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Cognitive impact of traumatic events

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Abstract
The impact of traumatic experiences on cognitive processes, especially memory, is reviewed. The major psychological sequelae of trauma (reexperiencing, avoidance, hypervigilance) and posttraumatic stress disorder (PTSD) are noted and related to traditional views of fear conditioning. Evidence indicating enhanced memory for the gist of emotional events is reviewed as are psychological and neurophysiological mechanisms underlying this enhancement. This view is updated by introducing the distinction between explicit and implicit memory and its relevance to traumatic memory and PTSD. The central role of "the experiencing ego" in the storage and retrieval of episodic memories is postulated. This leads into discussion of dissociative experiences during traumas and the occasional amnesia for voluntary recall of the trauma accompanied by involuntary, uncontrollable flashbacks of it. The relationship of dissociative experiences to hypnotizability and to pathological reactions to traumas is discussed, although the interpretation of those correlations is questioned. The article concludes by noting that beyond conditioning of fear, traumas often violate and shake the victims' basic assumptions about the benevolence, justice, and meaningfulness of their physical and social worlds. Psychotherapy with trauma victims then needs to attend not only to extinguishing the victims' fear and feelings of extreme vulnerability, but also to rebuilding their basic beliefs about the relative benevolence of the world.

Introduction

The topic of this Special Issue—the effects of trauma on cognitive processes and memory—is of both theoretical and practical interest to all who are interested in the interaction between mind and environment, across the life span. Unfortunately, the astute observations of those interacting with traumatized individuals tend to be far ahead descriptively of cognitive or developmental psychologists' ability to explain or elucidate the clinical phenomenology and associated patterns of emotional and behavioral dysfunctions. The reasons for the disparity are numerous, including restrictions on the types of laboratory research that can be done, questions about generalizability, and the large number of subjective variables that affect psychological outcomes in real life settings.

As the word "trauma" is used today to describe a range of emotionally unpleasant events, we feel it is important to first identify our use of the term. For this we turn to the fourth edition of *The Diagnostic and Statistical Manual* (1994) of the American Psychiatric Association, which characterizes trauma as an episode that creates overwhelming fear that oneself or a loved one is about to suffer severe injury or death and is accompanied by the belief that little can be done to control, minimize, or escape the injury. These "uncontrollable, inescapable" features of the threat lead to the victims' feelings of powerlessness and helplessness. While this definition captures the salient features of traumas, it is not an objective "operational definition"; rather, it refers to the victim's beliefs and fears regarding some on-going physical and/or social situation. As psychologists are well aware, numerous factors influence the person's

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construal of a potentially traumatic situation, including environmental factors, social support, and individual coping abilities (Lazarus, 1966, 1991). These situational factors vary greatly across the life span as well as across individuals. Thus, large differences often arise in individuals' reactions to the same objective, stressful situation. This is partly why studies of traumatic memory are interesting to research scientists, and partly why they are so difficult to study. In the following, we will begin by describing several effects of trauma on cognitive activity, especially memory.

Phenomena Accompanying Traumas

The primary effects of a horribly frightening experience can be summarized under the categories of later *re-experiencing* the trauma, behavioral *avoidance* of stimuli associated with the trauma, and symptoms of enhanced *arousal* (e.g., Grinker & Spiegel, 1945). These effects are expected to occur to some degree in all trauma victims, but when strong and persistent they lead to a diagnosis of posttraumatic stress disorder (PTSD; American Psychiatric Association, 1994). Consider rape as a paradigmatic example: Rothbaum, Foa, Murdock, Riggs, and Walsh (1990) found that shortly after an assault, 94% of rape victims exhibited sufficient symptoms to qualify for a PTSD diagnosis; 47% of these victims qualified for such a diagnosis 3 months after the assault; and 16.5% of rape victims still exhibited PTSD an average of 17 years after the assault. Reported levels of PTSD in sexually abused children range from 21 to 48%, though the time at which these measurements were taken was not specified (Kendall–Tackett, Williams, & Finkelhor, 1993).

Since these PTSD symptoms are central to both the treatment and understanding of clinical patients as well as to cognitive theories of memory and information processing, it is important to describe them in more detail.

Re-experiencing

Many victims of psychological trauma experience intrusive and distressing recollections of the event. These recollections come in many forms, including unbidden, intrusive thoughts, nightmares, visual or other sensory hallucinations, and vivid flashback memories that practically disconnect victims from their present surroundings. Such episodes are often triggered by situational cues (sounds, smells, locations, activities), covert thoughts or moods associated with the trauma. The person may act or feel as though the traumatic event were recurring, that the sensory experiences were being relived. In these instances, memory for the event impresses the patient as subjectively vivid, emotionally intense, and very accurate. Victims may be unable to suppress thinking about the trauma no matter how hard they try.

Avoidance and emotional numbing

Victims avoid stimuli associated with the trauma since those give rise to considerable distress. They avoid not only environmental stimuli, such as activities, places, and people, but also conversations and covert thoughts that remind them of the trauma. They often display a great reluctance to talk or think about the traumatic event. Indeed, they may be unwilling and in fact unable to produce (or remember?) a sustained recital or description of what occurred. Curiously, this inability to recall the traumatic memory on demand may coexist paradoxically in the same individual who experiences uncontrollable flashback memories. In addition to the victims' private mental distress, their avoidance behavior affects their relationships to the social world; they often withdraw into a protective shelter of isolation. Many victims report that they feel detached or estranged from familiar others, feel emotionally numb, have less interest in previously significant activities, and have a sense of a foreshortened future. Their future plans and goals may be abandoned and their self-esteem and motivation for achievement may plummet.

Hyperarousal

The trauma victim often displays persisting heightened arousal, as indicated, for example, by difficulty in falling asleep or staying asleep, irritability, difficulty concentrating,

hypervigilance, and exaggerated startle responses. These symptoms are often accompanied by chronically high levels of activation in the autonomic nervous system. For example, Blanchard, Kolb, Pallmeyer, and Gerardi (1982) reported that combat veterans with PTSD (compared to those without PTSD) had higher resting mean heart rate and systolic blood pressure, as well as greater increases in heart rate when exposed to visual and auditory combat-related stimuli.

Effects of trauma in maltreated children

Of relevance to the specialized audience of this journal, some brief remarks regarding the development of psychopathology associated with childhood trauma are in order here. Before children have developed sufficient cognitive resources to cope with assaults, verbal abuse, dangers of physical injury, extreme deprivation, neglect, and other forms of adversity and mild trauma, they are more easily upset and emotionally disturbed by such aversive events. When the trauma consists of repeated physical or sexual abuse of young children by adults of their family, the abuse is likely to lead into a variety of negative, maladaptive behaviors. We will list just a few that have been well researched or at least suggested in the literature on maltreated children (see the reviews in Cicchetti & Carlson, 1989; also Kendall–Tackett et al., 1993).

Firstly, infant maltreatment probably causes serious disturbances in the normal "attachment processes" so central to a child's emotional development (Bowlby, 1969; Carlson, Cicchetti, Barnett, & Braunwald, 1989; Cicchetti, 1989). Children maltreated by their caretakers or family members are likely to show fearful avoidance of social interactions. The child's social avoidance will be associated with insecure attachment to adults, so that maltreated children have no stable model to follow for forming intimate relationships in later life (Carlson et al.).

Second, children's social anxiety will cause them to avoid social contact with most adults, so that the normal transmission of social skills (e.g., language, social graces) and cultural education (e.g., what behaviors are appropriate in different settings) is delayed and deficient. In particular, the maltreated child is less likely to learn the subtle nuances of interpersonal situations and expressions needed to accurately identify the emotions of others, thus stunting their ability to empathically track others' emotions—an ability essential to interpersonal friendships (Barahal, Waterman, & Martin, 1981).

Third, the frightened child may often be a social isolate, a "loner," missing out on the joys of play with peers. They suffer from feeling unworthy, unloved, and have low self-esteem. As a consequence, they are at elevated risk for childhood and adolescent depression (Lee & Gotlib, 1991).

