

**EDITORIAL**

## Remembering, forgetting, and the effects of trauma on memory: A developmental psychopathology perspective

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**Abstract**

A developmental psychopathology framework, with its emphasis on an interdisciplinary perspective, the interplay between work conducted with normal and atypical populations, and its focus on investigating functioning in multiple domains of development concurrently, possesses significant potential for advancing work on memory and trauma. A brief historical overview of memory and trauma is provided. Significant issues are highlighted that must be confronted in order to advance the understanding of the effects of trauma on memory and the utility of a developmental psychopathology perspective for informing research efforts is examined. The implications of a developmental psychopathology perspective for guiding research, clinical, and social policy initiatives of relevance to trauma and memory are discussed.

The field of developmental psychopathology, in its relatively young history, has contributed to significant advances in the understanding of multiple domains of child and adult development (see Cicchetti & Cohen, 1995a, 1995b). In an early articulation of the field of developmental psychopathology, Sroufe and Rutter (1984) stated, “. . . in developmental psychopathology the focus is on the ontogenetic process whereby early patterns of individual adaptation evolve to later patterns of adaptation. The aim is to understand the origins and course of disordered behavior, whether disorder emerges in earliest childhood or not until adulthood. At times, study-

ing the course of adaptation in selected non-disordered individuals also is of great interest. . . .” (p. 25). In a more recent conceptual explication of developmental psychopathology, Cicchetti and Cohen (1995a) articulated that the field is characterized by “. . . a focus on the interplay between normal and atypical development, an interest in diverse domains of functioning, and an emphasis on the utilization of a developmental framework for understanding adaptation across the life course” (p. 3). For this Special Issue, we have asked contributors to bring a developmental psychopathology perspective to bear on matters related to risk, trauma, and memory (see, for example, Estes, 1998). In view of its emphasis on an interdisciplinary perspective, the mutually enriching interplay between work conducted with normal and atypical populations and its focus on examining functioning in multiple domains of development concurrently, a developmental psychopathology perspective is especially timely in providing a lens for better understanding the effects of trauma on memory.

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Indeed, since its inception, research conceived within a developmental psychopathology framework has emphasized the bidirectional benefit of conducting research on normal and abnormal development. In fact, Cicchetti (1990) argued that before developmental psychopathology could emerge as a discipline in its own right, a strong base in normal developmental theory and research needed to exist. It is this cornerstone that has allowed developmental psychopathologists to move into new and challenging areas of inquiry, in turn questioning and expanding upon theories derived from research on normal populations (Cicchetti, 1984, 1989, 1993; Garcia Coll et al., 1996; Sroufe, 1990). Developmental psychopathology continues to transcend traditional disciplinary boundaries and offers an overarching perspective that can contribute to the formulation of an understanding of normal and atypical developmental trajectories.

The value inherent in a developmental psychopathology approach for contributing to an understanding of trauma and memory is underscored through a statement made by Schacter (1995): “. . . our understanding of memory distortion will be enhanced by—and may even require—investigation and inquiry at several different levels of analysis by scientists and scholars from a variety of disciplines” (p. 3). The complexity of memory, with the accompanying need for interdisciplinary collaboration, is powerfully illustrated when trying to apply theoretical conceptualizations and research findings derived from cognitive neuroscience to individuals who have been traumatized. This boundary between methodologically rigorous investigations of memory processes and brain functioning in traumatized and nontraumatized persons, frequently conducted in controlled laboratory settings, and the realm of clinical case reports derived from the “real world” settings in which victims of trauma reside may, upon quick perusal, appear to be too divergent to allow for a productive interchange. However, it is this seeming disparity that holds the greatest promise for challenging extant assumptions and for fostering growth of different and potentially mutually enriching perspectives (cf. Loftus, Joslyn, & Polage, 1998).

Debates have raged over issues such as whether trauma enhances memory, thereby “burning an indelible trace into the brain,” or whether the stress associated with memory actually impairs the accuracy of recall, eventuating in alterations in brain structure and function in some individuals over periods of extended stress. Controversy also has escalated in recent years with regard to the scientific credibility of recovered memories, as well as with respect to the suggestibility of memory in young children and of the implantation of memories in adults in psychotherapeutic contexts. All of these issues possess significant implications not only for informing the scientific understanding of the operation of memory, but also for affecting society more broadly. For example, scientific evidence on the functioning of memory under conditions of extreme stress has been brought to bear in court decisions regarding the accuracy of the eyewitness testimony of victims of crime. Questions pertaining to the reliability of the memories of young children have also had far reaching impacts on cases involving allegations of sexual abuse, and adults who have purported to recall past trauma have brought law suits against the alleged perpetrators of their childhood abuse (cf. Ceci & Bruck, 1995).

In this article, we begin by providing a brief overview of the historical context within which to view investigations that are relevant to understanding how memory may operate in victims of trauma. This background material is by no means comprehensive but addresses a number of key issues (for example, see Schacter, 1995 for history pertaining to memory distortion). A repeated thread that is woven throughout historical and contemporary perspectives on memory and trauma involves the accuracy versus distortion that may accompany memories for trauma. We then highlight what we consider to be significant issues that need to be confronted and surmounted in order to advance the understanding of memory and trauma and examine the utility of a developmental psychopathology perspective for guiding research efforts in this area. We conclude by addressing implications of a developmental psychopathology framework for

guiding research, clinical, and policy initiatives of relevance to trauma and memory.

