Journal of the International Neuropsychological Society (2008), **14**, 297–308.

DOI: 10.1017/S1355617708080338

Cognitive models of medical decision-making capacity in patients with mild cognitive impairment

O.C. OKONKWO,[1] H.R. GRIFFITH,[2,3] K. BELUE,[2,3] S. LANZA,[2,3] E.Y. ZAMRINI,[4] L.E. HARRELL,[2,3,5] J.C. BROCKINGTON,[2,3] D. CLARK,[2,3,5] R. RAMAN,[6] AND D.C. MARSON[2,3]

[1]Department of Psychology, University of Alabama at Birmingham, Birmingham, Alabama
[2]Department of Neurology, University of Alabama at Birmingham, Birmingham, Alabama
[3]Alzheimer's Disease Research Center, University of Alabama at Birmingham, Birmingham, Alabama.
[4]Department of Neurology, University of Utah Health Sciences, Salt Lake City, Utah
[5]Veterans Administration Medical Center, Birmingham, Alabama
[6]Department of Family and Preventive Medicine and Neurosciences, University of California San Diego, San Diego, California

(RECEIVED June 12, 2007; FINAL REVISION October 30, 2007; ACCEPTED November 6, 2007)

Abstract

This study investigated cognitive predictors of medical decision-making capacity (MDC) in patients with amnestic mild cognitive impairment (MCI). A total of 56 healthy controls, 60 patients with MCI, and 31 patients with mild Alzheimer's disease (AD) were administered the Capacity to Consent to Treatment Instrument (CCTI) and a neuropsychological test battery. The CCTI assesses MDC across four established treatment consent standards—S1 (*expressing choice*), S3 (*appreciation*), S4 (*reasoning*), and S5 (*understanding*)—and one experimental standard [S2] (*reasonable choice*). Scores on neuropsychological measures were correlated with scores on each CCTI standard. Significant bivariate correlates were subsequently entered into stepwise regression analyses to identity group-specific multivariable predictors of MDC across CCTI standards. Different multivariable cognitive models emerged across groups and consent standards. For the MCI group, measures of short-term verbal memory were key predictors of MDC for each of the three clinically relevant standards (S3, S4, and S5). Secondary predictors were measures of executive function. In contrast, in the mild AD group, measures tapping executive function and processing speed were primary predictors of S3, S4, and S5. MDC in patients with MCI is supported primarily by short-term verbal memory. The findings demonstrate the impact of amnestic deficits on MDC in patients with MCI. (*JINS*, 2008, *14*, 297–308.)

Keywords: Medical decision making, Cognition, MCI, Functional change, Medical ethics, Alzheimer's disease

INTRODUCTION

Although not all patients with amnestic mild cognitive impairment (MCI) progress to Alzheimer's disease (AD), MCI is generally considered a preclinical phase of AD and is characterized by memory complaint by patient or reliable informant, objective memory impairment, preserved general cognitive function, essentially normal everyday functional activities, and absence of a dementia diagnosis (Gauthier et al., 2006). MCI is currently considered a strategic intervention point in the clinical management of AD and, as a result, individuals with MCI are increasingly receiving pharmacologic interventions aimed at delaying or preventing progression to AD (Petersen & Morris, 2005; Sherwin, 2000).

The marked functional and behavioral deficits that characterize AD have stimulated research into the functional characteristics of patients with MCI (Griffith et al., 2003; Ritchie et al., 2001; Tuokko et al., 2005). Studies show that individuals with MCI experience mild decrements in the performance of everyday activities compared with healthy older adults (Griffith et al., 2003; Tuokko et al., 2005) and that such emergent functional restrictions may predict subsequent progression to AD (Tabert et al., 2002).

Correspondence and reprint requests to: Dr. Daniel Marson, Department of Neurology, SC 650K, University of Alabama at Birmingham, Birmingham, AL 35294-0017. E-mail: dmarson@uab.edu

Disclosure: The capacity outcome measure used in the study is owned by the UAB Research Foundation (UABRF). Dr. Marson and Dr. Harrell receive royalty income through UABRF. Statistical analyses were carried out by Mr. Okonkwo, and statistical consultation was provided by Dr. Raman.

Medical decision-making capacity (MDC), hereafter also referred to as treatment consent capacity or consent capacity, represents an important functional domain to investigate in MCI (Okonkwo et al., 2007). Loss or diminution of MDC raises a range of ethical and medical–legal issues for patients with dementia, and for surrogate decision makers, healthcare professionals, and society as a whole (Marson et al., 1995b). There is unequivocal evidence in the literature that consent capacity is compromised in some AD patients even in the very early stages of the disease (Karlawish et al., 2005; Kim & Karlawish, 2003; Marson et al., 1995b; Moye et al., 2004). Recently, our group investigated consent capacity in patients with MCI (Okonkwo et al., 2007). We found that, as a group, patients with MCI also demonstrate impairments in MDC. Specifically, patients with MCI exhibited significant impairments on complex and clinically relevant consent standards of appreciating consequences of treatment choice, providing rational reasons for treatment choice, and understanding the treatment situation and choices (Okonkwo et al., 2007).

An important research question concerns the cognitive mechanisms that underlie MDC impairments in MCI. Neurocognitive studies have the potential to improve our understanding of the relationship between cognitive impairment and functional loss in MCI by illuminating specific cognitive processes essential to discrete consent abilities. With regard to MDC, such studies can alert clinicians to specific cognitive impairments threatening consent capacity in MCI. In turn, these findings can facilitate the development of enhanced consent procedures for persons with MCI (Gurrera et al., 2006; Marson et al., 1996; Mittal et al., 2007).

In this study, we investigated cognitive predictors of MDC in a well-characterized sample of patients with MCI using an objective capacity measure and a standard neuropsychological battery. We also sought to identify cognitive predictors of MDC in groups of healthy older adults and patients with mild AD to provide reference points on the dementia continuum for understanding the findings in the MCI group. We expected to find that measures of memory would be primary predictors of MDC in MCI, whereas a combination of executive and memory measures would predict performance in the mild AD group.

METHODS

Participants

As reported in an earlier study (Okonkwo et al., 2007), 56 healthy older adult controls, 60 patients with MCI, and 31 patients with mild AD participated in this study. All participants were community dwelling individuals recruited into a study of functional change in patients with MCI conducted at the University of Alabama at Birmingham (UAB). As part of the study, all participants were diagnostically characterized through the UAB Alzheimer's Disease Research Center (ADRC). Control participants were healthy older adults who underwent neurological, neuropsychological, and neuroradiological evaluations to ensure the absence of medical and psychiatric conditions that could compromise cognition. All controls were characterized as cognitively normal in the interdisciplinary ADRC diagnostic consensus conference.

MCI participants were either patients who presented for clinical evaluation at the UAB Memory Disorders Clinic, a tertiary care neurology outpatient clinic, or volunteers recruited from the community into the ADRC. They were also well characterized based upon neurological evaluation, neuroradiological evaluation, and neuropsychological testing. Diagnosis of MCI was made in the ADRC diagnostic consensus conference using Petersen/Mayo criteria (Petersen et al., 2001). MCI and control participants were matched on age, education, race, and gender.