Fourth, children who have been physically abused are likely to have acquired extraordinary sensitivity to social cues of impending violence and threats to themselves. Indeed, Rieder and Cicchetti (1989) found that, compared to nonmaltreated children, maltreated children were more vigilant to and distracted by aggressive extraneous stimuli when working on a cognitive task. Similarly, Hennessy, Rabideau, Cicchetti, and Cummings (1994) found that maltreated children were extraordinarily vigilant for (and disturbed by) interadult anger—presumably reminiscent of the adults who abused them.

Fifth, physically abused children are likely to have acquired a repertoire of aggressive behaviors (verbal and physical) by imitation of the behaviors of their abusers, and may have learned to get what they want or resolve conflicts mainly by aggressing against others (Dodge, Pettit, & Bates, 1994). Moreover, physically abused children are likely to imitate the attributional styles and rules of their abusing adults, so that they too misinterpret interpersonal conflict situations: They are biased to attribute hostile intent to others and to behave aggressively according to those hostile attributions (Dodge, Bates, & Pettit, 1990). Their aggressiveness will exacerbate their social isolation and rejection by peers.

Sixth, their aggressive tendencies can also cause these children to be uncooperative and oppositional with authorities and disruptive in school, which in turn may earn them the label of "problem children with conduct disorders."

And that is in turn a strong predictor of subsequent truancy and delinquency (Cicchetti, 1993). Thus does early childhood maltreatment play out into the possibility of a long litany of disastrous sequelae for the child and his or her social environment (Cicchetti & Toth, 1995).

The goals of this paper

While we acknowledge these developmental aspects of childhood trauma and abuse, we will not specifically address them further since we have little expertise in that regard. Instead, we will focus on some explanations for the cognitive sequelae of trauma in adults noted in the preceding sections, including the paradoxical memory intrusions along side of the memory losses, as well as disturbances in other cognitive processes such as attention and thinking. First, we review a learning theory account of these phenomenon. Second, some general considerations regarding memory for emotional events will be considered. The review will focus primarily on laboratory studies of emotional memories in adult human subjects, although we will touch on autobiographic memories as well as neurophysiological studies of emotional memory in lower organisms. We then introduce the distinction between conscious recollections ("explicit" memories) versus unconscious ("implicit") influences of stored events on performances, and how this distinction applies to symptoms of PTSD. This leads into a discussion of the important concept of dissociation, which is currently very popular in clinical investigations of trauma. Finally, theories which relate trauma response to violation of the victim's fundamental beliefs will be discussed. These theories do not contradict other explanations but rather suggest ancillary principles involved in psychological sequelae of trauma.

This paper will focus primarily on research on adults, since that is the work we are most familiar with. However, attempts have been made to include work from across the life span when possible. Furthermore, we have concentrated on those cases in which a clearly identifiable and specific traumatic event has occurred. We deliberately avoid discussion of the controversy surrounding the exhuming of allegedly long-repressed memories of childhood abuse, since the data are limited and much in dispute (Kihlstrom, in press; Loftus & Ketcham, 1994). Sufficient reviews and position papers regarding that literature already exist (e.g., Conway, in press; Lindsay & Read, 1994; Loftus & Ketcham, 1994; Lynn & Spanos, in press; Pezdek & Banks, 1996).

Learning Theory Account of Traumatic Neurosis

Within traditional learning theory, many of the symptoms following trauma are seen as consequences of classical conditioning of extreme fear to the traumatic situation, followed by overgeneralization of that fear to situations, stimuli, and activities that resemble the original traumatic situation (Dollard & Miller, 1950; more recently, Foa, Steketee, & Rothbaum, 1989; Foa, Zinbarg, & Rothbaum, 1992; Keane, Zimering, & Caddell, 1985; Mineka, 1992). Thus, a child molested while asleep in her bedroom may become conditioned to be afraid of being alone in her bedroom, of going to sleep, of most grown men, and nauseated by odors (beer breath, aftershave lotion) associated with her assailant.

The fears established to one specific situation (e.g., being alone in her darkened bedroom at night) may generalize more broadly to any room in the house, to any bedroom, to her district of the city, and so forth. The dynamics here are well known in animal studies of how conditioned fears generalize to stimuli progressively more remote from the specific conditioned stimulus (e.g., see Miller, 1951). Similarly, the avoidance behaviors are largely responses that have been reinforced by escape from or avoidance of fear-provoking stimuli, and are thus strengthened by fear-reduction (see Miller, 1951; Mowrer, 1960). Fear reduction reinforces not only overt avoidance actions but also deflection from fear-provoking ideational sequences as they might occur in social conversations, internal monologues, and private thoughts. When a current thought foreshadows the feared thought, the person tries to suppress that associative sequence and

replace it with a distracting thought. With practice, perhaps, this ideational deflection can become automatized and unconscious so that the person becomes unable to recover voluntarily much of the narrative memory of the original trauma. This was Dollard and Miller's (1950) reconstruction of how repression might come about.

The fact that the trauma is accompanied by the victim's beliefs in its uncontrollability and inescapability (and fear of its unpredictable recurrence) suggests that all the familiar effects of uncontrollable, inescapable stress will appear among trauma victims (see Maier & Seligman, 1976; Mineka, 1992). Indeed, such deficits have been noted in victims' later learning of contingencies and motivation to initate activities, along with persistent heightened arousal caused perhaps by elevated corticosterone along with depressed norepinephrine levels.

Standard conditioning theory also provides an account of effective therapies to help trauma victims overcome extreme fears. The more effective psychotherapies with PTSD victims are those that use varieties of anxiety management techniques (relaxation, thought-stopping, coping self-talk) along with prolonged exposure to thoughts of the original trauma situation (e.g., imaginal flooding), sometimes with, sometimes without, counter-conditioning that uses relaxation (as in systematic desensitization) or active counter-responses of self-defense (see Bandura, 1969, 1997; Foa, Rothbaum, Riggs, & Murdock, 1991; Foa, Hearst-Ikeda, & Perry, 1995; Keane, Fairbanks, Caddell, & Zimering, 1989; Leitenberg, 1976). An example of a coping counter-response was provided in a study by Ozer and Bandura (1990) who helped women (40% of whom had been assaulted or been forced into sex) overcome their feelings of vulnerability by giving them "empowerment training" in judo methods of self-defense. They were taught how to ward off and resist unexpected attacks and disable their attacker. Most increased their feeling (and behaviors) of being able to cope with unwanted advances and sudden physical attacks and consequently reduced their anxiety to tolerable levels.

The efficacy of exposure treatments derive from the fact that they are aimed directly at the heart of the disorder (i.e., the overwhelming anxiety aroused by memories of the traumatic encounter). Prolonged exposure to a feared conditioned stimulus (without reinstatement of the pain itself) has been shown in laboratory and analog studies to produce rapid extinction of fear and avoidance behaviors to that stimulus (e.g., Guthrie, 1935; Marks, 1987; Mineka, 1992; Rachman, 1980; Poppen, 1968). Apparently, during prolonged exposure, the person's fear reaction to the real or imagined phobic object (or idea) becomes "exhausted," just as one cannot cry or scream for a prolonged time. Behaviors incompatible with fear then become associated with the continuously present, phobic stimuli, thus overlaying and blocking expression of the fear. Current thinking is that such extinction or counter-conditioning experiences do not abolish the conditioned fear, but rather inhibit its expression in the safe context (see, e.g., Bouton, 1994). Hopefully, that inhibition of fear will generalize to other contexts resembling the safe situation. This inhibition account implies, for example, that the fear can be quickly reinstated should the treated person receive a subsequent conditioning trial of injury in the phobic scene, such as a second sexual assault, or even hearing about the rape of a neighbor.

While the traditional conditioning approach has much in its favor, it fails to account for several subjective phenomena of PTSD. For example, it does not account for the fragmentary nature of trauma memories, their excessively sensory quality, and the paradox that in the same individual the memories may be uncontrollably intrusive at times but then beyond voluntary retrieval at other times. A basic issue for the traditional learning theory account is how to deal with discrepancies between conscious versus unconscious phenomena, such as memories that are controllable versus those that are spontaneous and apparently outside conscious control. Other concepts must be added to the standard conditioning account to provide a more descriptively adequate theory of traumatic memories and PTSD symptoms.

Research on Emotion and Memory

What people explicitly remember from an event depends on how much attention they allocate to specific features of the complex occurrence. A major determinant of attention is the *interestingness* of the event or some aspect of it; and information is interesting primarily because it is either anomalous (unexpected) or emotionally arousing. We pay more attention to such events and as a consequence usually learn more about them.