### **A Historical Perspective on Memory and Trauma**

Although observations and theories pertaining to the nature of memory date to Aristotle's initial formulation of the laws of association (Sorabji, 1972), the first application of the experimental method to human memory occurred when Ebbinghaus published his classic treatise, *Memory, A Contribution to Experimental Psychology* (Ebbinghaus, 1885/1964). Through introducing a methodology that allowed for control over the input to the memory system, Ebbinghaus provided an important tool that allowed for determining whether a memory was true or false. Specifically, by knowing what an individual was being asked to remember, the experimenter could verify the "truth" versus "falsehood" of subsequent recall. This early scientific contribution underscores a continued challenge confronting those attempting to assess memory in victims of trauma, namely, that it is rarely, if ever, possible to know the complete reality of the trauma victim's experience. Therefore, evaluating the subsequent accuracy of reported memories for traumatic experiences becomes extremely difficult.

Experimental evidence for the existence of memory distortion dates to the 1900s, when Alfred Binet reported that misleading questions could result in distortions in children's recollections (see Ceci & Bruck 1993, for a review of the suggestibility of memory in children). Stern (1910), in describing experiments in which children were asked about an event that had been staged in their classrooms, reported that the accuracy of recall could be affected if children were asked misleading questions. Building on this early body of work, Ceci and his colleagues (see, for example, Ceci & Bruck, 1995; Ceci & Huffman, 1997) have continued to examine the accuracy of children's recall, utilizing analog paradigms similar to those reported by Stern (1910) and concluding that, in fact, children's memories, especially those of preschool age and younger, are very susceptible to distortion

as a result of suggestibility. Similarly, in their programmatic studies, Loftus and her colleagues have concluded that leading questions can alter the accuracy of recall (Loftus, 1993; Loftus & Palmer, 1974) and that information provided after an event has occurred can modify the recall of the initial event (Loftus, Miller, & Burns, 1978).

Another body of work has countered evidence on the fallibility and suggestibility of memory in young children (Goodman, Quas, Batterman-Faunce, Riddlesberger, & Kuhn, 1994; Peterson & Bell, 1996). These investigators have sought to more closely approximate actual traumatic experiences, using naturally occurring events such as visits to physicians offices to examine the accuracy of children's recall. Evidence provided by these investigations suggests that, in fact, children's memories can be quite accurate. The disparity between the conclusions derived from these various programs of research highlight an issue of considerable relevance to investigations of memory and trauma, namely, that differences in findings and resultant interpretations may arise through the utilization of varied methodological strategies. In experiments that have verified the accuracy of recall, typically efforts were not made to mislead children, but rather to evaluate the accuracy of their memories. Much of the work that has validated the suggestibility of memory, conversely, has manipulated experimental conditions in order to examine the likelihood of the incorporation of faulty information occurring, thereby contributing to evidence for memory distortion. Clearly, each of these paradigms possesses advantages as well as limitations. However, the conclusions that can be drawn from them and the resulting policy implications are quite discrepant and dramatic. Consequently, in investigations and subsequent conclusions about the accuracy of memory, the population being investigated and the approximation of the study design to actual traumatic occurrences, as well as the methodology utilized, must be taken into account.

Interestingly, the genesis of the current debate regarding the accuracy versus distortion of memories associated with reports of trauma

can be traced to the theories of Sigmund Freud. Although Freud initially maintained that repressed memories of sexual abuse contributed to pathological symptoms and, as such, needed to be recalled in order to free the patient from the traumatic past (Freud, 1896), he subsequently abandoned this conceptualization in favor of the position that “recovered memories” were, in fact, nothing more than fantasies (Freud, 1910). Characteristic of the difficulties associated with assessing the accuracy of memories for trauma was the fact that Freud’s theorizing was based on clinical reports and that he, therefore, could not verify the veridicality or lack thereof of his patients’ memories.

In more recent years, considerable research on the relation between emotion and memory has been conducted; this work is especially relevant to a consideration of the effects of trauma on memory. Studies of mood and memory have concluded that mood congruent information between the occurrence of an event and the time of recall is likely to be more readily recalled than mood incongruent material (Bower, 1981, 1992). Investigations of “flashbulb memories” (Brown & Kulik, 1977) have asserted that highly arousing and unique events can be remembered clearly (Christianson, 1989; Conway et al., 1994; Koss, Tromp, & Tharan, 1995). However, it also has become increasingly clear that flashbulb memories are subject to decay and distortion in a manner that is not dissimilar to that of more mundane memories (Neisser & Harsch, 1992; Weaver, 1993). Thus, despite a long tradition of scientific interest, in many ways we are at the frontier of understanding the effects of trauma on memory.

This brief overview serves to illustrate the fascinating threads related to remembering and forgetting that have intrigued philosophers, clinicians, theoreticians, and experimentalists, both historically and continuing into the present day. Significant advances have emerged with respect to understanding memory in recent years. Perhaps most relevant for informing studies of trauma and memory are conceptualizations that memory is comprised of various systems and subsystems that are separate but interacting (see

Schacter & Tulving, 1994, for a review). Because various kinds of memory (e.g., implicit versus explicit) are thought to be dependent on different brain structures and functions (Schacter, 1994), accurate versus inaccurate recall may occur as a function of the status of an individual’s neurobiological development at the time of the occurrence of a traumatic event. Views on trauma and memory that elucidate the importance of considering the developmental influences that are affecting memory for trauma are extremely compatible with a developmental psychopathology approach to assessing how experiences that occur at various developmental periods may affect biological and psychological functioning differentially (Cicchetti & Tucker, 1994).