Participants with mild AD were also patients in the UAB Memory Disorders Clinic who were referred to the ADRC. Their dementia was well characterized based on neurological, neuropsychological, and neuroradiologic procedures. Diagnosis of mild stage probable AD was made in the ADRC diagnostic consensus conference using NINCDS-ADRDA criteria (McKhann et al., 1984) and the Clinical Dementia Rating (CDR) (Morris, 1993). Informed consent was obtained from all control and MCI participants, and from all AD participants and their caregivers, as part of this institutional review board-approved research.

Measures

Consent capacity measure

Consent capacity was assessed with the Capacity to Consent to Treatment Instrument (CCTI) (Marson et al., 1995b), a conceptually based, reliable, and valid instrument for the assessment of MDC in healthy and cognitively impaired older adults (Griffith et al., 2005; Marson et al., 1995b). The conceptual basis and psychometric properties of the CCTI have been described in prior studies (Dymek et al., 1999; Marson et al., 1995b, 1996). The CCTI consists of two specialized clinical vignettes that each present a hypothetical medical problem (A: neoplasm, B: cardiovascular disease) and symptoms, and two treatment alternatives with associated risks and benefits. The vignettes are presented to participants simultaneously in both oral and written formats; participants then answer questions designed to test consent capacity under each of four core consent standards (Ss) derived from legal and medical literature (Appelbaum & Grisso, 1988)—S1: expressing a treatment choice (*expressing choice*); S3: appreciating the consequences of a treatment choice (*appreciation*); S4: providing rational reasons for a treatment choice (*reasoning*); and S5: understanding the treatment situation, treatment choices, and respective risks/benefits (*understanding*). In addition, we tested a fifth standard described as making the "reasonable" treatment choice (*reasonable choice*, [S2]). This standard tests whether an individual makes a decision that is similar to one that a

https://doi.org/10.1017/S1355617708080338

reasonable person in like circumstances would make. The [S2] (*reasonable choice*) is not a clinically accepted consent standard because of concerns about the arbitrariness of the operative term "reasonable" (Tepper & Elwork, 1984). Therefore, we treat it as experimental and use brackets to distinguish it from the four core consent standards.

CCTI administration procedures

Both vignettes were administered in an uninterrupted disclosure format and were counterbalanced across participants to control for potential order effects. After the vignette story is read to the participant (and he/she reads along), the examiner removed the participant's copy of the story before initiating questioning. This procedure is modeled on actual treatment consent processes that typically occur as "unassisted" oral conversations between physician and patient. Each participant's responses were audiotaped and subsequently transcribed to ensure the highest level of accuracy in scoring. CCTI administration and scoring were performed by trained staff according to detailed and well-operationalized criteria (Marson et al., 1995b).

Neuropsychological assessment

A standardized neuropsychological test battery was administered to all participants as part of their ADRC evaluations. This battery consisted of measures representing clinically relevant neurocognitive domains linked to dementia and also to MDC (Lezak et al., 2004; Marson, 2001; Marson et al., 1996).

Global cognitive status. Mini-Mental Status Examination (MMSE) (Folstein et al., 1975) and total score on the Dementia Rating Scale, 2nd edition (DRS-2) (Jurica et al., 2001).

Depressive symptoms. Geriatric Depression Scale (GDS) (Yesavage, 1988).

Attention. Attention subscale of the DRS-2, the Spatial Span subtest of the Wechsler Memory Scale, third edition (WMS-III) (Wechsler, 1997a), and Omission and Commission errors on the Conners' Continuous Performance Test (CPT) (Conners, 1992).

Expressive language. Boston Naming Test (Kaplan et al., 1983) and a semantic fluency composite (animals, fruits/vegetables, clothing) (Spreen & Strauss, 1991).

Memory. Memory subscale of the DRS-2, the Logical Memory subtest of the Wechsler Memory Scale, revised edition (WMS-R) (Wechsler, 1987), the Visual Reproduction subtest of WMS-III, the California Verbal Learning Test, second edition (CVLT-II) (Delis et al., 2000), and the10/36 Spatial Recall Test (Boringa et al., 2001).

Processing speed. Trails A (Reitan & Wolfson, 1993), the Digit Symbol subtest of the Wechsler Adult Intelligence Scale, third edition (WAIS-III) (Wechsler, 1997b), and CPT Hit Reaction Time (Conners, 1992).

Visual spatial abilities. Construction subscale of the DRS-2 and the copy portion of the Executive Clock Drawing Task (CLOX 2) (Royall et al., 1998).

Abstraction. Conceptualization subscale of the DRS-2 and the Verbal Reasoning subtest of the Cognitive Competency Test (Wang & Ennis, 1986).

Executive function. Initiation/Perseveration subscale of the DRS-2, CPT Perseverations, spontaneous generation portion of the Executive Clock Drawing Task (CLOX 1), Trails B (Reitan & Wolfson, 1993), and Trails 3 (see below).

Individual achievement. Arithmetic subtest of the Wide Range Achievement Test, third edition (WRAT-3) (Wilkinson, 1993).

Trails 3 is a measure developed by our group to evaluate higher level executive function in patients with MCI. Trails 3 adds a third set (quantity) to the existing sets of number and letter used in Trails B, and is administered after Trails A and B in an identical format. Participants are asked to draw a line connecting numbers, letters, and dots, in this sequential order, as quickly and accurately as possible. Errors are corrected during performance resulting in a time penalty. Numbers range from 1 to 8, letters from A to G, and dots from one dot to eight dots. Maximum time allowed for task completion is 360 s. Figure 1 displays the practice item for Trails 3.

Trails 3 has shown promising levels of reliability and validity. Test–retest reliability of Trails 3 within a normal older control group ($n = 42$) over a 1-year follow-up assessment period was 0.68 ($p < .001$). In terms of construct

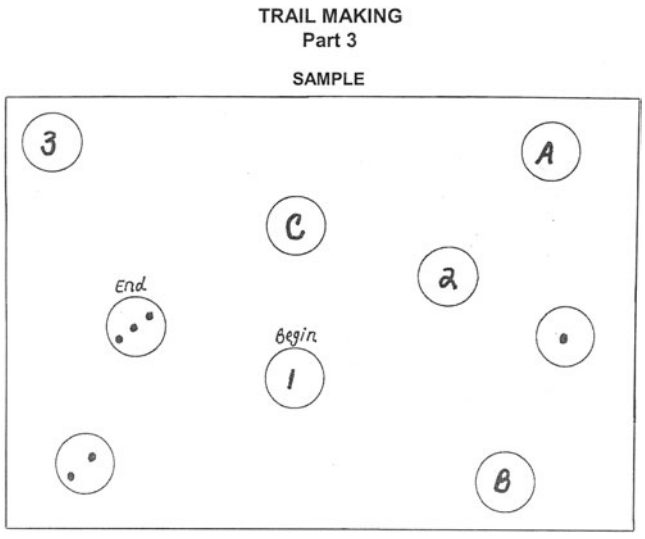

Fig. 1. Practice items for Trails 3. Participants are required to sequentially connect numbers, letters, and dots with lines as quickly and accurately as possible.