The idea that learning is partly directed by unexpectedness and expectation-failure (or "error-correction") is central to modern learning theory. Expectation failures are emotionally arousing, since they are typically caused by an interruption of a goal-directed plan or a survival policy (see Mandler, 1984, 1992, for an interruption theory of emotion). Goal interruption or failure causes frustration that mobilizes attention and new learning towards two goals: to identify some feature of the failed action plan that can be modified to overcome the immediate blockage and to remember the modification to avoid this frustration in the future. Attention is drawn towards that relevant feature of the situation that probably caused the plan to fail, so that people can modify their plan efficiently. Perhaps because failed plans and painful threats are so often sources of negative emotions, an intimate relationship exists between emotions and learning.

Two consistent findings arise in research on emotion and memory. First, if the emotion is irrelevant to the material being learned, it often reduces the amount learned or remembered. This negative impact of emotion is familiar in cases of performance anxiety, test anxiety, and the poor overall learning ability of patients with psychiatric depression and anxiety disorders. It can also be created in non-clinical college students by subjecting them to a mild mood induction (positive or negative) just before they carry out a complex learning task. Evidence is fairly strong that the poor learning arises because of task-irrelevant thoughts experienced while trying to work on the learning task (see Siebert & Ellis, 1991). Persistant emotional thoughts (e.g., "I'm going to fail") use attentional resources, thus reducing resources available for learning (for a review, see Ellis & Ashbrook, 1988).

The second consistent finding arises when the to-be-remembered information is the cause of the emotional arousal. In these cases, memory is better for emotionally arousing events, and this benefit increases (within limits) with the intensity of the emotional arousal. Classical conditioning studies have shown that the strength of a conditioned fear response grows proportionately to the intensity of the aversive unconditional stimulus paired with the neutral stimulus (Mackintosh, 1974). Human memory research lends further support to this intensity claim. In combat and natural disasters (fires, earthquakes, etc.), witnesses are far more likely to suffer intrusive reminiscences the closer they were to the actual dangers. Laboratory experiments also indicate that words or pictures that evoke more intense emotional reactions (according to subjects' ratings) during encoding are remembered better. Similar benefits for emotional events have often been reported for autobiographical memories (e.g., Brewer, 1988; Holmes, 1970). For example, if college students record more or less stressful events in a daily diary and rate their emotional intensity, their recall of the diary entries several weeks later tends to be higher for events rated as more emotionally arousing, with a slight advantage for positive over negative experiences.

Selectivity of emotional learning

The greater memorability of emotional events does not hold true for all aspects of an occurrence. In any complex event, an individual explicitly encodes (via selective attention and associative elaboration) only a limited range of specific features of the emotional event sequence, essentially those most relevant to his or her personal concerns (e.g., the elements most causally proximal to blocking or threatening significant goals). High emotional arousal can cause a "narrowing of attention" (Easterbrook, 1959) to only selected aspects of the scene. For example, a victim of a robbery may focus attention on the robber's

weapon (a gun or knife). As a consequence, peripheral details of the robber (his appearance, clothing, etc.) may be encoded less well than if a weapon had not been brandished. Presumably, the extent of attentional narrowing would be greater for more traumatic events.

Considerable evidence supports this view regarding the selective learning of central versus peripheral features of emotional scenes. A typical experiment was conducted by Christianson and Loftus (1987), who had subjects view a series of 12 slides: for some subjects, the middle four slides with accompanying text told an emotionally arousing story about an injury auto accident leading to a bloody amputation of the victim's limb; for other subjects, these four emotional slides were replaced by others which told a neutral story connecting the first four and last four slides. Later memory tests showed that subjects who saw and heard the emotional-slide story recalled the gist of the emotional slides more than did control subjects, and their recognition memory for central, critical aspects of these slides was better (see also Heuer & Reisberg, 1990, 1992). However, recognition for some peripheral background details (or for camera angle of the photograph) was somewhat poorer.

Mechanisms promoting emotional memory

Several factors working in concert promote better memory for highly emotional events. Prominent among these are the personal significance of the event, its distinctiveness or rarity and selective rehearsal. A strong correlate of memorability of emotional experiences is their *personal relevance* (hence, emotional reactions to action films are quickly forgotten) along with their low frequency and uniqueness or *distinctiveness* in the subject's life. The details of highly frequent, routine events (e.g., a child playing on the playground) are rapidly forgotten because of interference from so many similar occasions. But highly distinctive events that rarely occur (e.g. seeing a playmate break her arm) are remembered well since they are segregated from the myriad routine happenings of our daily life (Brewer, 1988). Highly emotional events may be well remembered in part because they are rare and distinctive in the ecology of people's lives, and thereby protected from interference from similar events. This applies even more so with highly traumatic events.

In addition to an event's personal relevance and distinctiveness, a strong affective reaction during or after an event causes its later reactivation in working memory. Material from long-term memory is revived into working memory, where it is replayed and reexperienced. Although the emotional system evolved to react rapidly to some sudden threat or upset, the system also has means for prolonging its reaction far beyond the initiating stimulus. When emotionally aroused, the brain triggers reactions from the autonomic nervous system and the endocrine system; the latter releases stress hormones into the blood stream, creating persistent arousal and reactivation of whatever thoughts are salient in the cognitive system. This arousal persists for several minutes and has an effect analogous to involuntary recycling of the stressful occurance and events leading up to it. Such rehearsal enhances the degree of learning of whatever aspects of the event were encoded.

Beyond this physiological arousal that continues for several minutes, our minds have a tendency to return repeatedly over many hours or days to memories of emotionally upsetting events, perhaps triggered by external cues or ideational sequences that have been associated with the aversive event. As the first author wrote earlier:

> We ruminate and go over these emotionally loaded events again and again as though trying to habituate their painfulness. The rumination or replaying may continue for brief spasms distributed over many hours, even days, but with dwindling frequency and emotional impact as we habituate to the experience. The memories of these events are connected to such strong emotions that we seem barely able to suppress intrusive thoughts of them (see Horowitz, 1986). It is as though the upsetting thought lies barely submerged below consciousness as we try to occupy ourselves with the busy work of daily chores; but it lies ready to spring into consciousness the moment we disengage our

attention from other chores—for example, when we try to fall asleep at night." (Bower, 1992, p. 14)

Neurophysiological evidence for emotional learning

Many investigators have examined the neurophysiological substrate underlying the enhanced emotional learning. From research on fear conditioning in animals, it is known that the adrenal hormone epinephrine (adrenaline) is released during and immediately after stressful stimulation, and appears to play a role in consolidating memories of stressful events. Injection of epinephrine, even if given several minutes *after* a one-trial learning experience, enhances the learning of a passive avoidance response in rats and mice (Gold & von Buskirk, 1975, 1976, 1978). A variety of other drugs and chemical compounds have been discovered that produce enhancement of learning of simple conditioned responses in rodents (for a review, see McGaugh, 1992). Importantly, the enhancement is dose-dependent: too little or too much epinephrine produces a reduced enhancement of learning. Possibly, a traumatic situation could involve the release of unusually large amounts of stress hormones, thus reducing learning.

The role of adrenergic hormones in emotional learning of human subjects has also been implicated in an experiment by Cahill, Prins, Weber, and McGaugh (1994). The Christianson–Loftus type of experiment (described above) was repeated with subjects injected with propranolol (a beta-adrenergic blocker) before they viewed the story slides. Relative to control subjects, the propranolol-injected subjects showed no enhanced memory for the emotional slides of the series, whereas their memory for the nonemotional slides of the series were not impaired. The implication is that propranolol blocked the action of adrenergic hormones which normally cause the enhanced memory for the emotional materials.

Fear conditioning is modulated by the amygdala complex of the limbic system. Lesions of the amygdala in rats retard learning of aversively-motivated responses, and also block the enhancement of aversive learning that usually result from pre- or post-trial injections of epinephrine. Additionally, amygdala lesioned rats fail to respond to stimuli previously associated with shock. Confirming the role of the amygdala in emotional learning, a patient with bilateral degeneration of his amygdala complex showed no enhanced memory of the emotional (compared to the nonemotional) slides in the Christianson–Loftus kind of material (Cahill, Babinsky, Markowitsch, & McGaugh, 1995).