Based on the cognitive neuroscience and clinical literatures relating to memory, as well as work emanating from developmental psychopathology, we next raise a number of questions that we believe must be addressed in the area of trauma and memory. We also offer insights derived from developmental psychopathology on how best to address these concerns.

### Issues in Trauma and Memory

#### *Do memories for trauma differ from memory for more general events?*

Perhaps first and foremost, theoreticians, clinicians, and researchers interested in memory and trauma must grapple with a central question; specifically, does memory for trauma operate similarly to or differently from memory more generally? This issue is critically important to decisions regarding the utility of laboratory findings derived from cognitive neuroscience, frequently conducted with non-traumatized populations, for informing an understanding of memory in victims of trauma. One view on this issue is conveyed emphatically by van der Kolk and Fisler (1995): “If trauma is defined as the experience of an inescapable stressful event that overwhelms one’s existing coping mechanisms, it is questionable whether findings of memory distortion in normal subjects exposed to videotaped stresses in the laboratory can serve as mean-

ingful guides to understanding traumatic memories” (p. 506). Approaching this question from a very different scientific perspective, a similar warning is made: “Before we can confidently apply evidence and ideas from basic cognitive neuroscience, the phenomena that we are attempting to explain must be characterized more fully. Unless and until more reliable information becomes available we urge caution when extrapolating from cognitive neuroscience to the complex and important issues at stake in debates about recovered memories” (Schacter, Koutstaal, & Norman, 1996, p. 211).

As evidenced by these statements proffered by clinical researchers as well as by cognitive neuroscientists, more agreement than disagreement is noted regarding the possible pitfalls inherent in applying results obtained from research conducted with normal populations to conclusions about the operation of memory in victims of trauma. Clearly, caution in extrapolating from controlled studies of nontraumatized populations to victims with respect to the functioning of memory are warranted. Currently, the extant research on memory for traumatic events is inconclusive (see Goodman, Emery, & Haugaard, 1997 for a review), as are findings on the effects of stress more generally on children’s memory (Bugental, Blue, Cortez, Fleck, & Rodriguez, 1992). Although some investigators argue that memory for traumatic events behaves similarly to memory in general (Howe, 1997, 1998), this view might erroneously be interpreted as suggesting that trauma is insignificant in the overall functioning of memory. However, as made clear by Howe (1998), memory in general operates differently under conditions of emotional stress versus mundane daily occurrences. Thus, statements that maintain that memory operates similarly in traumatized and nontraumatized individuals do not discount the unique effects of trauma on memory (e.g., central details of an event are recalled while peripheral ones are forgotten; emotionally significant information is more likely to be remembered than less personally meaningful events). Memory for trauma varies just as memory for positive versus negative events or for routine versus

unique occurrences does. What is becoming increasingly clear is that memory for traumatic events is related to developmental and individual differences in basic information processing skills, including encoding, storage, organization, and recall. Issues related to contextual and social factors also are increasingly being thought to influence the recall of trauma (Eisen & Goodman, 1998).

In view of the role that development and individual differences exert on the recall of trauma, it is not surprising that a developmental psychopathology perspective possesses relevance for informing the critical question regarding the ways in which memory for trauma may mirror or diverge from memory for more typical events in nontraumatized populations. Individuals working within a developmental psychopathology tradition have long maintained not only that research on normal populations can be used to inform investigations on more atypical development, but also that knowledge gained from examining processes in atypical populations may provide new insights on developmental theory more broadly (Cicchetti, 1984, 1990, 1996; Sroufe, 1990). For example, investigations with atypical populations have enhanced the understanding of the nature of the interplay that exists between cognitive and emotional development in infancy through the study of babies with Down Syndrome (Cicchetti & Pogge-Hesse, 1982; Cicchetti & Sroufe, 1976; Izard & Harris, 1995). Likewise, investigations of child maltreatment, with the extremes in parenting experienced by children, have resulted in a better understanding of the criticality of adaptive parenting practices in fostering adjustment in normative populations (Rogosch, Cicchetti, Shields, & Toth, 1995). In addition, studies of atypical children have been critical in elucidating a new form of attachment organization (Carlson, Cicchetti, Barnett, & Braunwald, 1989), the disorganized-disoriented Type D, contributing to re-evaluations in how attachment in normative, as well as in other atypical populations, has been studied (Main, Kaplan, & Cassidy, 1985; Main & Solomon, 1986, 1990). Thus, although much more scientific evidence must be brought to bear on understanding ways in

which investigations of memory in normal populations converge or diverge from memory in victims of trauma, it would be surprising if work conducted with traumatized populations did not offer some new information regarding memory processes that could challenge or augment theories derived from normal populations.

*Does trauma enhance or impair memory?*

Considerable controversy exists over whether stress, and relatedly trauma, improves or adversely affects memory. To begin to address this issue, the literature on emotion and memory is relevant. Scientific evidence has converged to demonstrate two consistent findings; namely, if emotion is not relevant to the material being learned, then its presence adversely affects memory, and, if the to-be-remembered material is the cause of emotional arousal, then memory is enhanced (Bower & Sivers, 1998). The caveat to this general scenario relates to the occurrence of narrowing of attention, whereby certain personally relevant aspects of an emotional event are encoded to the exclusion of less meaningful aspects of the situation (Easterbrook, 1959). Thus, whereas emotion can be seen as improving memory with respect to relevant aspects of the episode, not all aspects of the situation will be similarly well recalled.