https://doi.org/10.1017/S1355617708080338

validity, we expected that Trails 3 would correlate most highly with cognitive measures of executive function and processing speed, thereby providing evidence for both convergent and discriminant validities, the two major subtypes of construct validity. In the older control sample ($n = 42$), Trails 3 demonstrated significant correlations at the .01 α level with only Trails B ($r = .673$; $p = .001$), Trails A ($r = .476$; $p = .001$), CPT Omissions ($r = .421$; $p = .003$), and WAIS-III Digit Symbol ($r = -.385$; $p = .006$). These are all measures of executive function and processing speed, with the possible exception of CPT Omissions. We also examined receiver operating characteristic curves (ROC) to determine the extent to which Trails 3 discriminated control and MCI groups relative to other study executive function and processing speed measures. The ROC analyses revealed that Trails 3 attained an area under the curve (AUC) of 0.79 [95 confidence interval (CI): 0.70–0.88; $p = .001$] for discriminating MCI patients from controls. In comparison, Trails A had an AUC of 0.68 (95 CI: 0.58–0.77; $p = .001$); Trails B had an AUC of 0.77 (95 CI: 0.68–0.85; $p = .001$); and WAIS-III Digit Symbol had an AUC of 0.82 (95 CI: 0.75–0.90; $p = .001$). Trail 3's optimum sensitivity and specificity (0.82, 0.61) for discriminating between MCI patients and controls was a completion time of 76.5 s.

Data Analyses

Demographic variables were analyzed using one-way analysis of variance (age, education, MMSE, DRS-2 Total Score, CDR-sum of boxes, and GDS) or χ^2 analyses (gender, race, and CDR–global). Group comparisons on the neurocognitive variables were conducted using one-way analysis of variance.

Participants' scores on each CCTI standard were summed across vignettes A and B to create a composite variable (except for *reasonable choice*, which is unique to vignette A). Comparisons of group performance on these composite variables were performed using one-way analysis of variance (*expressing choice, appreciation, reasoning, and understanding*) or χ^2 analysis (*reasonable choice*).

As a data reduction strategy, zero-order correlations were computed within each study group to assess the simple bivariate relationship between CCTI standards and neuropsychological variables. Next, maintaining a minimum ratio of 10 subjects per variable (Tabachnick & Fidell, 2007), those neuropsychological measures correlated with the CCTI standards at the .01 α level were selected for entry into multivariable stepwise linear (*expressing choice, appreciation, reasoning, and understanding*) or logistic (*reasonable choice*) regression analyses to create models of consent capacity within each group. Neuropsychological variables were included in each model only if the change in R^2 achieved by their entry was significant at the .05 significance level. We adopted a bivariate .01 α level and a 10:1 subject-to-variable ratio in the selection of variables for entry into the multivariable stepwise analyses to control for the probability of Type I error. For similar reasons, and as reported in the original study (Okonkwo et al., 2007), we followed up all significant omnibus tests of group differences on CCTI and neuropsychological variables with Bonferroni-corrected *post hoc* tests (for interval level data) or with subsequent χ^2 tests with $\alpha \leq .01$ (for categorical data). All analyses were performed using SAS 9.1.

RESULTS

Demographics

Table 1 shows the result of group comparisons on demographic and clinical variables (Okonkwo et al., 2007). As expected, MCI patients differed significantly from controls on all measures of global mental status and dementia staging—MMSE, DRS-2 Total Score, CDR–global ratings, and CDR—sum of boxes scores. However, the two groups did not differ from each other in age, years of education, depressive symptoms, or in gender or racial distributions.

Mild AD patients were older and had fewer years of education than both control and MCI participants. They also differed from the control and MCI groups on all measures of mental status and dementia staging, but not on depressive symptoms or in gender or racial distributions.

As described in the preceding MCI study (Okonkwo et al., 2007), group comparisons on neuropsychological measures and CCTI performance were adjusted for age and education because the study groups were not balanced on these two demographic variables. This procedure ensured that observed group differences on neurocognitive functioning and MDC were not artifacts of the noted demographic imbalance.

Neuropsychological Assessment

Table 2 displays Bonferroni-corrected and demographic-adjusted group comparisons on the neurocognitive variables. Control participants performed better than mild AD patients on all measures with the exception of CPT Hit Reaction Time, DRS-2 Construction, and CPT Perseverations. The control group also performed better than the MCI group on all measures of memory and on some measures of attention (Spatial Span, CPT Commissions), expressive language (Semantic Fluency), processing speed (Digit Symbol), executive function (Trails B and Trails 3), and individual achievement (WRAT-3 Arithmetic). MCI patients performed equivalently with controls on other measures of attention, expressive language, and executive function, and on all measures of visuospatial and abstraction skills. The MCI group also performed better than the mild AD group on all measures, with the exception of DRS-2 Attention, DRS-2 Construction, Spatial Span, CPT Commissions, CPT Hit Reaction Time, and CPT Perseverations.

CCTI Performance Results

Table 3 presents the comparisons of group performance on the CCTI (Okonkwo et al., 2007). On *post hoc* testing (Bonferroni-corrected and demographic-adjusted), there

https://doi.org/10.1017/S1355617708080338

Table 1. Demographic and clinical characteristics of study participants

Demographic	Controls $n = 56$	MCI $n = 60$	Mild AD $n = 31$	*p* value	*Post hoc*
Age (years)	64.63 (8.50)	68.05 (6.77)	74.45 (8.59)	.001	A > M C
Gender, *n* (%)				.183	—
Female	38 (67.9)	34 (56.7)	15 (48.4)		
Male	18 (32.1)	26 (43.3)	16 (51.6)		
Race, *n* (%)				.731	—
African American	13 (23.2)	43 (76.8)	5 (16.1)		
Caucasian	12 (20.0)	48 (80.0)	26 (83.9)		
Education	15.23 (2.37)	14.87 (3.14)	13.26 (3.07)	.008	C M > A
MMSE	29.55 (0.76)	28.37 (1.50)	24.81 (2.97)	.001	C > M > A
DRS-2 Total Score	138.50 (3.76)	132.92 (5.87)	117.87 (12.34)	.001	C > M > A
CDR–global, *n* (%)				.001	C > M > A[a]
0.0	55 (98.2)	0 (0.0)	0 (0.0)		
0.5	1 (1.8)	60 (100.0)	18 (58.1)		
1.0	0 (0.0)	0 (0.0)	12 (38.7)		
2.0	0 (0.0)	0 (0.0)	1 (3.2)		
CDR–sum of boxes	0.07 (0.18)	0.91 (0.81)	3.68 (1.95)	.001	A > M > C
GDS	6.59 (6.21)	7.98 (5.38)	7.06 (4.93)	.404	—

Note. Except for gender, race, and CDR–global, values are mean (*SD*). *p* values are for omnibus tests of group differences. A > M C = AD mean greater than control and MCI means; C > M > A = control mean greater than MCI and AD means and MCI mean greater than AD mean; C M > A = control and MCI means greater than AD mean; A > M > C = AD mean greater than MCI and control means and MCI mean greater than control mean. MCI = mild cognitive impairment; AD = Alzheimer's disease; MMSE = Mini-Mental State Examination; DRS-2 = Dementia Rating Scale, second edition; GDS = Geriatric Depression Scale; CDR = Clinical Dementia Rating.