A further critical result was reported in a study by Cahill et al. (1996). They recorded the brain glucose metabolic rate in the amygdala region (using positron emission tomography [PET]) as human subjects viewed two different series of 12 2-minute film clips over 2 days: the films on one day depicted neutral events; those on the other day depicted emotional events evoking disgust or fear. Three weeks later subjects were asked to recall the gist of the film clips in each series. Overall, more emotional than nonemotional film clips were recalled (about 6.0 vs. 2.5 out of 12). Importantly, recall of the emotional films increased directly with the glucose metabolic rate in the right amygdala complex recorded during the initial viewing (learning) session. Across the 8 subjects, the number of emotional films recalled correlated $r = .93$ with subjects' glucose metabolism in the right amygdala—an astoundingly high correlation. On the other hand, recall of the neutral films was not significantly correlated with the glucose metabolism in the same region.

From such results, Cahill et al. (1996) argue that learning about emotional scenes involves somewhat different brain mechanisms than does learning about nonemotional events, and more specifically that these emotional mechanisms include adrenocortical hormones and the amygdala complex. A similar array of evidence in support of the amygdala's role in emotional learning has been marshaled by LeDoux (1992, 1996). He argues further that this fear conditioning system can operate in advance of a cortical ("conscious") evaluation of a threatening stimulus (see also Zajonc, 1980). Thus, we note a possible brain basis for a dissociation between a primitive, subcortical emotional conditioning system versus a

cortically based, cognitive system that mediates people's becoming consciously aware of threatening stimuli and being able to talk about them.

Chronic stress and general memory performance

Exposure to chronic stress is known to affect regions of the brain involved in learning and memory. Chronic stress in monkeys (improper, overcrowed caging) leads to damage to important areas of the hippocampus (Uno, Tarara, Else, Suleman, & Sapolsky, 1989); and high levels of glucocorticoids released during chronic stress have been found to be associated with hippocampal damage (Sapolsky, Uno, Rebert, & Finch, 1990). Such hippocampal damage in animals is associated with memory deficits (e.g., Luine, Villages, Martinex, & McEwen, 1994). Other studies imply that stress-enhanced norepinephrine release in the hippocampus is associated with the memory deficits typical of PTSD patients (Krystal, Southwick, & Charney, 1995).

Neuroimaging studies in humans also find some hippocampal abnormalities of people exposed to prolonged stressful conditions. Studies of concentration camp survivors after World War II found significant cerebral atrophy and/or encephalopathy in the majority (Thygesen, Hermann, & Willanger, 1970). However, it is difficult to assess the relative contribution of psychological stress as compared to prolonged starvation, untreated illnesses, and general poor health to creating encephalopathy in such survivors. Similarly, Bremner, Krystal, Southwick, and Charney (1995) reviewed their neuroanatomical studies of Vietnam veterans with PTSD and found that those patients had an 8% reduction in volume of the right hippocampus. Moreover, deficits in verbal free recall as measured by the Wechsler Memory Scale-Logical Component were associated with lower hippocampal volume in the PTSD patients ($r = .64$). A difficulty in interpreting such results is that a high percentage (estimates over 90%) of veterans with PTSD also have problems with alcoholism and drug abuse. And those conditions, rather than the specific PTSD pathology, might have created these brain and memory deficits.

The unusual involvement of the hippocampus and amygdala complex during traumas has been suggested as an explanation of some puzzling aspects of fragmented memory for the trauma. The hippocampus appears to act as a critical structure for bringing together and binding a variety of inputs to those multiple neocortical regions that are encoding and recording the various parts of the traumatic experience (see McClelland, McNaughton, & O'Reilly, 1995). Abnormalities of hippocampal function during and after the trauma may affect this binding-and-integration function (see Bremner et al., 1995; Krystal et al., 1995). In particular, sensory parts of the episode may be stored in isolation from an association to the cortically based, experiencing ego or self. This hypothesis could explain the patients' remembering of fragmented images and parts of the trauma in an incoherent jumble, and the involuntary intrusion into consciousness of traumatic memories. The abnormality may also explain the occasional amnesia for parts of the trauma, because the victim cannot retrieve those memories by standard retrieval cues that refer to what happened to him or her. These ideas are developed more fully later.

Accuracy of emotional memories

Although the foregoing review suggests that the gist of central emotional information is better encoded and more accessible for recall by humans, a separate issue regards the accuracy of details when emotional memories are recovered from long ago. Abundant evidence indicates that autobiographic memory of temporally remote events is a largely "reconstructive" process (Loftus & Ketcham, 1994; Schacter, 1995). Fragments of true memories are combined with the person's past and current knowledge, beliefs, and expectations in order to compose a more or less coherent story of what probably happened. Often, a person will confuse several different memories and blend them together, or may misremember the source or context in which a given memory fragment was acquired. Recon-

struction occurs when people try to fill in gaps in their memory of an event, making educated guesses as to what probably happened. This filling in between fragments can occur either consciously or unconsciously. Furthermore, fill ins which began knowingly as conscious reconstructions may be accepted later as confident truths after repeated retellings. This process leads to the many "memory illusions," intensively studied in the past decade of laboratory research (e.g., Roediger & McDermott, 1995; Schacter, 1995).

We may ask whether emotional memories are subject to similar kinds of reconstructive distortions. One might think that the rarity and significance of such events would make them different. In fact, a claim is sometimes made that emotional memories exist as "raw photographic prints" that recur inflexibly and without modification over repetitions. These so-called "flashbulb" memories (Brown & Kulik, 1977) refer to recollections of sudden, surprising, and emotionally arousing events such as the assassination of President John F. Kennedy, the explosion of the *Challenger* spaceship on launching, or the sudden death of Princess Diana Spenser. Memories of such events are typically experienced as quite vivid and long-lasting, including details of how the witness first heard about the event. It is the subjective vividness and inclusion of source details that distinguish these flashbulb memories from the less intense or less personally significant emotional memories discussed earlier. Brown and Kulik (1977) proposed that the properties of such memories implicate a different, more primitive memory system (exercising a "Now Print!" command) than that engaged in daily memory of common experiences.

In opposition to that "special status" claim, numerous studies indicate that such memories share many "reconstructive" properties with common, garden-variety memories (see the chapters in Winograd & Neisser, 1992). Flashbulb memories do indeed fade over time, and their details are subject to many errors in reconstruction. For example, Neisser and Harsch (1992) found that when probed 4 years later people had often forgotten or misremembered where they were when they heard of the *Challenger* explosion, and they provided rather different stories of the event. Similarly, Terr (1979) reported that elementary-school children who had witnessed a sniper attack in their Sacramento school playground progressively distorted over time their recollections of where they were when the shooting happened and what exactly happened during the episode. In a thorough review of this research, Christianson (1992; see also McCloskey, Wible, & Cohen, 1988) concluded that flashbulb memories were just quantitatively stronger than normal memories of surprising and/or emotional events, but that no major qualitative difference in properties or laws should be ascribed to them. That is, memories of highly emotional scenes are expected to exhibit the usual dynamic laws—fading and fragmenting with time, with gaps being filled with reconstructed material, and with fragments of several similar episodes becoming intermingled and confused. The difference lies only in the subjective experience of the one remembering.

The main deterrent to progressive memory distortion could occur if the event is recalled repeatedly at periodic intervals (as people converse about the dramatic event), so that the extra rehearsals strengthen components of the memory trace (see below). Each rehearsal acts to "reset" the strength of the otherwise decaying memory trace. However, while spaced rehearsals increase the accuracy of a memory recital, they do not guarantee it (Bartlett, 1932). Subtle errors and misconstructions can still creep into successive delayed rehearsals, causing the account to become progressively inaccurate. Errors in retellings often arise to render the story more coherent, dramatic, and piquant to one's audience. Progressive reconstructive errors are especially likely if the original fragments are incoherent or beyond one's normal understanding (see Bartlett, 1932).

State dependent memory

The extreme fear of victims during trauma suggests that memories of the event will probably be stored in association to this fear, and that they may be best retrieved later if the per-

son becomes very fearful again. Evidence suggests that one's emotional state during an event can act as an internal context that becomes part of the complex associated in memory with that event. Thus, reinstatement of that emotional context may result in recovery of a formerly inaccessible memory. This section reviews some of this research.