Although seemingly straightforward, research cannot easily explain discrepancies related to accurate recall of trauma versus partial or complete amnesia for traumatic events. In attempting to resolve this disparity, Christianson and Lindholm (1998) argue that inconsistencies in research findings can be explained as a function of a number of dimensions of the to-be-remembered material, including the information studied, differences in elaboration and processing of the to-be-remembered information, and differences in retrieval circumstances. Additionally, these disparities may be partially attributable to the evolutionary value of the importance of remembering and recognizing danger so as to avoid future similar events, in conjunction with the mechanisms that have evolved over time to help individuals cope with traumatic

events by excluding them from conscious awareness (Christianson & Lindholm, 1998).

The explanation provided by Christianson and Lindholm (1998) highlights a number of areas whereby developmental psychopathology may offer guidance for the design and implementation of investigations that can further resolve this issue. In the developmental psychopathology literature, considerable effort has been directed toward improving definitional aspects of the trauma variable. To begin, work conducted with maltreated children can help to inform the operationalization of the to-be-remembered material (cf. Barnett, Manly, & Cicchetti, 1993; Cicchetti, 1991; McGee & Wolfe, 1991). Although we present examples derived from maltreatment for illustrative purposes, a similar approach in which the independent variable is clearly and comprehensively operationalized is warranted with respect to other forms of trauma (Cicchetti & Toth, 1997b). Specifically, it has become increasingly clear that conveying information regarding the type of maltreatment that has been experienced (e.g., physical abuse, sexual abuse, neglect, emotional maltreatment) can provide a much more elaborate portrayal of functioning than that available when trauma is described broadly as "maltreatment." Over and above subtype information, aspects related to the developmental period(s) during which maltreatment may have occurred are very relevant to the processing of material to be remembered. Relatedly, the level of development of various domains of development (e.g., language, self) at the time of occurrence of trauma can have significant implications for the subsequent recall of the trauma. With respect to the role of elaboration of the trauma on subsequent recall, issues such as who perpetrated the maltreatment assume significance. For example, if a child's father perpetrated abuse and he is the child's primary caregiver, then it is unlikely that the child will be afforded the opportunity to discuss traumatic events. In turn, with less rehearsal, memory decrements may occur.

Relationship factors independent of the perpetrator per se also can affect memory. The security of attachment can enter into conditions existing in the retrieval situation in

which the child is asked to recall traumatic events. Specifically, research has shown that children with secure attachment histories recall positive events more accurately than negative events, whereas children with insecure attachment histories recall negative events more accurately (Belsky, Spritz, & Crnic, 1996). Quality of attachment organization also has been shown to affect children's memory for both positive and negative information (Kirsh & Cassidy, 1997). In the first study to examine the role of attachment and memory in traumatized children, Lynch and Cicchetti (1998) report that security of mental representation moderates the effect of trauma on the recall of mother referent words. Issues such as these underscore the different dimensions of trauma that exist when an event is very proximal to the child's social ecology (e.g., in the home) versus occurrences that may occur more distally (e.g., being assaulted in the community). Confounds in dimensions of acute versus chronic trauma also may be likely to vary across different traumatic events and need to be considered in assessing the overall context within which trauma occurs as these dimensions relate to recall.

Matters pertaining to the evolutionary value of remembering versus forgetting traumatic events also can benefit from a developmental psychopathology conceptualization. Evolutionary biology provides a framework whereby natural selection is viewed as shaping the mental mechanisms available to our species that subsequently enhance adaptation and survival (Buss, Haselton, Shackelford, Bleske, & Wakefield, 1998). Such a perspective maintains that to understand overall functioning, we must first know what adaptational problems a given strategy evolved to solve (Jensen, Mrazek, Knapp, Steinberg, Pfeffer, Schowalter, & Shapiro, 1997; Pollak, Cicchetti, & Klorman, 1998). Accordingly, although hypervigilance and enhanced memory for danger may, historically, have protected the species, a child who is living in an ongoing abusive environment and who must present an "all is well" attitude to avoid further abuse may be better served by "forgetting" traumatic experiences. An evolutionary biology perspective necessitates a clear under-

standing of past as well as current circumstances that may be affecting memory functioning. Moreover, such an understanding also possesses implications for intervention, as trying to foster recall of trauma may not necessarily be the most appropriate strategy, depending upon the genesis and maintaining conditions that are contributing to the lack of recall (see also, Post et al., 1998).

*Does memory for traumatic events vary as a function of single (acute) versus repeated (chronic) traumatic experiences?*

A number of theories have been put forth to account for the variability that has been reported, primarily in the clinical literature, on the accuracy of memory for trauma. Clinical case reports of victims of posttraumatic stress disorder (PTSD) speak of vivid, often involuntary, visual images of prior terror (Golier & Yehuda, 1998). Conversely, the sexual abuse literature is replete with examples of individuals who do not recall their experiences at various periods of their lives or who "recover" previously forgotten memories (Williams, 1994). One possible explanation for seemingly disparate memory processes has been related to the occurrence of single versus repeated experiences of trauma.