[a]CDR–global is a categorical variable. Therefore, these are subsequent 2×4 χ^2 tests ($\alpha = .01$), not pairwise comparisons.

were no group differences on the simple standard of *expressing choice*. Control participants performed better than mild AD patients on all other consent standards. There were no differences between the control and MCI groups on *reasonable choice*. However, MCI patients performed worse than control participants on *appreciation*, *reasoning*, and *understanding*, which are the more stringent and clinically relevant consent standards (Appelbaum & Grisso, 1988). MCI patients performed better than mild AD patients on *reasonable choice*, *reasoning, and understanding*.

Bivariate Correlations of Cognitive Measures and CCTI Standards

Table 4 presents the results of the bivariate correlation analyses within each group. All within-group correlations are reported in order of decreasing absolute magnitude. Among MCI patients, there were no significant correlates of *expressing choice*. *Reasonable choice* was correlated with a measure of simple visuospatial construction and visual attention. *Appreciation* was correlated with three verbal memory measures, and *reasoning* was correlated with verbal memory, executive, and attentional measures. *Understanding* was correlated with verbal and nonverbal memory, and with executive measures.

Among mild AD patients, *expressing choice* was associated with executive and attentional measures, whereas *reasonable choice* was associated with visual memory. *Appreciation* was correlated with processing speed, everyday reasoning, and simple visuospatial construction/visual attention measures, and *reasoning* was associated with word fluency/executive, visual memory, and processing speed measures. The significant correlates of *understanding* were executive and memory measures. Among controls, there were no significant neuropsychological correlates of the CCTI standards with the exception of *understanding* which correlated with an executive measure.

Multivariable Models of Consent Abilities

The results of the within-group stepwise regression analyses are also displayed in Table 4. Within the MCI group, DRS-2 Construction was the only predictor of *reasonable choice*, accounting for 27% of the variance (Nagelkerke R-square) and resulting in an overall classification accuracy of 95%. Logical Memory II was the predictor of *appreciation* and accounted for 16% of the variance, whereas CVLT-2 Total Recall score and Trails 3 were the significant predictors of *reasoning*, accounting for 30% of the variance. The significant predictors of *understanding* were Logical Memory II, CVLT-2 Total Recall score, and Trails 3, accounting for 53% of the variance.

Among the mild AD patients, *expressing choice* was predicted by CPT Perseverations and CLOX 2, and they accounted for 51% of the variance. The only predictor of *reasonable choice* was 10/36 Immediate Recall, which accounted for 40% of the variance (Nagelkerke R-square)

https://doi.org/10.1017/S1355617708080338

Table 2. Group comparisons on neuropsychological measures

Measures	Range	Controls $n = 56$	MCI $n = 60$	Mild AD $n = 31$	p value	*Post hoc*
Attention						
DRS-2 Attention	0–37	35.80 (1.33)	35.17 (1.44)	33.87 (2.78)	.014	C > A
Spatial Span Total	0–32	14.64 (2.80)	13.07 (3.29)	11.06 (3.03)	.001	C > M A
CPT Omissions		2.86 (4.09)	9.14 (10.49)	26.15 (27.73)	.001	A > M C
CPT Commissions		7.88 (5.19)	13.02 (7.49)	14.37 (7.35)	.001	A M > C
Expressive Language						
Boston Naming	0–30	27.79 (2.05)	26.07 (3.73)	23.10 (4.81)	.001	C M > A
Semantic Fluency		59.96 (9.95)	46.30 (8.03)	34.10 (10.28)	.001	C > M > A
Memory						
DRS-2 Memory	0–25	24.00 (0.93)	21.62 (3.14)	15.84 (2.49)	.001	C > M > A
Logical Memory I	0–50	26.50 (4.41)	19.10 (6.66)	9.45 (5.54)	.001	C > M > A
Logical Memory II	0–50	22.55 (5.01)	11.90 (7.59)	2.03 (2.83)	.001	C > M > A
Visual Reproduction I	0–104	76.11 (12.98)	60.77 (15.89)	38.00 (12.59)	.001	C > M > A
Visual Reproduction II	0–104	51.96 (19.02)	28.83 (21.38)	6.48 (8.93)	.001	C > M > A
CVLT-2 Total Recall	0–80	46.57 (8.15)	32.28 (8.83)	23.39 (7.35)	.001	C > M > A
10/36 Immediate Recall	0–30	20.00 (4.42)	15.95 (4.11)	11.16 (3.07)	.001	C > M > A
10/36 Delayed Recall	0–10	6.77 (2.01)	4.92 (2.14)	3.45 (1.55)	.001	C > M > A
Processing Speed						
Trails A (seconds)	0–300	33.64 (10.29)	43.58 (18.54)	68.45 (38.18)	.001	A > M C
Digit Symbol	0–133	63.23 (14.71)	44.68 (12.80)	30.19 (11.44)	.001	C > M > A
CPT Hit Reaction Time		447.66 (59.53)	460.04 (81.91)	524.43 (158.61)	.199	—
Visual Spatial						
DRS-2 Construction	0–6	5.64 (0.72)	5.72 (0.83)	5.52 (0.96)	.623	—
CLOX 2	0–15	13.41 (1.19)	13.10 (1.36)	12.23 (1.59)	.007	C M > A
Abstraction						
DRS-2 Conceptualization	0–39	36.75 (2.23)	35.48 (2.87)	32.65 (4.10)	.001	C M > A
Cognitive Competency	0–20	17.91 (1.41)	17.28 (1.66)	15.19 (3.23)	.001	C M > A
Executive Function						
DRS-2 I/P	0–37	36.30 (1.32)	34.93 (2.78)	30.00 (6.08)	.001	C M > A
Trails B (seconds)	0–300	79.09 (23.47)	129.48 (65.19)	215.10 (89.01)	.001	A > M > C
Trails B (errors)		0.54 (0.81)	0.98 (1.08)	1.15 (1.50)	.128	—
Trails 3 (seconds)	0–360	72.88 (25.10)	136.20 (78.53)	291.19 (97.33)	.001	A > M > C
Trails 3 (errors)		0.76 (1.32)	1.45 (1.60)	2.45 (2.46)	.048	—
CPT Perseverations		0.32 (0.61)	2.25 (7.06)	2.70 (2.91)	.069	—
CLOX 1	0–15	11.70 (2.28)	11.53 (2.14)	9.84 (2.77)	.012	C M > A
Individual Achievement						
WRAT-3 Arithmetic	0–55	41.48 (4.52)	38.31 (5.20)	33.42 (5.52)	.001	C > M > A

Note. Values are mean (*SD*). The p values are for omnibus tests of group differences adjusted for age and education. C > A = control mean greater than AD mean; C > M A = control mean greater than MCI and AD means; A > MC = AD mean greater than MCI and control means; A M > C = AD and MCI means greater than control mean; CM > A = control and MCI means greater than AD mean; C > M > A = control mean greater than MCI and AD means and MCI mean greater than AD mean; A > M > C = AD mean greater than MCI and control means and MCI mean greater than control mean. MCI = mild cognitive impairment; AD = Alzheimer's disease; DRS-2 = Dementia Rating Scale, second edition; CPT = Conners' Continuous Performance Test; CVLT-2 = California Verbal Learning Test, second edition; 10/36 = 10/36 Spatial Recall Test; CLOX = Executive Clock Drawing Task; WRAT-3 = Wide Range Achievement Test, third edition.

and resulting in an overall classification accuracy of 81%. Trails A was the only predictor of *appreciation*, accounting for 33% of the variance, whereas Semantic Fluency and 10/36 Immediate Recall were the significant predictors of *reasoning*, accounting for 35% of the variance. *Understanding* was predicted by Trials A, DRS-2 Memory, and Logical Memory I, which together accounted for 73% of the variance. For control participants, Trails 3 was the only predictor of *understanding*, accounting for 16% of the variance in this standard.