External contexts. State-dependent memory is just part of memory theorists' general principle that retrieval is "context cue-dependent." That is, people best remember something if the retrieval context (internal and external) closely resembles that prevailing at the time the memory was stored. The power of external contexts to alter recall of particular memories has been demonstrated repeatedly. Contextual changes (say, in an animal's conditioning chamber) have powerful effects in classical and operant conditioning (e.g., Bouton, 1993, 1994) as well as in verbal memory. Everyone has anecdotes about memories of distant times that were inaccessible (in lay language, were "forgotten") but that return when they return to places and meet persons from their childhood. In laboratory studies, changing lab rooms between study and test of some verbal items often causes some memory loss (for a review, see Smith, 1988, 1994). A classic experiment by Godden and Baddeley (1975) on context changes found that word lists learned by deep-sea divers while on land or submerged underwater were best remembered if recall was tested when subjects were in the same environment (on land or submerged).

Incidentally, an important didactic point should be underlined here: the context-specificity of memory retrieval suggests extreme caution in referring to memories as "forgotten" or "repressed" but then "recovered" on a later occasion. For instance, memory researchers routinely study arrangements in which subjects are unable to remember items when given a generalized prompt (e.g., "Recall the words you just studied."), but readily remember when given a more specific cue (e.g., "Recall the BIRD names on the list you just studied."). The lesson is that some memory can be said to be forgotten only with respect to a particular kind of retrieval cue. The power of appropriate retrieval cues to recover formerly inaccessible memories is an analogue of repression but without the psychodynamic baggage of repression theory.

Experiments by Smith (1979, 1988) suggest that changing environments often has detrimental effects on recall because the person's "mental context" or inner state is altered by the change. The effect of changing laboratory environments can be appreciably reduced by instructing subjects to mentally imagine themselves in the original learning environment before and during their recall. Apparently, mental cues from the original environment suffice to trigger memories of events that transpired there. This effect probably reflects the fact that objects and features of the original environment were closely associated with the earlier events, so that mental review of these features activates those associations.

Drug states. An extension of this idea, that "mental contexts" enter into associative learning, focuses on the effect of changes in bodily states and emotional (or mood) states. Most research on state-dependent memory has been conducted with psychoactive drugs such as alcohol, nembutal, marijuana, heroin, valium, cocaine, and barbiturates (for reviews, see Eich, 1980; Overton, 1978; Swanson & Kinsbourne, 1979). The general finding is that these drugs usually produce main effects (usually negative) on learning, but context-dependent effects on retrieval. That is, free recall for material originally learned when drugged (or non-drugged) improves when retrieval is tested in the same drug state. Within limits, the outcome is dose-dependent.

Emotional states. Similar state-dependent memory effects arise with emotional states (see Bower, 1981; Eich, 1995). In inital laboratory experiments, adult subjects were induced to feel happy while learning one list of words and sad while learning a second list (Bower, 1981). They later attempted free recall of both lists after being induced to feel either happy or sad. A mood-state dependent effect was observed: subjects who retrieved when happy recalled more of the list they had

learned earlier while happy, whereas subjects who retrieved when sad recalled more of the list they had learned while sad. This effect has been replicated many times, although failures to replicate the effect are also common (for reviews, see Bower, 1987, and Eich, 1995). To obtain the effect, experimenters need to use strong mood inductions and weakly cued or free recall tests of memory. Moreover, the effect is best observed if the subject originally produces the to-be-remembered items. Significantly, mood dependency is almost always observed when subjects retrieve autobiographic memories (see Bower, 1987). When happy, subjects will recall more positive than negative memories of their recent or remote history; when sad, they will recall more unpleasant than pleasant memories.

A simple theory to account for such results uses the notion of an emotion as a unit or node in an associative network of concepts (Bower, 1981; Clark & Isen, 1982). When aroused, an emotion unit becomes associated to events being encoded in working memory. In associative network theories of memory, events are recorded by setting up links (associations) that inter-relate pre-existing concepts within the network that describe the ongoing event (Anderson & Bower, 1973; Anderson, 1983). Thus, a child has prior concepts of "myself," "my schoolmate," "playground," and "death." These would become interlinked to record an occasion when a schoolmate dies in an accident on the playground. The proposal is that an emotion unit for fear or sadness would be activated during such an event, and consequently would be linked into its encoding.

In associative networks, retrieval occurs by supplying one or more cues (external stimuli or internal thoughts), and then "spreading activation" along associative linkages from those cues to memory structures representing past events. If a given event receives sufficient activation to pass threshold and is not interfered with by strong competitors, then it will become consciously available for recall. Reinstatement of the exact mental and/or emotional context at retrieval helps recall mood-congruent memories, because these receive activation from the prevailing mood as well as from specific retrieval cues. Thus, a child who is currently afraid and is asked to recall something about the playground would be likely to recall the incident causing the death of her friend there. On the other hand, if not currently afraid, she would be less likely to recall this specific episode.

Cognitive biases induced by emotions

Associative network theory can be used to explain the ruminative thoughts, mood-congruent cognitive biases, and hypervigilance seen in PTSD (see Bower, 1983, 1995). Emotion units become associated not only with episodes when that emotion was aroused but also with perceptual categories, images, themes, ideas, and beliefs closely associated to that emotion. Thus, when a person becomes frightened for any reason, the aroused fear will activate other fears, associated ideas and perceptual categories. As the first author wrote earlier,

> When emotions are strongly aroused, concepts, words, themes, and rules of inference that are associated with that emotion will become primed and highly available for use by the emotional subject. We can thus expect the emotional person to use top-down or expectation-driven processing of his social environment. That is, his emotional state will bring into readiness certain perceptual categories, certain themes, certain ways of interpreting the world that are congruent with his emotional state; these mental sets then act as interpretive filters of reality and as biases in his judgments. (Bower, 1983, p. 395)

An example is that traumatized people become anxious, hypervigilant for signs of danger, and have their consciousness filled with intrusive thoughts and images of their more frightening scenarios. In turn, their selective attention to frightening thoughts and threats feeds back into activating the fear unit in the network. Thus, a vicious circle is established in which thoughts and congruent emotions fuel one another in an interlocked, continuous cycle. Similar feedback loops operate as well in maintaining mental depression.

Considerable evidence indicates that chronically fearful people are hypervigilant

for threatening stimuli relevant to their fears (for reviews, see Mathews & MacLeod, 1994; Mineka & Nugent, 1995). As illustration of this selectivity, Wessel and Merckelbach (1998) confronted spider-phobics with a large bulletin board filled with many stimuli that were threatening for them (a dead spider, a photograph of one, the word *spider*) scattered among a larger number of nonthreatening stimuli (items related to babies and ink pens). During a 1-min period of inspecting the bulletin board, the spider-phobics showed elevated electrodermal responses. Moreover, in a later free recall test, the phobics recalled more spider-related items but fewer nonthreatening items of the array than did nonfearful control subjects.

A question is whether such emotional biases arise from selective attention (i.e., "narrowed focus on feared objects") or from selective rehearsal and dwelling on the fear-relevant stimuli once they are identified. Do anxious people "see" threatening stimuli more quickly, or do they just give a larger reaction once they identify them? Relevant research was reported by MacLeod, Mathews, and Tata (1986) who found that patients with general anxiety disorder are especially attuned to detecting sources of threatening material (even words related to anxiety). Such patients attended longer to regions of their perceptual field where a threatening word had recently appeared. Likewise, maltreated children demonstrate difficulty in avoiding distracting information, particularly aggressive stimuli, in both experimental and observational research (Pollack, Cicchetti, Klorman, & Brumaghim, 1997).

A similar bias arises when patients with PTSD are tested on the Stroop color-naming test. When PTSD-related words such as "body-bag" or "AK-47" are used with Vietnam veterans with PTSD, color naming is significantly slowed relative to that with neutral words (McNally, English, & Lipke, 1993). Moreover, the greater the severity of PTSD, the greater the slowing of color-naming PTSD-related words. In theory, this arises because the patient's anxiety persistently activates the concepts and words related to his combat schemas, thus making those words highly available; their high availability thus interferes more with saying the color of the printed word rather than the word itself. Stroop interference has also been shown in patients with panic disorder (Clark, 1988) and PTSD related to sexual assaults (Cassiday, McNally, & Zeitlin, 1992; Foa, Feske, Murdock, Kozak, & McCarthy, 1991).