In general, individuals, both children and adults, have been found to have difficulty accurately recalling common and repeated daily occurrences (see Fivush, 1998). Basically, the mundane nature of an event becomes encoded as a general memory that can reflect the consolidation of routine daily experiences, borrowing elements from shared but discrete event episodes. Although memory of repeated experiences is likely to contain core elements that are common across events, more unique aspects of these experiences may be confused or forgotten (Fivush, 1998). However, evidence also exists, especially with very young children, that a single event for which limited prior experience is present and for which rehearsal does not occur may be more easily forgotten than a more experience-typical event (Bauer, 1996; Bauer, Kroupina, Schwade, Dropik, & Wewerka, 1998). Research has shown that infants given a single exposure to

material evidenced a significant delay in recall over a period of 1 month. However, if provided with three exposures to an event, recall after 1 month was equivalent to that evidenced after 1 week (Bauer, Hertsgaard, & Wewerka, 1995). Thus, once again, the importance of factoring developmental considerations into our investigations and models of trauma and memory is underscored.

In addressing memory for chronic versus acute trauma, Terr (1991) described Type I trauma as involving single traumatic events and Type II trauma as consisting of multiple, chronic experiences. According to Terr, Type I trauma is recalled accurately and with great detail, whereas Type II traumas are considered to be more poorly recalled and often dissociated. Although lacking in empirical verification, this conceptualization is interesting in that it is consistent with previously described research on the confusion that may occur when repeated experiences are recalled (cf. Fivush, 1998). Thus, a single traumatic event might be more accurately recalled because of its uniqueness. However, although intuitively appealing, this model fails to consider developmental aspects such as level of self-development or language capabilities that may differ for cases of acute versus chronic trauma and that, therefore, could alter its recall.

Developmental psychopathology, with its emphasis on the importance of assessing functioning in multiple domains and in varied contexts, could be helpful in shedding light on this matter. Specifically, more recently developmental psychopathologists have directed their attention toward understanding possible contextual influences on development (see Boyce et al., 1998; Cicchetti & Aber, 1998). Significantly for studies of memory, empirical work has demonstrated that social-contextual experiences can affect neurobiological structure and functioning (Cicchetti & Tucker, 1994; Eisenberg, 1995). For example, a number of investigations have found that a mother's emotional condition may impact her infant's developing patterns of brain organization during the early year of life, when sensitive periods for neurobiological growth are present (Dawson, Grofer Klinger, Panagiotides, Hill, & Spieker, 1992; Nelson &

Bloom, 1997). Infants of depressed mothers also have been shown to exhibit frontal-lobe EEG asymmetries, suggestive of an emerging propensity for greater negative affectivity (Dawson et al., 1992; Field, Fox, Pickens, & Nawrocki, 1995). Although it does not require a huge conceptual leap to extrapolate from studies such as these that involve increased stress to considerations of trauma, evidence revealing that exposure to severe trauma can affect brain structure, as evidenced by altered hippocampal volume in patients with post traumatic stress disorder and adults who report childhood sexual abuse, also has been obtained (Bremner & Narayan, 1998; Bremner et al., 1995; Stein, Koverola, Hanna, Torchia, & McClarty, 1997).

*Does trauma affect brain structure and function, which subsequently affects memory?*

As alluded to in our discussion of contextual influences and memory for traumatic events, evidence is emerging that trauma can affect brain structure and functioning. The exact nature of these brain alterations in various traumatized individuals and how brain organization relates to memory requires further empirical investigation (Nelson & Carver, 1998). However, a number of lines of evidence are currently available that can help to inform this important issue.

Individuals who are suffering from PTSD constitute one major investigative arena with respect to neurobiological effects of stress on memory. Because PTSD is characterized by the reexperiencing of traumatic experiences involving intrusive images and intense physiologic reactivity, as well as memory impairment, examining victims of PTSD has been an active area of inquiry for those invested in understanding the effects of trauma on neurobiology and, consequently, memory. Golier and Yehuda (1998) discuss neuroendocrine alterations seen in PTSD, including lower basal cortisol levels, higher glucocorticoid receptor number, enhanced sensitivity to exogenous steroids, and increased variation in basal cortisol levels over the diurnal cycle. These changes also are thought to be likely in other



populations exposed to trauma (see Hart, Gunnar, & Cicchetti, 1995, 1996). In considering the relation among these neurobiological alterations and memory, Golier and Yehuda speculate that cortisol levels may be related to memory-related symptoms in conditions of PTSD.

Additionally, in examinations of actual trauma victims, stress has been found to result in decreased hippocampal volume (Bremner & Narayan, 1998; Gurvits et al., 1996; Stein et al., 1997). Early investigations of high levels of glucocorticoids in animals exposed to extreme stress have been linked to hippocampal damage, which was ultimately related to deficits in memory function (Luine, Billages, Martinex, & McEwen, 1994; Sapolsky, Packan, & Vale, 1988; Sapolsky, Uno, Rebert, & Finch, 1990). Recent studies utilizing magnetic resonance imaging (MRI) with humans have revealed decreased hippocampal volume in Vietnam veterans with PTSD (Bremner et al., 1995; Gurvits et al., 1996), which has subsequently been linked with deficits in short-term memory (Bremner & Narayan, 1998). Likewise, women who reported sexual abuse in their childhoods have been found to have diminished hippocampal volume, although hippocampal volume was not related with indices of explicit memory functioning (Stein et al., 1997).

