replicates previous studies. Correspondence: *S. Christman, Department of Psychology, University of Toledo, Toledo, OH 43606.*

S.M. KORSNES & S. MAGNUSSEN. Are There Hemispheric Priming Differences Between Related Words and Structural Objects?

Cognitive mechanisms of semantic priming in individuals with intact cerebral hemispheres were examined. Two experiments compared the effects of visual field differences on implicit memory in similar spatial and semantic tasks, investigating the automatic activation of categorically related priming using possible and impossible 3-dimensional patterns and words and nonwords. The priming effects that were observed for the experiments could be attributed to structural analyses that are carried out in the course of making judgments about functional properties of novel objects and words. Priming effects for both words and possible stimuli occurred in both hemispheres, and a left-hemispheric priming effect for low frequency objects with structural errors was found for the stimulus onset asynchrony used. The present data may support the existence of a structural representation system, and suggests that this may be lateralized to the left hemisphere. There are no particular differences in priming of structural objects and related words, and this may indicate that similar processing mechanisms are involved.

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T.M. ROEBUCK, S. MARION, W. BROWN, S.N. MATTSON, & E. RILEY. Bimanual Coordination in Alcohol-Exposed Children: Role of the Corpus Callosum.

The corpus callosum (CC) is one of several brain structures affected in children prenatally exposed to alcohol. Reductions in the size of the CC have been documented in alcohol-exposed children as a group, and the rate of callosal agenesis in children with Fetal Alcohol Syndrome is higher than in the general population or other developmentally disabled populations. The functional implications of these findings are unclear. The CC plays a major role in coordinating motor activity from opposite sides of the body, and deficits on tests of bimanual coordination have been documented in individuals with callosal agenesis and compromise to the CC, particularly when they have to perform the task without visual feedback. In the current study, the Bimanual Coordination Test was used to assess speed and accuracy when both hands must coordinate to complete a series of angled pathways. Twenty-one alcohol-exposed (ALC) and 17 nonexposed control children (NC), matched closely in age, sex, and ethnicity were tested. For trials with visual feedback (WV), ALC children were slower than NC children but were equally accurate. On trials completed without visual feedback (WOV), both groups of children performed slower than they did on WV trials, although groups did not differ from each other. ALC children were similar to NC children on most WOV accuracy measures, but were significantly less accurate on a trial believed to be particularly

sensitive to interhemispheric interaction. These results indicate that ALC children are slower than NC children but equally accurate on measures of basic visuomotor ability, and ALC children are less accurate than NC children on trials heavily dependent on interhemispheric interaction.

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S.R. GARRELS, L.K. PAUL, B.M. SCHIEFFER, E.V. FLORENDO, M.M. FOX, A.A. TURK, & W.S. BROWN. Abstract Problem-Solving in Children With Callosal Agenesis.

Previous research has shown that adults with agenesis of the corpus callosum (ACC) exhibit neurocognitive deficits in abstraction, concept formation, and problem solving due to reduced interhemispheric activity. We hypothesized that the same deficits would be demonstrated in children with ACC. However, since normal children have incomplete myelination of the corpus callosum, deficits in ACC children may be less apparent than in adults. The Halstead Category Test (HCT), Wisconsin Card Sorting Test (WCST), Raven's Standard Progressive Matrices (SPM), and Trail Making Test B were administered to 10 normally intelligent ACC children (ages 7–12; IQ > 80) and to 9 age and IQ matched controls. ACC children performed below controls on all tests (HCT: ACC T = 47, Control T = 59; WCST: ACC T = 45, Control T = 512; SPM: ACC = 26.1 correct, Control = 33.6 correct; Trails B: ACC = 180 s, Control = 102 s). However only the HCT revealed a significant deficit in ACCs relative to controls ($t = -2.636, p < .05$). These findings are consistent with previous results in that both adult and child ACCs showed greater performance deficits on the HCT than on other problem-solving tasks. Of these tasks, the HCT is the most complex, suggesting the greater role of the corpus callosum in more complex problem-solving. These findings also suggest that problem-solving deficits in ACC, while broadly evidenced in adults, are less clear in children likely due to the lack of callosal myelination in their peers. Correspondence: *Warren Brown, Ph.D., Travis Research Institute, Fuller Graduate School of Psychology, 180 North Oakland Avenue, Pasadena, CA 91101.*