Another example of a mood-congruent bias appears when anxiety patients interpret ambiguous homophones (Eysenck, MacLeod, & Mathews, 1987). When asked to spell the first word that comes to mind when they hear a spoken word, anxiety patients (compared to normal controls) tend more to spell DIE rather than DYE, PAIN rather than PANE, GROAN rather than GROWN, and so on. Mathews, Richards, and Eysenck (1989) found that this result disappeared in recovered anxiety patients. Again, it is argued that persistent generalized anxiety activates concepts associated with threat, so they are more ready to be selected when the ambiguous sound is heard; once the prevailing anxiety state is removed, the excess activation on the threat words recedes.

A bias can be found not only in attention allocation but in later memory for threat related information. When patients with PTSD, phobias, or depression are tested in verbal learning experiments, patients show better memory for words relevant to their disorder compared to neutral words, especially when the items are encoded in a self-referential manner (for review, see Mineka & Nugent, 1995). So, in these instances, implications of the emotional priming theory hold up reasonably well (but for a critical review, see Mathews & MacLeod, 1994).

What is absent in the original associative network theory (as in the earlier conditioning theory) is a detailed account of conscious versus unconscious processes. The standard view is that people will become consciously aware of only those few mental representations that reach a certain level of activation; all other memories and thoughts with lesser activation may be considered to be temporarily outside awareness. One might hypothesize that these "unaware" levels of activation on emotional units and their associative circuits provides a

chronic level of mild arousal or hypervigilance for people with PTSD or generalized anxiety disorder. This consideration brings us to our next topic, conscious versus unconscious influences of past events.

Implicit Versus Explicit Memory

So far our discussion has concentrated on conscious or explicit memory for past stressful events. The discussion needs now to be expanded to include a fundamental distinction between explicit (direct) tests of memory and implicit (indirect) tests. Direct tests explicitly ask subjects to consciously recall a past episode (an "episodic memory") or to identify a stimulus as having been witnessed or experienced earlier in a given context ("recognition memory"). In contrast, indirect tests ask subjects to process stimuli without referring to past experiences. That is, subjects are not consciously aware of remembering episodes during such tests; nonetheless, their performance on such tests can be shown to be strongly influenced by past experiences. Examples of indirectly influenced performances arise with *repetition priming* of verbal and nonverbal materials: Previously presented stimuli are perceived more quickly on a later test, can be completed more readily from fragments, and can be read and judged (as a familiar word or object) more quickly than control stimuli not previously presented.

In many circumstances, subjects show performance facilitation because of past learning on indirect tests but not on direct tests. As one example, Tulving, Schacter, and Stark (1982) found that when tested at several weeks' delay after studying a list of words, subjects' ability to remember whether a test word had been studied earlier (a direct test) was weak and statistically independent of their degree of facilitation in giving that word as a completion to its letter fragments (an indirect measure). As further evidence, some experimental manipulations (e.g., reading versus associative generation) are known to influence the two modes of testing in completely opposite directions (e.g., Jacoby & Dallas, 1981); reading facilitates perceptual identification more than does associative generation, whereas generation facilitates recognition memory more than does reading. The exact theoretical interpretation of these experimental "dissociations" between direct and indirect memory tests is still debated (e.g., Bower, 1996; Roediger, 1990; Tulving & Schacter, 1990), but there has been considerable convergence on how to think about them.

Such outcomes have caused a reconceptualization of personal memories of episodes. The general view that is developing comes almost full circle to one proposed long ago by Claparède (1911/1995). This is the view that in humans the sense of "selfhood" or one's own consciousness plays a leading role in storing episodic memories. Specifically, consciously perceived events are recorded in memory as happening to oneself, as things that were personally witnessed. The later conscious recollection of an episodic memory then requires retrieval of an association of the event memory-trace to this feeling of consciousness and selfhood, of having been a witness to the event in the past. As Claparède wrote:

> The theory states that when the objects come to consciousness [during encoding] they get the characteristic coloring of this consciousness of self, a little like a wooden bench that has just been varnished gives its color to anyone who sits on it. So that when this consciousness finds them later [during retrieval] it carries its imprint. (Claparède, 1911/1995, p. 373)

> We must distinguish between two sorts of mental connections: those established *mutually between representations*, and those established between *representations and the self*, the personality. In the case of purely passive associations or idea-reflexes, solely the first kind of connection operates; in the case of voluntary recall and recognition, where the self plays a role, the second kind of connection enters. (Claparède, 1911/1995, p. 375.)

In these passages, Claparède is acknowledging that memories of events can be recorded with or without an accompanying association to the witness's self. In particular, he recognized the possibility that people can record events and associations without con-

necting them to their sense of selfhood; consequently, people will not be able later to identify these events as things that happened to them, although the events may produce nonconscious influences upon their behaviors. For this reason subjects would not be able to retrieve these memories voluntarily, "on demand," since these memories cannot be activated by cueing oneself with the probe, "Something that happened to *ME* in context X."

In line with this analysis, Howe and Courage (1997) have recently proposed that children's development of the cognitive self is directly linked to the emergence of their autobiographical memory. Specifically, while research has demonstrated that very young infants can display memory for a specific episode, the ability to remember information as "something that happened to me" does not emerge until one has a "me" by which to organize it (Howe & Courage, 1997). The "infantile amnesia" exhibited by adults presumably covers the period prior to the emergence of a stable self-concept.

The relation of consciousness to direct and indirect memories has been an exceptionally active research topic in cognitive psychology for the past 15 years. Tulving (1983, 1985) has been a leader in bringing these issues into the forefront of currrent discussion. Kihlstrom (1993, 1995) has proposed a theory of conscious control of memories very close to that of Claparède and indicated its implications for understanding clinical/pathological aspects of memory. Further, Moscovitch (1992) has proposed a brain-based theory wherein structures underlying consciousness might be linked into those brain circuits that are encoding episodic memories. The first author has also written some on the topic, including the following:

> The [author's] present theory assigns considerable importance to the role of contextual associations in the elaboration and control of explicit, personal memories. Moreover, it views the experiencing self or ego as a central component of that autobiographical context. . . . . The distinction between implicit and explicit memories, which hinges upon the subjects' "memory awareness", is rendered in the model as Type-1 versus Type-2 contextual associations. Retrieval of the latter associations provides the basis for subjects' memory awareness, the subjective sense of remembering "being there then" during a past experience. These explicit memories of personal experiences provide a sense of unity, coherence, and continuity to our conscious mental life. The ability to form and retrieve contextual associations also supplies us with the means for *controlling* the expression of our memories—for combining and reasoning about our past experiences, for monitoring, editing, suppressing, and reshaping the contents of our memory reports. Lacking contextual associations to recent experiences, amnesics have lost conscious control of their memories and in the process have lost the subjective sense of having "been there, done that" for their post-injury experiences. (Bower, 1996, pp. 62–64)

While the preceding quotation emphasized conscious or voluntary control over the expression of explicit memories, an equally important aspect that might have been mentioned is the lack of voluntary control over the expression of implicit memories. Implicit memories are often stimulated involuntarily, without subjects' conscious intention to remember. Just as laboratory subjects have difficulty preventing effects of repetition priming in their perceptual identifications and stimulus-bound thoughts (e.g., in generating word associates), so can a PTSD patient not easily prevent situational cues from triggering flashback memories of sensory fragments from his or her traumatic episode.

Implicit memory and Emotion

All the theories agree that indirect tests may demonstrate learning of conditioned emotional responses to stimuli despite the subjects' inability to recall consciously the past basis from which that emotional evaluation was derived. The clearest demonstrations of such dissociations arise with patients suffering global amnesia. Weiskrantz and Warrington (1979) found that a classically conditioned eyeblink and emotional response could be established in amnesic patients who could not consciously recollect (verbally describe) the occasions of their prior conditioning trials. The article cited above by Claparède (1911/1995) was centered around his studies of an

amnesic patient who could not remember having met him, yet was reluctant to shake hands with him because on an earlier occasion Claparède painfully pricked the man's hand with a hidden pin while shaking hands with him. An experiment by Johnson, Kim, and Risse (1985) showed a similar effect: amnesic patients first studied photographs of men, some of whom were described with positive traits and others with negative traits. Several weeks later, when asked to compare photos of pairs of these men, the patients indicated that they thought the men previously described with positive traits appeared more friendly and they preferred to meet them, even though these amnesics could not recollect ever having seen these photos before. The interpretation of such findings is that amnesic patients have suffered injury to those parts of the brain that are necessary for establishing associations of events to their sense of selfhood. After their injury they have lost the ability to store and later recollect consciously having been a witness to specific events.