DISCUSSION

Providing informed consent to treatment is a complex decision-making task that is subserved by multiple neurocognitive abilities related to type/stage of disease and to the consent standard under examination. Some cognitive abilities that have been implicated by prior research include verbal reasoning, verbal memory, executive function, and semantic knowledge (Dymek et al., 1999; Marson et al., 1996; Moye et al., 2007). In the present study, we sought to

https://doi.org/10.1017/S1355617708080338

Table 3. Group Comparisons on Consent Standards (S)

Measures	Range	Controls $n = 56$	MCI $n = 60$	Mild AD $n = 31$	p value	*Post hoc*
S1, *expressing choice*	0–4	3.88 (0.38)	3.88 (0.56)	3.52 (0.89)	.065	—
[S2], *reasonable choice*, n (%)						
Yes		56 (100.0)	56 (93.3)	23 (74.2)	.001	C M > A[a]
No		0 (0.0)	4 (6.7)	8 (25.8)	.001	
S3, *appreciation*	0–8	7.55 (0.71)	6.82 (1.52)	5.94 (1.90)	.001	C > M A
S4, *reasoning*	0–12	9.52 (2.64)	7.48 (3.03)	4.52 (2.63)	.001	C > M > A
S5, *understanding*	0–78	62.61 (8.32)	49.78 (12.60)	29.94 (9.75)	.001	C > M > A

Note. Except for [S2], values are mean (*SD*). The p values are for omnibus tests of group differences adjusted for age and education. [S2] is a dichotomous variable; therefore, these are subsequent 2×2 χ^2 tests ($\alpha = .01$), not pairwise comparisons. C M > A = control and MCI means greater than AD mean; C > M A = control mean greater than MCI and AD means; C > M > A = control mean greater than MCI and AD means, and MCI mean greater than AD mean. MCI = mild cognitive impairment; AD = Alzheimer's disease.
Printed with permission from Lippincott Williams & Williams for this table that appeared in an article by Okonkwo et al. (2007), *Neurology*, *69 (15)*, pp. 1528–1535 (see reference section).

identify cognitive models of MDC in patients with MCI, and in control and mild AD groups. In the context of neurodegenerative dementias like AD, *understanding* is the most stringent consent standard, requiring comprehensive factual knowledge and understanding of the treatment situation and choices (Marson et al., 1996). Within the MCI group, we found that a measure of delayed verbal recall (Logical Memory II) was the primary predictor of this consent ability. Secondary predictors were a measure of high-load verbal learning (CVLT-2 Total Recall score) and an executive measure of visuomotor tracking, processing speed, planning, and mental flexibility (Trails 3). In contrast, among mild AD patients the primary predictor of *understanding* was a measure of processing speed and visuomotor tracking (Trails A). Secondary predictors were a measure of simple memory (DRS-2 Memory) and a measure of immediate verbal recall (Logical Memory I). For control participants, the only predictor of *understanding* was the complex executive measure Trails 3.

The neurocognitive models for *understanding* were similar for MCI and mild AD groups, with measures assessing memory, executive function, and processing speed emerging as predictors in both groups. This finding suggests that the ability of preclinical and mild AD patients to comprehend a treatment situation and its associated risks and benefits is primarily undergirded by memory, executive function, and processing speed. Executive function also predicted performance on *understanding* among controls. Taken together, these findings are consistent with our knowledge of the *understanding* consent ability. Because it is highly factually intensive, successful performance on *understanding* demands that the individual be able to mentally process, comprehend, encode, organize, and initially consolidate fairly complex medical information presented to them, and to recall this information *on demand* shortly thereafter. Disruption of any of these cognitive abilities, either as a function of normal cognitive aging (Dodge et al., 2006; Salthouse, 1996) or of a dementing disorder (Okonkwo et al., 2006; Tuokko et al., 2005) threatens the integrity of this consent ability. For the MCI group, the prominence of short-term verbal memory predictors suggests that their primary amnestic deficit is the key factor affecting performance on this standard.

Reasoning is also a demanding standard that evaluates an individual's ability to reason about the relative risks and benefits of various treatment options and to arrive at a decision on the basis of this comparative process (Appelbaum & Grisso, 1988). On this standard, a measure of high-load verbal acquisition/recall (CVLT-2 Total Recall score) was the primary predictor within the MCI group, whereas an executive measure (Trails 3) was the secondary predictor. Among patients with mild AD, the primary predictor of *reasoning* was a measure of semantic word fluency (Semantic Fluency), and the secondary predictor was immediate visual memory recall (10/36 Immediate). Semantic word fluency tasks involve the generation of words belonging to specified categories within a limited time period (Lezak et al., 2004). They are characterized as executive in nature; rely on higher order cognitive processes such as initiation, conceptual reasoning, self-monitoring, and cognitive flexibility; have been linked to frontal lobe functioning; and are known to be impaired in AD (Henry & Crawford, 2004; Lezak et al., 2004; March & Pattison, 2006). We also note that impairment on measures of semantic fluency, relative to phonemic fluency, is a hallmark of AD (Murphy et al., 2006; Taylor et al., 2005). Therefore, it is likely that the emergence of Semantic Fluency as the key predictor of *reasoning* in mild AD also reflects the impact of degradation in semantic networks on reasoning abilities regarding medical information.

Taken together, the MCI and mild AD models for *reasoning* suggest that cognitive difficulties related to memory, executive function, and semantic knowledge underlie diminishing ability to reason about a treatment choice. Cognitive measures of memory and executive function are relevant to *reasoning*, because this standard requires the individual to both recall the various risks and benefits of each treatment option, and to logically and comparatively weigh this information in explaining his/her treatment decision. The present

https://doi.org/10.1017/S1355617708080338

Table 4. Neuropsychological predictors of CCTI performance*

	Controls, $n = 56$					MCI, $n = 60$					Mild AD, $n = 31$				
Standard	Variable	r	p	R^2	p	Variable	r	p	R^2	p	Variable	r	p	R^2	p
S1, *expressing choice*	—	—	—	—	—	—	—	—	—	—	CPT Perserv.	−.588	.001	.35	.001
											CLOX 2	.553	.001	.16	.009
											Trails B	−.457	.010		
[S2], *reasonable choice*	—	—	—	—	—	DRS-2 Constr.	.479	.001	.27‡	.025	10/36 Immediate	.520	.003	.40‡	.012
											10/36 Delayed	.515	.003		
S3, *appreciation*	—	—	—	—	—	LM II	.400	.002	.16	.001	Trails A	−.575	.001	.33	.001
						LM I	.385	.002			Cog. Comp.	.541	.002		
						CVLT-2 Total	.353	.006			DRS-2 Constr.	.531	.002		
S4, *reasoning*	—	—	—	—	—	CVLT-2 Total	.460	.001	.24	.001	Semantic Fluency	.502	.004	.25	.004
						LM II	.422	.001			10/36 Immediate	.468	.008	.10	.05
						Trails 3	−.393	.005	.06	.05	Trails A	−.455	.010		
						CPT Omissions	−.343	.008							
S5, *understanding*	Trails 3	−.403	.004	.16	.004	LM II	.689	.001	.44	.001	Trails A	−.710	.001	.50[1]	.001
						LM I	.585	.001			DRS-2 Memory	.707	.001	.06[3]	.02
						CVLT-2 Total	.578	.001	.05	.03	LM I	.685	.001	.17[2]	.01
						Trails B	−.566	.001							
						VR II	.528	.001							
						Trails 3	−.512	.001	.04	.05					