C. CLASON, B. HALLAM, & W.S. BROWN. Morphological Subregions of the Corpus Callosum: Replication in Alzheimer's Disease.

Recent research has attempted to examine structural variance in the morphology of the corpus callosum (CC) in order to identify subregions. This study investigated the stability of the structural analyses of the MRI mid-sagittal view of the CC by Cowell et al. Cowell et al. identified 7 callosal subregions that were determined by factor analyses of fine grain callosal measurements (99 widths) from neurological patients and healthy adults. We hypothesized that greater definition of CC subregions might accrue from the callosal degeneration known to occur in Alzheimer's disease (AD). Callosal measurements were obtained from MRIs of 19 AD patients and 7 normals. Ninety-nine width measurements were subjected to principal component analysis and an oblique rotation. Seven factors (eigenvalues greater than 1.5) were identified and rotated (oblique rotation) which accounted for 94% of total variance prior to factor rotation. CC width variables with factor loadings of .600 or greater were included in the definition of each of the 7 subregions. Although the boundaries for each callosal subregion did not exactly replicate Cowell et al., there was significant factor coherence across all seven factors. Exactly equivalent factors were found in the isthmus area (widths 65–74) and the splenium (widths 94–99). These results indicate that the Cowell et al. definition of callosal subregions is stable across various populations, and that division of the CC into these 7 subregions is a methodological improvement over the geometrically defined subregions used in much previous research.

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P. MOES. Corpus Callosum Function and Measures of Cognitive Ability.

Several studies have linked corpus callosum (CC) function with language or general learning deficits. However, the link between CC function and

cognition for healthy adults has not been well established. The present study relates cognitive ability to CC function in a large group of normal adults. CC function was measured using a visual color matching task (same/different decision). Two colored diamonds were presented (160 ms) either unilaterally or bilaterally. A bilateral field advantage (BFA) score was calculated by subtracting the bilateral condition reaction time (RT) from the unilateral condition RT. Intellectual functioning was assessed with the Kaufman Brief Intelligence Test (K-BIT). Sixty-four females and 30 males completed both the color matching and the K-BIT test. The Definitions sub-test (verbal concepts) was significantly correlated ($r = .22, p = .03$) with the BFA score, but the Matrices sub-test (visual analogies) was not significantly correlated with BFA. For females, both of these correlations were significant ($r = .26, p = .04$; $r = .33, p = .03$, respectively), but neither correlation was significant for males. Multiple regression analysis found that the bilateral condition RT contributed a significantly greater amount of variation to the K-BIT scores than did the unilateral condition RT, suggesting that the relationship is not due to generalized speed of processing. While the gender difference may be the result of the larger number of female participants, this result is consistent with Davatzikos and Resnick who found a similar gender difference when relating CC size to cognitive ability.

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Symposium 10/11:00 a.m.–12:45 p.m.

APPLICATIONS OF NEUROIMAGING ADVANCES TO TRAUMATIC BRAIN INJURY

Organizer and Chair: Joseph H. Ricker

J.H. RICKER. Applications of Neuroimaging Advances to Traumatic Brain Injury.

Symposium overview: Numerous neural mechanisms thought to underlie cognitive impairment after traumatic brain injury (TBI) have been identified, primarily through animal models or in post-mortem studies of humans. Some *in vivo* substrates have been proposed in human studies, but have usually involved individuals who sustained some form of focal cerebral injury. In TBI, the damage is often multifocal or, more likely, diffuse thus making specific neuroanatomical inferences more difficult. Advances in brain imaging now allow investigators to more accurately assess the anatomic, biochemical, and functional changes that might be associated with brain injury and subsequent reorganization. The present symposium will examine three classes of brain imaging techniques (3-D and quantitative MRI, MRI spectroscopy, and functional MRI) that have seen recent application to individuals with TBI.