Such disconnections between cognitive ("factual") knowledge and affective judgments can be demonstrated in nonpatient populations as well. A common example is that people will remember their liking or disliking for a person, place, or object (say, a city, person, or movie) without being able to recall much specifically about the object of their affections, to justify their evaluations. Even further, Murphy and Zajonc (1993; Murphy, Monahan, & Zajonc, 1995) reported emotional conditioning established outside normal awareness: their subjects preferred nonsense figures that had been paired with a subliminally presented, smiling face over figures that had been paired with a frowning face presented equally briefly (4 ms), despite the fact that subjects were unaware that any face photographs had been presented just before the nonsense figures. Thus, people could make rapid emotional associations with little or no awareness of their cause (for a review, see Bornstein & Pittman, 1992).

It took no persuasion to convince researchers in psychopathology of the relevance of the implicit/explicit memory distinction to understanding some symptoms of mental disorders. Indeed, psychodynamic theorists have argued for the past 150 years for a strong role of unconscious determinants of behavior (for reviews, see Ellenberger, 1970). It is easy to imagine how a patient might harbor an emotional reaction to an external situation without being able to recall why that situation should trigger such discomfort. Thus, an adult may feel upset and frigid about sex or fearful of specific places or people due to earlier experiences yet be unable consciously to recall any specific episode that could have led to that reaction. Early traumatic experiences which the person has consciously forgotten may still have lingering effects in terms of later emotional or behavioral responses. However, and relevant to the exhumed memory controversies, we would caution that the possibility of such scenarios tells us little about their likelihood or authenticity. Specifically, an unexplained aversion to some person or place need not warrant an inference that this must reflect earlier unconscious conditioning.

This implicit/explicit distinction plays a pivotal role in accounts of PTSD provided by Brewin, Dalgleish, and Joseph (1996). They refer to implicit, cue-dependent memories as "situationally accessible memories," and refer to explicit, conscious memories as "verbally accessible memories." They proceed to relate much of the symptomatology of PTSD to these memory systems: for example, re-experiencing of sensory memories of the trauma triggered by external cues reflect the first, implicit/emotional system, whereas the coherent verbal narrative of the trauma that is gradually constructed during psychotherapy reflects the second, verbal system.

This account needs to be augmented with Claparède's ideas plus the further idea that the trauma victim's consciousness may be distorted (or attention narrowed?) during the traumatic event, so that traumatic memories are more likely to be stored in the situationally accessible memory system rather than in association with the cognitive self. This analysis may provide a useful account of why some trauma victims are at times unable to recall voluntarily the trauma, while at other times they suffer from spontaneous flashback memories of it. That is, initial memories of

the trauma stored in the situationally accessible memory are difficult to retrieve voluntarily with verbal probes asking, "What happened to you?" On the other hand, situational cues may trigger these particular sensory memories.

Some evidence for this bifurcation of sensory versus verbal memory storage during traumas comes from a neuroimaging study by Rauch et al. (1996). When traumatic memories were provoked in PTSD patients (Vietnam veterans), the investigators observed decreased activation of Broca's area of the brain along with increased activation of right cerebral hemisphere areas. Broca's area is the area of the brain most centrally involved in transforming subjective experience into speech, whereas the right hemisphere has been implicated in processing intense emotions and visual images. Thus, the activations in different brain areas correspond to conclusions regarding the emotional-imagery-based versus speech-based nature of traumatic memories.

We have presented a theory of explicit or verbally accessible memories as events recalled through accessing a knowledge structure of self. In light of this approach, one might ask what would happen if this cognitive structure is disrupted. In the remainder of this paper we will present work that addresses if, how, and when this might occur.

Dissociation During Traumas

A frequent accompaniment of trauma is that the person reports that he or she "spaces out," feels "unreal," and perceives events as strange and distant, as though they were not really happening to him or her. Often, time seems to "slow down" or "stand still" just before or during the traumatic event (e.g., as one's car is skidding into a bus). Thus, the victim experiences a disruption in self. Dissociative phenomena were first identified over 100 years ago by French psychiatrist Pierre Janet. Janet (1889, 1907) proposed that the intense emotion aroused during trauma could interfere with the assimilation and integration of perceptions, thoughts and experiences; he believed that this lack of integration or "dissociation" of unusual experiences lay at the heart of hysterical psychopathology (Janet, 1889, 1907).

Janet's concept of dissociation is central to current research and psychiatric theorizing about trauma (e.g., Butler & Spiegel, 1997). In the psychiatric literature, dissociation is characterized by the victim having subjective experiences of emotional numbing, derealization, depersonalization, and perceptual alterations during the trauma. Dissociation has been identified as both an acute response to overwhelming trauma as well as a chronic condition produced in some individuals following traumas. Furthermore, dissociation appears to be linked to psychopathology. Bremner and Brett (1997) found a complete separation in reports of dissociation (during the causative combat trauma) between war veterans who developed PTSD and those who did not: all of the PTSD victims reported (in retrospection) dissociating at the time of the event, whereas none of the control sample did. Such findings implicate dissociation as a critical variable in research on trauma response. However, such reports are retrospective at a very long delay (over 20 years). Not only would one expect significant forgetting, but judgements of past mental states could be colored by present experiences of dissociation as well as confusion with dissociative flashbacks that have occurred throughout the intervening decades.

Acute dissociative reactions are commonly assessed by asking victims to check off items that describe their subjective experiences either during the trauma or in the days and weeks following the event. As noted above, dissociative experiences during trauma have been reported by combat veterans (Bremner et al., 1992; Marmar et al., 1994) and by victims of sexual abuse (Spiegel, 1984; Putnam, Guroff, Silberman, Barban, & Post, 1986), injury-accidents, and survivors of natural disasters such as floods, hurricanes, earthquakes, and fires (Koopman, Classen, & Speigel, 1994, 1996; Cardena & Speigel, 1993). In one study, Cardena and Speigel (1993) surveyed about 100 Californians who had recently experienced a severe earthquake. Occasions of dissociation in the week following the event were reported by many individuals, ranging

from 17% feeling distant from their sensations, 25% who reported depersonalization, 33% who reported derealization, and 76% who reported hypervigilance.

The function of dissociation in patients' mental life has been much discussed. Many clinicians believe that patients use dissociation as a defensive coping strategy to protect them in the face of overwhelming horror and traumatic stress (Bremner & Brettt, 1997). Although the long-term protection provided by the strategy is debatable considering its link to later PTSD and other pathology, the immediate relief provided by dissociative maneuvers during trauma can be readily appreciated. The separation of consciousness and the illusion that the occurrences are unreal enables victims to mentally escape and distance themselves from what is otherwise an uncontrollable and inescapable horror (Koopman et al., 1994, 1996). Dissociating may be a desperate, last-resort option, the sole means available to the victim to reduce overwhelming terror. Moreover, if the trauma event is repeated often, victims may learn to dissociate quickly as a convenient strategy for walling themselves off from the terror they are confronting. Several lines of evidence suggest that people who have experienced repeated traumas become sensitized (or learn it as a coping strategem), so that they report more frequent dissociative experiences in their later life (Spiegel, 1984; Koopman et al., 1996; Bremner, Southwick, Johnson, Yehuda, & Charney, 1996).

We may ask why traumatic events often lead to these anomalies of consciousness, perception, and fragmentary memories. One perspective on dissociation supposes that these alterations of consciousness and encoding arise due to massive discharge of stress hormones and neurotransmitters during the trauma, leading to extreme levels of activation of the sympathetic nervous system. Conceivably, this unusual over-production of neurotransmitters and stress hormones causes the brain to enter an unusual biochemical state radically different from the normal brain and neurotransmitter states that prevail during the everyday experiences that accompany encoding of normal memories. Furthermore, the victims may be so focused on and terrified by the event that they fail to encode its features and sequence of scenes into meaningful, semantic categories from which they could later compose a coherent narrative. That is, during the trauma victims are probably not talking to themselves, conducting an internal monologue describing what is happening to them. After all, traumatic events are often characterized as unspeakable (van der Kolk, 1987) and beyond the range of normal human experiences.