Despite these important findings, investigations of neurobiological changes as a function of experiences of trauma in humans remain in their infancy. To date, there has been a dearth of investigations of neurobiological changes related to trauma that also have incorporated comprehensive assessments of psychological and contextual variables in the same individuals and that have sought to relate these factors to individual differences in memory functioning. This is especially true with respect to such studies in children. Prospective studies also are needed to ascertain whether there may be a genetic predisposition or vulnerability to decreased hippocampal volume in some individuals that may increase their vulnerability to the subsequent development of memory problems following traumatization. Because a developmental psychopathology perspective calls for the integration

of psychological, biological, social, and contextual influences on adaptation and maladaptation across the lifespan, this framework has much to offer to investigations of the neurobiological substrates of trauma and memory functioning.

*Can "trauma" broadly defined be related to variations in memory, or must we rather ascertain how different forms of trauma that may occur during different periods of development affect different kinds of memory?*

In trying to understand the effects of trauma on memory, two very complex issues emerge. First, it is becoming increasingly clear that one cannot discuss "memory" as a unidimensional entity. Rather, as discussed by Schacter (1994), different and interacting subsystems of memory exist. Thus, explicit (declarative) memory, which involves conscious recollection of past experiences, may be affected very differently from implicit (procedural) memory, which pertains to nonconscious effects of prior experiences on subsequent behavior and performance (Schacter, 1992). Perhaps most importantly for discussions of memory and trauma is implicit memory, the memory subsystem which is thought to operate without conscious awareness. Thus, although decrements may not be present in explicit memory, implicit memory may be affected in an individual who has experienced trauma. However, if, in fact, trauma results in some basic brain changes, we must understand where and how these changes might affect memory more broadly.

Interestingly with regard to a developmental psychopathology perspective is the widely held conclusion, drawn from theories that proffer a hierarchical perspective on development and work conducted with amnesic adults, that implicit memory is a primitive system functional shortly after birth whereas explicit memory matures late in the first year of life (Rovee-Collier, 1997). In fact, evidence reviewed by Rovee-Collier (1997) reveals that implicit and explicit memory follow the same developmental progression, thereby disputing the notion that different systems

mediate retention of different types of acquired knowledge at different points in development. This challenge to a generally accepted developmental notion of memory subsystems is intriguing and certainly calls for further investigations of these systems in traumatized populations.

Just as we cannot ask simply if memory is affected by trauma, nor can we assume that all trauma affects memory similarly. As discussed previously, contextual issues related to acute versus chronic trauma might affect memory very differently. Similarly, understanding the impact of trauma on the individual more broadly and on memory specifically must consider the meaning of the event to the individual (Cicchetti & Toth, 1997a). A view on trauma that is compatible with a developmental psychopathology perspective has been postulated by Janoff-Bulman (1992), who states that the psychological disequilibrium that occurs as a result of trauma arises when the fundamental assumptions that the world is benevolent and the self is worthy are assaulted. The incorporation of a developmental perspective into this conceptualization of trauma perhaps raises more questions than can be simply answered, as issues such as how developmental level may affect an individual's capacity to know that his or her world view has been challenged arise (Cicchetti & Toth, 1997a). Clearly, the myriad faces and possible impacts of trauma must be conceptualized within a framework that elaborates on the nature of the experience before research on the impact of the experience on memory systems can proceed.

Pynoos, Steinberg, and Wraith (1995) present a comprehensive model to account for the etiology of and reaction to childhood traumatic stress. This model possesses a number of critical elements that, we believe, should be incorporated into investigations of trauma and memory. Specifically, the complexity of the traumatic experience, the role of traumatic reminders and secondary stress, the differences among stress resistance, resilience, and vulnerability, and the nature, severity, and course of posttraumatic distress and its interactions with emerging personality, development, psychopathology, and the social ecol-

ogy of the child all must be considered (Pynoos et al., 1995). Such a conceptualization underscores the criticality of involving scientists with diverse training and approaches in efforts to understand trauma and its effects on memory.

*Is memory for trauma affected by an individual's functioning in other domains of development?*

Case reports of preverbal children who have witnessed or experienced a traumatic event and inquiries over whether or not such experiences are "remembered" have abounded in the clinical literature. Such issues are not insignificant, as answers to this question possess significant implications for whether or not to address directly early traumatic experiences with children once they gain verbal facility, the type of therapeutic intervention to utilize if symptoms are present that are thought to be related to the prior trauma, and even whether to intervene preventively with children who have experienced trauma if no overt symptoms are present (Toth & Cicchetti, 1993). To date, investigations of these matters with victims of trauma have not been undertaken. However, significant developments in controlled laboratory research with non-traumatized victims have much to offer to informing investigations with traumatized populations (see, for example, Bauer et al., 1998). In fact, advances over the last decade have seriously challenged the previously held belief that, prior to 2–3 years of age, infantile amnesia obstructed the retention of all early experiences. We now know that accurate immediate and delayed recall for the imitation of action sequences is present in the first year of life (see Bauer, 1997, for a review). Importantly, evidence also has emerged that memories that were encoded when children were preverbal can, subsequently, be expressed verbally (Bauer et al., 1998). The significance of these findings for helping to inform investigations of memory in young traumatized children cannot be underscored enough. We now have a literature that supports the capacity to verbally recall events even if language was not present at the time the event occurred.

Whether or not similar results are obtained with child victims of trauma remains to be seen. Moreover, investigations that follow young children into adulthood will be necessary to ascertain the durability of early memories. In view of studies of neurobiological changes in victims of trauma, it also will be critical to incorporate assessments of neuroendocrine function and brain structure and function into investigations of memory in very young children, as these neurobiological and neuroendocrine alterations also may affect later memory.