Note. The superscripts next to the R^2 values for predictors of S5 among mild AD patients indicate the order of variable entry into the regression model. The double dagger symbols indicate Nagelkerke R^2. r = simple bivariate correlation between neuropsychological measure and CCTI standard; R^2 = percentage of variance in CCTI standard accounted for by neuropsychological measure upon entry into multivariable regression model. MCI = Mild Cognitive Impairment; AD = Alzheimer's disease. DRS-2 Constr. = DRS-2 Construction; LM II = Logical Memory II; LM I = Logical Memory I; CVLT-2 Total = Total Recall score on the California Verbal Learning Test, second edition; CPT Omissions = Omission errors on Conners' Continuous Performance Test; VR II = Visual; Reproduction II; CPT Perserv. = Perseveration errors on Conners' Continuous Performance Test; CLOX = Executive Clock Drawing Task; 10/36 = 10/36 Spatial Recall Test; Cog. Comp. = Verbal Reasoning subtest of the Cognitive Competency Test; DRS-2 Memory = DRS-2 Memory.

*A more extensive version of Table 4 is available as a supplementary material at the *JINS 14:2*, March 2008 table of contents on CJO: journals.cambridge.org/jid_INS.

findings are generally consistent with evidence from earlier MDC studies by our group. In one study (Marson et al., 1995a), we found that measures of word fluency were key univariate and multivariable correlates of the *reasoning* consent ability among normal controls and AD patients. In another study (Earnst et al., 2000), we found that measures of semantic knowledge and memory predicted physicians' judgments of treatment consent capacity in AD patients under this consent standard.

Appreciation is a moderately stringent and clinically relevant consent standard. It calls for a person to go beyond the factual treatment information presented in the CCTI vignettes and to identify the short- and long-term personal consequences of a treatment choice (Marson et al., 1996). Performance on this standard thus requires capacities for empathy, emotional processing, social functioning, foresight, and planning (Marson et al., 1996). Such abilities have been found to be subserved by a frontotemporal network of brain regions that is compromised in AD and other degenerative dementias (Rankin et al., 2006). In MCI patients, we found that a measure of delayed verbal recall (Logical Memory II), a temporal lobe mediated cognitive ability, was the only multivariable predictor of this consent ability. Among mild AD patients, a measure tapping processing speed and visuomotor tracking (Trails A), cognitive abilities that largely have their neural substrate in frontosubcortical pathways (Denney et al., 2004; Sachdev et al., 2004) was the predictor of this consent standard. In an earlier study, we also found that measures of executive function (word fluency) and processing speed (Trails A) were very strong predictors of AD patients' performance on *appreciation*, jointly attaining a remarkable classification accuracy of 100% (Marson et al., 1996).

We note that of the five consent standards, *appreciation* had the least variance accounted for by cognitive models within the MCI (16%) and mild AD (33%) groups. This relative weakness in the cognitive models of *appreciation* is consistent with findings from prior studies (Dymek et al., 2001; Gurrera et al., 2006), and underscores that *appreciation* is the consent standard that probably relies most heavily on abilities not fully represented in the neuropsychological armamentarium (Marson et al., 1996). Consequently, performance on *appreciation* is less well modeled by standard cognitive measures.

In addition to the three clinically relevant standards of *understanding, reasoning*, and *appreciation*, we also examined neuropsychological models of clinically less stringent consent standards: *expressing choice* and *reasonable choice*. *Expressing choice* simply requires the individual to express a treatment choice, whereas *reasonable choice* evaluates the reasonableness of a treatment choice by inquiring whether the person made a decision that is congruent with the decision a reasonable person in similar circumstances would make. Within the MCI group, a measure of simple visuospatial construction and visual attention (DRS-2 Construction) was the predictor of *reasonable choice* performance, whereas among mild AD patients, immediate visual recall (10/36 Immediate) was the predictor. These findings suggest that MCI patients arrive at a "poor" treatment choice by means of disruption of attentional processes, whereas mild AD patients make a poor choice as a result of disruption of short-term memory. Mild AD patients arguably do not remember sufficient detail from the vignette to realize that a particular treatment choice is not a good option. It is notable but not entirely clear why the predictors of *reasonable choice* in both the MCI and mild AD models have a visual component.

Among MCI patients, no neuropsychological model emerged for S1. The multivariable predictors of S1 within the mild AD group were measures of response perseveration (CPT Perseveration) and visuospatial construction/simple attention (CLOX 2). By design and scoring algorithm, the latter measure is also sensitive to deficits in planning, organization, self-monitoring, and intrusion (Royall et al., 1998). Both measures, therefore, appear to have varying components of complex attention and simple executive function. On S1, verbal prompts are provided (and a point deduction is made) when a participant fails to make a choice, or when the initial response is vague or circuitous. A participant receives no points if they fail to provide an explicit treatment choice even after cueing. In the present study, the impaired performance of mild AD patients on S1 appears related to problems with simple attention and perseveration, resulting in both initial decisional hesitancy and a failure to use proffered cues to appropriately modify a vague response.

The convergent evidence from our neurocognitive models, across consent standards and study groups, suggests that treatment consent capacity in dementia is primarily subserved by two broad domains of cognitive abilities—memory and executive function (Marson, 2001). Other cognitive domains that also contributed to performance, especially within the mild AD group, include semantic knowledge and processing speed. Within the MCI group, memory measures were more prominent, relative to executive function measures, on all consent standards. As discussed, this finding suggests that the impaired MDC of MCI patients is primarily a consequence of their cardinal amnestic deficits. On the other hand, measures of executive function, semantic knowledge, and processing speed were more prominent in the mild AD models. However, the mild AD findings, specifically the absence of memory predictors, should be interpreted with caution. It is likely that the role of memory measures in the mild AD models was muted by floor effects—an increasingly restricted range of memory test scores. As reflected in other studies, memory impairment is a crucial, and arguably the pre-eminent, cognitive basis for declining MDC in AD (Dymek et al., 1999; Gurrera et al., 2006; Marson et al., 1997).