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E. BIGLER. 3-D and Quantitative Neuroimaging and Neuropsychological Outcome in Traumatic Brain Injury.

Using magnetic resonance (MR) imaging, a variety of elegant techniques have been developed that permit 3-D viewing of the brain and quantification of brain structures in normal and pathological states. These techniques are particularly useful in providing quantification of structural changes that occur as a result of traumatic brain injury (TBI). Research over the past decade has been systematically demonstrated both the focal and disseminated nature of traumatically induced damage. In terms of generalized changes, white matter atrophy occurs in proportion to severity of injury and relates most to ventricular expansion (hydrocephalus *ex vacuo*). Reduced white matter volume is also partially responsible for the increased sulcal dilatation. As for specific focal atrophy, the hippocampus appears to be vulnerable to injury but the fornix may be even more vulnerable. In fact, recent work suggests that disrupted memory in TBI may become disrupted more via damaged fornix projections than focal mesial

temporal lobe damage. The timing when quantitative image analyses are performed is also critical in demonstrating the nature and degree of structural damage. In fact, the timing post injury may be the critical factor when it comes to relating structural brain pathology to neuropsychological outcome. The other problem in relating structural outcome to neuropsychological performance is that structural lesions tend to underestimate the functional disruption. This will be shown by comparing quantitative MR imaging findings with positron emission tomography (PET), single photon emission computed tomography and magnetoencephalography (MEG). Lastly, clinical integration of quantitative MR imaging findings with neuropsychological outcome will be reviewed.

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S.D. FRIEDMAN, W.M. BROOKS, C. GASPAROVIC, R.E. JUNG, & R.A. YEO. Evaluation of Traumatic Brain Injury Using Magnetic Resonance Spectroscopy.

In recent years, magnetic resonance spectroscopy techniques (MRS) have been increasingly employed to non-invasively probe the severity and time-course of alterations in brain metabolism/neurochemistry within myriad diseases such as stroke, near-drowning, and traumatic brain injury (TBI). A majority of investigations have focused on probing the integrity of tissues that appear normal by MRI, often demonstrating markedly abnormal brain neurochemistry levels that relate strongly to the severity of behavioral dysfunction. In studies of TBI specifically, extensive metabolic rearrangement is present soon after injury in normal-appearing tissues both in primary injury regions (i.e., frontal lobes) and in areas remote from these common injury loci. Importantly, these measures of early neurochemical integrity appear predictive of behavioral outcome in the studies to date. Additionally, longitudinal MRS investigations of injury evolution demonstrate that the metabolic changes following TBI progress over an extended time course (i.e., months) following the acute injury phase. Such changes may reflect persistent deleterious processes as well as injury resolution. The duration of these changes may define an extended temporal window for neuroprotective intervention in TBI. The use of MRS as an additional tool within head trauma patient management/rehabilitation will be discussed.

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J.H. RICKER & J. DeLUCA. Functional Activation Studies (O-15 PET and fMRI) in Traumatic Brain Injury.

There have been several resting functional neuroimaging studies following TBI, most demonstrating hypometabolism or hypoperfusion within the frontal cortex. Such findings are not, however, specific to TBI, and the simple presence of resting hypometabolism or hypoperfusion does not provide *de facto* evidence of nonfunctional neural tissue. Few functional imaging studies have attempted to correlate findings with neuropsychological tasks, and in those that have, imaging and cognitive testing are usually separated in time (by weeks or months). Thus, reliable and valid conclusions cannot be made regarding the relationship between cognition and brain status. Functional activation studies, however, can allow for such comparisons. Advances in functional imaging technology and physiological tracers allow for paradigms in which participants can perform cognitive tasks during functional image acquisition. We will discuss the application of two approaches (Oxygen-15 PET and fMRI) that have recently been used to examine aspects of memory following TBI. Activated functional brain imaging findings that we will discuss suggest possible functional reallocation and reorganization of brain substrates involved in verbal memory following brain injury. The findings are also clearly in line with other research that indicates a large role for the frontal lobes in memory functioning, and support the concept of distributed neural networks for memory-related functions, cognitive load, and the potential for examining brain reorganization after injury.

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