Although interesting and relevant to whether language ability is required for subsequent event recall, the findings just discussed do not speak directly to another issue that has been raised in the literature. Namely, are autobiographical memories dependent on the emergence of the self before they can be retained? Bauer et al. (1998) speculate that, just as prelanguage memories were subsequently recalled verbally once these skills had emerged, so, too, could preself memories be subsequently recalled once that construct has emerged.

Bearing on this matter is the work of Howe and his colleagues (Howe & Courage, 1997), who argue that autobiographical memory is integrally related to the presence of the self. Interestingly, links between the establishment of the self and factors such as stress reactivity and temperament have been discovered (DiBiase & Lewis, 1997; Lewis & Ramsay, 1997). For Howe and Courage (1997), the emergence and development of autobiographical memory arises as a function of advances in related domains of development, specifically with regard to the presence of the self. Because the self is thought to emerge in the second year of life, the lower limit for autobiographical memory is argued to occur at this age (Howe & Courage, 1997).

Although logically consistent and in accord with much evidence and theorizing regarding the absence of memory in the first year of life, the work of Bauer and her colleagues offers some intriguing possibilities for further examination of this issue. Additionally, as stated by Howe (1998), the role that individual differences in neurobiological,

temperamental, social, and cognitive factors play in the retention of autobiographical memories must be better understood. Not surprisingly, to successfully conduct research such as this, Howe (1998) calls for interdisciplinary collaboration. It is interesting that this echo is heard repeatedly throughout articles addressing trauma and memory. Again, therefore, we reiterate the value that a developmental psychopathology perspective can bring to bear on such collaborative endeavors (see Cicchetti & Toth, 1991).

### **Implications of a Developmental Psychopathology Perspective on Trauma and Memory for Informing Research, Clinical, and Social Policy Initiatives**

The preceding precis has served to highlight some of the challenges that pervade efforts to understand the role of trauma in affecting the processing of traumatic and, possibly, routine memories, as well as the opportunities afforded by vigorously addressing this complex issue. The articles contained in this Special Issue reflect a confluence of opinion in illustrating the value of increased interdisciplinary efforts and in promoting a more direct interplay between work conducted with normal populations and investigations of memory in victims of trauma. As such, shared models, methodologies, and interpretive strategies have been recommended. Therefore, we next turn our attention toward elucidating the contributions that the utilization of a developmental psychopathology framework can make to advancing research, clinical, and social policy initiatives related to trauma and memory.

In reviewing research that has been conducted on trauma and memory, it is apparent that significant gaps exist in this literature, especially if standards derived from a developmental psychopathology perspective are utilized to gauge progress. Perhaps foremost with regard to omissions are the paucity of investigations that have been conducted with traumatized populations of children. Much of the work that has been brought to bear on memory for trauma has involved analog experiments with nontraumatized populations or relatively acute and/or routine stressors in-

volving treatment for accidental injuries or visits to physicians' offices. Although certainly important, such investigations represent only a subset of the population of traumatized children. It is critical that more work be directed toward assessing memory for trauma in populations that have experienced severe and/or prolonged conditions of trauma, including chronic maltreatment, exposure to violent crime, and living in war torn communities. Such studies need not focus solely on children's memory for the trauma that they have experienced; it will be equally important for investigators to take a comprehensive approach to evaluating the functioning of all memory systems in children who have experienced various types of trauma, even if a given system would not seem to be affected by trauma.

An approach invoked by a developmental psychopathology perspective involves examining the organization of memory systems in individuals who have experienced trauma. Rather than focusing on a single subset of memory, more comprehensive assessments of multiple memory systems in the same individual could elucidate possibly unique ways in which trauma affects the interrelations among various memory systems. Relatedly, investigations that integrate neurobiological and physiological measurement of systems relevant to memory with examinations of socioemotional and cognitive domains that may affect memory are recommended. As work proceeds in this direction, the importance of using a person-oriented rather than only a variable-oriented approach to grappling with issues of trauma and memory is underscored by a developmental psychopathology perspective (Bergman & Magnusson, 1997). Utilization of a person-oriented approach to elucidating memory functioning in victims of trauma also possesses implications for informing intervention and policy initiatives, as individual differences are not obscured by group data and the variability in functioning across individuals can be captured.

Diversity in process and outcome, another concept widely discussed in the developmental psychopathology literature (Cicchetti & Rogosch, 1996), also is important to consider

when examining memory in victims of trauma. In developmental psychopathology, the concepts of multifinality and equifinality are germane. Rather than focus on main effects models that look broadly at the effects of trauma on memory, it is important to recognize that not all trauma victims are affected equally. The principle of multifinality suggests that similar experiences of trauma may not affect memory in the same way in different individuals. Thus, for example, it is unlikely that all physically or sexually abused children will evidence similar memory changes. This principle also is helpful in addressing some of the seemingly discrepant findings in the literature regarding enhanced versus impaired memory in traumatized populations. Conversely, equifinality indicates that there may be multiple pathways to the same outcome. According to this conceptualization, various kinds of traumatic experiences might result in similar memory deficits or symptomatology.