Our findings have several scientific and clinical implications. First, as discussed, they demonstrate the importance of memory deficits to MDC, and presumably to other higher functional capacities, in MCI. Second, it is plausible that memory and executive function processes represent a final common pathway between neuropathological changes in

https://doi.org/10.1017/S1355617708080338

AD and loss of higher order functional abilities such as MDC. Specifically, neuropathological alterations in AD result in memory problems and executive dysfunction that, in turn, impact functional abilities because of information loss and diminished ability to adequately organize or manipulate residual information (Marson et al., 1997). The contributions of processing speed and semantic knowledge to consent capacity in AD are also worth noting because a valid consent entails an ability to internally process relatively large chunks of information and to ultimately communicate a treatment decision to a clinical professional (Alexander, 1988; Marson, 2001). Third, given these findings, it will be important for healthcare professionals working with MCI patients to be increasingly sensitive to the potential impact of memory and executive function impairments on informed consent capacities—both for treatment and research. Fourth, the different patterns of cognitive correlates of MDC across study groups provide insight into the dynamic way MDC is differentially impacted by diverse cognitive deficits at various stages of a dementing process such as AD. Finally, clinical strategies and interventions that address memory and executive function abilities may be helpful in enhancing the consent capacities of both MCI and mild AD patients (Moye et al., 2007; Okonkwo et al., 2007). There is preliminary evidence for the efficacy of such clinical procedures (Mittal et al., 2007).

Some limitations of this study should be noted. First, medical decisions based on hypothetical vignettes may not be fully representative of the decisions individuals might make when faced with actual, personal medical problems. We also note that, although our assignment of relative stringency to the consent standards is consistent with findings from other studies of decisional capacity in dementia (Lai & Karlawish, 2007; Moye et al., 2004, 2007), such a hierarchy has not been found in some studies conducted with psychiatric and medically ill patients (e.g., Grisso & Appelbaum, 1995). Third, because statistical regression procedures may overfit data to specific samples, it will be important for our findings to be validated in replication studies.

Finally, although we found that measures of memory and executive function were significant predictors of consent capacity, it is unlikely that all cognitive tests of memory or executive function will be equally sensitive to decrements in MDC in patients with preclinical and mild AD. Future research should use the current findings as a platform for identifying the most sensitive and specific memory and executive function measures. These can be organized into a specialized neuropsychological battery to be used, in conjunction with direct assessment capacity instruments such as the CCTI, in supporting clinician judgments of treatment consent capacity in patients with MCI and AD (Marson et al., 1997).

ACKNOWLEDGMENTS

This research was supported by grants 1R01 AG021927 (Marson, PI) and 1P50 AG16582 (Alzheimer's Disease Research Center) (Marson, PI) from the National Institute on Aging. The authors thank the staff of the Neuropsychology Laboratory in the Department of Neurology for their assistance with data collection.

REFERENCES

Alexander, M. (1988). Clinical determination of mental competence. *Archives of Neurology*, *45*, 23–26.

Appelbaum, P.S. & Grisso, T. (1988). Assessing patients' capacities to consent to treatment. *New England Journal of Medicine*, *319*, 1635–1638.

Boringa, J.B., Lazeron, R.H.C., Reuling, I.E.W., Ader, H.J., Pfennings, L.E.M.A., Lindeboom, J., de Sonneville, L.M.J., Kalkers, N.F., & Polman, C.H. (2001). The Brief Repeatable Battery of Neuropsychological Tests: Normative values allow application in multiple sclerosis clinical practice. *Multiple Sclerosis*, *7*, 263–267.

Conners, C.K. (1992). *Conners' Continuous Performance Test*. Toronto: Multi-Health Systems.

Delis, D.C., Kramer, J.H., Kaplan, E., & Ober, B.A. (2000). *California Verbal Learning Test* (2nd ed.). San Antonio, TX: Psychological Corporation.

Denney, D.R., Lynch, S.G., Parmenter, B.A., & Horne, N. (2004). Cognitive impairment in relapsing and primary progressive multiple sclerosis: Mostly a matter of speed. *Journal of the International Neuropsychological Society*, *10*, 948–958.

Dodge, H.H., Yangchun, D., Saxton, J.A., & Ganguli, M. (2006). Cognitive domains and trajectories of functional independence in non-demented elderly. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *61*, 1330–1337.

Dymek, M.P., Atchison, P., Harrell, L.E., & Marson, D.C. (2001). Competency to consent to medical treatment in cognitively impaired patients with Parkinson's disease. *Neurology*, *56*, 17–24.

Dymek, M.P., Marson, D.C., & Harrell, L.E. (1999). Factor structure of capacity to consent to medical treatment in patients with Alzheimer's disease: An exploratory study. *Journal of Forensic Neuropsychology*, *1*, 27–48.

Earnst, K.S., Marson, D.C., & Harrell, L.E. (2000). Cognitive models of physicians' legal standard and personal judgments of competency in patients with Alzheimer's disease. *Journal of the American Geriatrics Society*, *48*, 919–927.

Folstein, M.F., Folstein, S.E., & McHugh, P.R. (1975). Mini-mental state: A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*, *12*, 189–198.

Gauthier, S., Reisberg, B., Zaudig, M., Petersen, R.C., Ritchie, K., Broich, K., Belleville, S., Brodaty, H., Bennett, D., Chertkow, H., Cummings, J.L., de Leon, M., Feldman, H., Ganguli, M., Hampel, H., Scheltens, P., Tierney, M.C., Whitehouse, P., Winblad, B., & the International Psychogeriatric Association Expert Conference on mild cognitive impairment. (2006). Mild cognitive impairment. *Lancet*, *367*, 1262–1270.

Griffith, H.R., Belue, K., Sicola, A., Krzywanski, S., Zamrini, E., Harrell, L.E., & Marson, D.C. (2003). Impaired financial abilities in mild cognitive impairment. *Neurology*, *60*, 449–457.

Griffith, H.R., Dymek, M.P., Atchison, P., Harrell, L.E., & Marson, D.C. (2005). Medical decision-making in neurodegenerative disease: Mild AD and PD with cognitive impairment. *Neurology*, *65*, 483–485.

Grisso, T. & Appelbaum, P.S. (1995). Comparison of standards for assessing patients' capacities to make treatment decisions. *American Journal of Psychiatry*, *152*, 1033–1037.

Gurrera, R.J., Moye, J., Karel, M.J., Azar, A.R., & Armesto, J.C. (2006). Cognitive performance predicts treatment decisional abilities in mild to moderate dementia. *Neurology*, *66*, 1367–1372.

Henry, J.D. & Crawford, J.R. (2004). A meta-analytic review of verbal fluency performance following cortical lesions. *Neuropsychology*, *18*, 284–295.

Jurica, P.J., Leitten, C.L., & Mattis, S. (2001). *Dementia Rating Scale* (2nd ed.). Lutz, FL: Psychological Assessment Resources.

Kaplan, E., Goodglass, H., & Weintraub, S. (1983). *Boston Naming Test*. Philadelphia: Lea & Febiger.

Karlawish, J.H.T., Casarett, D.J., James, B.D., Xie, S.X., & Kim, S.Y.H. (2005). The ability of persons with Alzheimer's disease (AD) to make a decision about taking an AD treatment. *Neurology*, *64*, 1514–1519.

Kim, S.Y.H. & Karlawish, J.H.T. (2003). Ethics and politics of research involving subjects with impaired decision-making abilities. *Neurology*, *62*, 1645–1646.

Lai, J.M. & Karlawish, J.H.T. (2007). Assessing the capacity to make everyday decisions: A guide for clinicians and an agenda for future research. *American Journal of Geriatric Psychiatry*, *15*, 101–111.

Lezak, M.D., Howieson, D.B., & Loring, D.W. (2004). *Neuropsychological Assessment* (4th ed.). New York: Oxford University Press.

March, E.G. & Pattison, P. (2006). Semantic verbal fluency in Alzheimer's disease: Approaches beyond the traditional scoring system. *Journal of Clinical and Experimental Neuropsychology*, *28*, 549–566.

Marson, D.C. (2001). Loss of competency in Alzheimer's disease: Conceptual and psychometric approaches. *International Journal of Law and Psychiatry*, *24*, 267–283.

Marson, D.C., Chatterjee, A., Ingram, K., & Harrell, L.E. (1996). Towards a neurologic model of competency: Cognitive predictors of capacity to consent in Alzheimer's disease using three different legal standards. *Neurology*, *46*, 666–672.

Marson, D.C., Cody, H., Ingram, K., & Harrell, L.E. (1995a). Neuropsychological predictors of competency in Alzheimer's disease using a rational reasons legal standard. *Archives of Neurology*, *52*, 955–959.

Marson, D.C., Hawkins, L., McInturff, B., & Harrell, L.E. (1997). Cognitive models that predict physician judgments of capacity to consent in mild Alzheimer's disease. *Journal of the American Geriatrics Society*, *45*, 458–464.

Marson, D.C., Ingram, K., Cody, H., & Harrell, L.E. (1995b). Assessing the competency of patients with Alzheimer's disease under different legal standards. *Archives of Neurology*, *52*, 949–954.

McKhann, G., Drachman, D., Folstein, M., Katzman, R., Price, D., & Stadlan, E.M. (1984). Clinical diagnosis of Alzheimer's disease: Report of the NINCDS-ADRDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's Disease. *Neurology*, *34*, 939–944.

Mittal, D., Palmer, B., Dunn, L., Landes, R., Ghormley, C., Beck, C., Golshan, S., Blevins, D., & Jeste, D.V. (2007). Comparison of two enhanced consent procedures for patients with mild Alzheimer disease or mild cognitive impairment. *American Journal of Geriatric Psychiatry*, *15*, 163–167.

Morris, J.C. (1993). The Clinical Dementia Rating (CDR): Current version and scoring rules. *Neurology*, *43*, 2412–2414.

Moye, J., Karel, M.J., Azar, A.R., & Gurrera, R.J. (2004). Capacity to consent to treatment: Empirical comparison of three instruments in older adults with and without dementia. *Gerontologist*, *44*, 166–175.

Moye, J., Karel, M.J., Gurrera, R.J., & Azar, A.R. (2007). Neuropsychological predictors of decision-making capacity over 9 months in mild-to-moderate dementia. *Journal of General Internal Medicine*, *21*, 78–83.

Murphy, K.J., Rich, J.B., & Troyer, A.K. (2006). Verbal fluency patterns in amnestic mild cognitive impairment are characteristic of Alzheimer's type dementia. *Journal of the International Neuropsychological Society*, *12*, 570–574.

Okonkwo, O., Griffith, H.R., Belue, K., Lanza, S., Zamrini, E., Harrell, L.E., Brockington, J.C., Clark, D., Raman, R., & Marson, D.C. (2007). Medical decision-making capacity in patients with mild cognitive impairment. *Neurology*, *69*, 1528–1535.

Okonkwo, O., Wadley, V.G., Griffith, H.R., Ball, K., & Marson, D.C. (2006). Cognitive correlates of financial abilities in mild cognitive impairment. *Journal of the American Geriatrics Society*, *54*, 1745–1750.

Petersen, R.C., Doody, R., Kurz, A., Mohs, R.C., Morris, J.C., Rabins, P.V., Ritchie, K., Rossor, M., Thal, L., & Winblad, B. (2001). Current concepts in mild cognitive impairment. *Archives of Neurology*, *58*, 1985–1992.

Petersen, R.C. & Morris, J.C. (2005). Mild cognitive impairment as a clinical entity and treatment target. *Archives of Neurology*, *62*, 1160–1163.

Rankin, K.P., Gorno-Tempini, M.L., Allison, S.C., Stanley, C.M., Glenn, S., Weiner, M.W., & Miller, B.L. (2006). Structural anatomy of empathy in neurodegenerative disease. *Brain*, *129*, 2945–2956.

Reitan, R. & Wolfson, D. (1993). *The Halstead-Reitan Neuropsychological Test Battery: Theory and Clinical Interpretation*. Tucson, AZ: Neuropsychology Press.

Ritchie, K., Artero, S., & Touchon, J. (2001). Classification criteria for mild cognitive impairment: A population-based validation study. *Neurology*, *56*, 37–42.

Royall, D.R., Cordes, J.A., & Polk, M. (1998). CLOX: An executive clock-drawing task. *Journal of Neurology, Neurosurgery, and Psychiatry*, *64*, 588–594.

Sachdev, P.S., Brodaty, H., Valenzuela, M.J., Lorentz, L., Looi, J.C., Wen, W., & Zagami, A.S. (2004). The neuropsychological profile of vascular cognitive impairment in stroke and TIA patients. *Neurology*, *62*, 912–919.

Salthouse, T.A. (1996). The processing-speed theory of adult age differences in cognition. *Psychological Review*, *103*, 403–428.

Sherwin, B.B. (2000). Mild cognitive impairment: Potential pharmacological treatment options. *Journal of the American Geriatrics Society*, *48*, 431–441.

Spreen, O. & Strauss, E. (1991). *A Compendium of Neuropsychological Tests*. New York: Oxford University Press.

Tabachnick, B.G. & Fidell, L.S. (2007). *Using Multivariate Statistics* (5th ed.). New York: Harper Collins.

Tabert, M.H., Albert, S.M., Borukhova-Milov, L., Camacho, Y., Pelton, G., Liu, X., Stern, Y., & Devanand, D.P. (2002). Functional deficits in patients with mild cognitive impairment: Prediction of AD. *Neurology*, *58*, 758–764.

Taylor, K.I., Salmon, D.P., Monsch, A.U., & Brugger, P. (2005). Semantic and phonemic sequence effects in random word gen-

eration: A dissociation between Alzheimer's and Huntington's disease patients. *Journal of the International Neuropsychological Society*, *11*, 303–310.

Tepper, A. & Elwork, A. (1984). Competency to consent to treatment as a psychological construct. *Law and Human Behavior*, *8*, 205–223.

Tuokko, H., Morris, C., & Ebert, P. (2005). Mild cognitive impairment and everyday functioning in older adults. *Neurocase*, *11*, 40–47.

Wang, P.L. & Ennis, K.E. (1986). *The Cognitive Competency Test*. Toronto: Mt. Sinai Hospital Neuropsychology Laboratory.

Wechsler, D. (1987). *Wechsler Memory Scale–Revised edition*. San Antonio, TX: Psychological Corporation.

Wechsler, D. (1997a). *WAIS-III: Wechsler Adult Intelligence Scale–3rd edition*. San Antonio, TX: The Psychological Corporation.

Wechsler, D. (1997b). *WMS-III: Wechsler Memory Scale–3rd edition*. San Antonio, TX: Psychological Corporation.

Wilkinson, G. (1993). *Wide Range Achievement Test Administration Manual* (3rd ed.). Wilmington, DE: Wide Range Incorporated.

Yesavage, J. (1988). Geriatric depression scale. *Psychopharmacology Bulletin*, *24*, 709–713.