The criticality of conducting studies with actual trauma victims, a recommendation embodied in developmental psychopathology's commitment to examining atypical as well as normal populations, has been underscored by data obtained with adults. In discussing studies on eyewitness testimony, Yuille and Cutshall (1986) report that between 1974 and 1982, 92% of investigations purporting to examine eyewitness testimony involved college students participating in simulation studies. Clearly, the implications that can be drawn from studies such as these are hindered by a lack of ecological validity and it is misleading to characterize such studies as providing assessments of eyewitness testimony (Koss et al., 1995). In effect, research with actual victims has shown that conclusions on the suggestibility of memory derived from nontraumatized populations have been overstated (Koss et al., 1995). Studies assessing memory in witnesses to, and victims of, crime have demonstrated that such individuals resist incorporating misinformation into their reports (Cutshall & Yuille, 1992; Yuille & Cutshall, 1986) and that intrusions or confabulations are rare in diary studies of autobiographical memory (Brewer, 1988; Larsen, 1992). Based

on the empirical evidence with adults involving victims of crimes and atrocities, shocking events, and simulated emotionally arousing events, Koss et al. (1995) conclude that “. . . a strong consensus emerges from the literature regarding the relative accuracy and persistence of traumatic memories compared to more ordinary ones” (p. 126). Although less empirical work of this nature has been conducted with children, Petersen and Bell (1996) found that children between 2 and 13 years of age who had experienced traumatic injury requiring hospital emergency room treatment were able to provide considerable accurate information regarding the event and that they made few errors of commission.

Clearly, generalizing from laboratory investigations with nontraumatized populations to memory accuracy in individuals who have experienced trauma directly is risky at best and may lead to erroneous conclusions. Although much value can be gained from building on methodologies and results obtained with normal groups of children and adults, firm conclusions regarding memory and trauma await further empirical investigations with populations who have actually experienced trauma. To date, investigations of memory in victims of trauma have been limited to traumatized adults, most often including individuals suffering from PTSD or adults who recollect having experienced sexual abuse (Bremner et al., 1993; McNally, 1997; Stein et al., 1997). It is critical that methodologically rigorous studies such as these be extended to other trauma victims, as well as to children who have been traumatized. Only then will a comprehensive understanding of memory functioning under sufficiently varied conditions be available. Until that time, extreme caution must be exercised in utilizing results obtained with normal populations to gauge the reliability of memory in victims. It also cannot be assumed that all trauma affects memory similarly. Rather, the type of trauma experienced and how it may affect memory must be considered. Premature conclusions regarding memory processes in victims in the absence of solid empirical evidence derived from a variety of traumatized populations may further victimize the victim. As scientists, we

can yield considerable influence in affecting court proceedings involving the accuracy of recall under conditions of trauma. In fact, the legal arena has been an area that has sought out information from social sciences research. It is our responsibility to ensure that the information being provided is sufficiently comprehensive so that faulty conclusions are not drawn regarding issues such as the reliability of eyewitness testimony or the accuracy of childrens' memories. We strongly urge that research be conducted with trauma victims to ensure that a sufficient breadth of knowledge is being directed toward issues of societal import.

The implementation of investigations of memory in children and adults who have experienced trauma also are necessary for informing approaches to prevention and intervention with these populations. Knowing how various types of trauma interact with developmental status to affect memory will be imperative for suggesting types of therapeutic strategies to use. For example, is it necessary that a child verbally recall past trauma in order to cope with negative socioemotional trauma? Similarly, depending on an adult's recall of past traumatic experiences, should therapeutic efforts be made to address the trauma itself, or, rather, might efforts be more well placed helping the individual to modify current patterns of behavior that may be exerting a negative effect on the ability to enter into and sustain positive relationships? Basically, must victims “rework” the past to be freed from it, or might a continued emphasis on prior trauma serve only to immobilize a patient to move forward? Questions such as these could benefit significantly from data derived from the effects of trauma on memory, especially if such investigations also examine moderators of trauma on memory, as well as include assessments of functioning in various domains of development that accompany different patterns of memory organization.

In addition to benefits directly relevant to the provision of intervention for trauma victims, the evaluation of intervention effectiveness also can inform developmental theory. Specifically, efforts to determine how the provision of intervention might modify neurobio-

logical functioning holds great promise for informing theoretical perspectives on developmental plasticity. For example, it remains to be determined whether or not intervention can normalize brain organization only at certain developmental periods or whether developmental plasticity may be operative across the life course (Cicchetti, 1996, in press). Moreover, investigations of the effectiveness of intervention as a function of the proximity between the occurrence of trauma and subsequent intervention are recommended. It might be that intervention provided as soon after a trauma has occurred as possible could more effectively impact on neural organization, thereby preventing alterations in brain structure and function that might be less amenable to change over time.

The contributors to this Special Issue include prominent cognitive neuroscientists, as well as researchers on the cutting edge of investigating the functioning of victims of trauma. In many cases, articles contained

herein already reflect a merger of these often separate worlds. In other instances, renowned scholars in research and theory with normal populations have expanded their thinking to speculate on the implications of their work for traumatized populations. A willingness to venture into new territory and to engage in scientific speculation is always somewhat risky and we applaud the contributors to this issue for choosing to examine and challenge some of their own assumptions. By inviting such a knowledgeable and diverse group of scientists to this Special Issue, we strove to stimulate new ideas that could, subsequently, be adopted and elaborated upon by others in the fields of trauma and cognitive neuroscience. Through our own reading of these exemplary articles, we cannot help believing that we have succeeded in this quest. It is with anticipation that we look forward to future work addressing the interface between trauma and memory.

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