Because of the extreme attention to the external threat and their fear of dying, victims may be reacting to external stimulation as would an automaton, without connecting their perceptions to their interior sense of self. Thus, memories of the events may not be associated to their self in the same manner as normal memories are. Consequently, retrieval of those memory fragments would not be under voluntary control, and could not be retrieved by probing memory with, "What happened to ME?" as a cue. Rather, these sensory fragments would be revived in consciousness primarily from associated external cues that resemble those in the original traumatic situation. Similarly, this inability to voluntarily recollect most of the episode would explain victims' occasional inability to provide a coherent narrative account of the event.

Dissociation as an enduring personal trait

Dissociation is not just a phenomenon correlated with acute trauma reactions or psychopathology. Even in nontraumatic situations, individuals differ consistently in having, or at least reporting, dissociative experiences in everyday life. A self-report measure, the Dissociative Experiences Scale (DES), has been devised by Bernstein and Putnam (1986). Its items ask subjects to report how often they engaged in daydreaming, displayed absentmindedness, have felt outside themselves, lost track of time (e.g., "highway hypnosis"), became totally absorbed in a book or movie, and so on. Subjects' frequency of claiming such experiences in the course of their everyday life is reliably assessed by such questionnaires. Mild, transient feelings of depersonalization and derealization are reported among

nonclinical populations and are especially common in adolescence, with their incidence ranging from 8.5 to 70% of the normal population depending on the age of the population sampled as well as the definition and method of assessing dissociative experiences (Bernstein & Putnam, 1986).

The fact that strange subjective phenomena are frequently reported need not guarantee their veracity, any more than reports of alien abductions or extrasensory perceptions support their claims. Part of the problem is that people use metaphoric language to refer to interpersonal situations, to their vague physiological sensations and feelings of selfhood. People often use casual idioms, saying that they "are beside themselves," "lost in thought," "out of it," "spaced out," "just going through the motions," and so on. But whether these are valid indicators of a substantive subjective reality or just casual idioms to express odd social situations and/or physiological tempests is difficult to say. Certainly behavioral scientists who want to make something of these subjective reports should be cautious in interpreting the meaning and reference of such verbal reports. A similar argument was made by Ortony, Clore, and Foss (1987; also Ortony, Clore, & Collins, 1988) regarding the 600-plus words in English referring loosely to emotional feelings. At least we need some understanding of how people initally learn to talk about their subjective experiences using the idioms available in their language community. However, rather than engaging in that analysis here, we will content ourselves by noting that the validity and causes of such phenomenological reports is a topic worthy of investigation.

Leaving aside its use in discussions of hypnosis, dissocation is a concept largely derived from clinical observations, and there are no known ways to induce it and study it in normal laboratory settings. Consequently, experimental/cognitive psychologists have viewed the concept and its attendent hypotheses somewhat skeptically, asking what it is exactly, how and why it occurs, how is it to be distinguished from an illusory and deceptive exercise of the subject's imagination. Most critically, we ask how criterial features of dissociation might be re-created to conduct analog studies of it in the laboratory.

Hypnosis as a laboratory analog of dissociation

Because laboratory research on traumatic dissociation is ruled out by ethical constraints, cognitive psychologists must search for acceptable laboratory analogs of the phenomenon. Historically, dissociation has been considered nearly synonymous with hypnosis (Janet, 1907). Both phenomena demonstrate an apparent functional separation of conscious awareness, such that complex activities are performed with individuals claiming not to be aware or in control of their actions. In the case of dissociation, actions are controlled automatically or unconsciously, while in hypnosis, control is given over to the hypnotist. Both cases also emphasize absorption of attention on a limited number of environmental stimuli. Janet, Charcot, and many others thought of dissociative symptoms of hysteria as a form of hypnosis, and for them the two concepts were virtually identical. Indeed, Janet's patients with hysterical disorders were usually highly hypnotizable and were routinely treated with hypnotic suggestions.

Modern research has continued to confirm that patients with dissociative disorders have significantly higher hypnotizability scores than do patients with other psychiatric disorders and normals (e.g., Bliss, 1986). This high correlation has been reported for patients with PTSD (Spiegel, Hunt, & Dondershine, 1988) and those with multiple personality (Putnam, 1989; Bliss, 1986). Butler, Duran, Jasiukaitis, Koopman, and Spiegel (1997) offer a diathesis-stress model for such pathological dissociation. They argue that innate hypnotic ability interacts with environmental stressors to lead to dissociative reactions which are then learned as a defensive, neurotic maneuver. Some investigators have also argued that early childhood trauma contributes to both PTSD and multiple personality (Faith & Ray, 1994; Frischholz, 1985; for an opposing view, see Nash et al., 1993 and Spanos, 1996). However, while a high correlation has been identified between dissociative phenomena in

clinical populations and hypnotizability, the correlation disappears in normal populations. In a study of college students, Faith and Ray (1994) found that dissociation (DES) and hypnotizability scores were practically independent, with correlations around .10 in several independent replications. Thus, scores on the DES measure of every-day dissociation explained only about 1% of the variance in hypnotic ability. Such null results raise difficulties for theories which claim a biological, innate connection between proneness to dissociative experiences and hypnotizability.

As noted earlier, hypnosis may be the closest and most convenient laboratory analog of dissociation available to cognitive-experimental researchers. Unfortunately, hypnosis brings along its own controversies regarding how it is to be interpreted (e.g., Hilgard, 1986; Sarbin & Coe, 1972; Spanos, 1996; Spanos & Chaves, 1989), and one hesitates to attempt to elucidate one mystery by using another. Assuming hypnosis is a useful analog to the dissociations observed in hysteria, one's interest is immediately drawn to situations in which hypnotized subjects are instructed to carry out two tasks simultaneously, with the further suggestion that the tasks will not interfere with one another. For example, under hypnosis subjects may be instructed to divide their mental resources into two parts, one conscious and the other unconscious. An engaging primary task (e.g., rapidly naming visual color patches) is to be carried out consciously, whereas an effortful, secondary task (e.g., rapidly writing successive subtractions of sevens from a starting three-digit number) is assigned to be carried out subconsciously at the same time.

Although highly hypnotizable subjects in such conditions will *report* that they feel that the two tasks were completely isolated mentally from one another and that the secondary task requires no conscious effort, objective performance measures indicate considerable interference (slowing) between the two tasks—as though the two "streams of consciousness" must share the same (limited) attentional resources (see Green & Lynn, 1995; Stevenson, 1976). In fact, nonhypnotized subjects (not having to pretend that one task is unconscious) perform objectively at a slightly higher level than do the hypnotized subjects instructed to dissociate the two tasks. The social-psychological perspective on hypnosis (Sarbin & Coe, 1972; Spanos, 1996; Spanos, & Chaves, 1989) suggests that the hypnotic suggestions influence participants' interpretations of their subjective experiences and their verbal reports but not the objective measures (rate of color naming); on the contrary, the latter indicate that hypnotic role-playing cannot overcome what is largely a biological limitation on processing capacity.

Similar conclusions arise from critical analyses of the functional amnesias created by post-hypnotic suggestions (see Bower, 1990; Spanos, 1996)—which are often construed as a form of dissociation. Measures of explicit memory will show deficits following suggestions for post-hypnotic amnesia; subjects will *report* being unable to retrieve items which they have been told to forget. In marked contrast, measures of implicit memory which are obligatory and not under voluntary control reveal full effects of the earlier learning experiences that were supposedly covered by amnesia (Coe, 1989; Kihlstrom & Hoyt, 1990; Tobias, Kihlstrom, & Schacter, 1992). Such results make more pressing the need to investigate and understand the subjective phenomena of dissociation. A central issue is the disconnection between subjects' subjective reports and feelings of volitional control compared to their objective performances. Advances in our understanding of intention and volitional action (the will of olden times) are clearly needed to aid our understanding of dissociation. Important ideas on this matter have been advanced by Wegner (1994; also Vallacher & Wegner, 1987) and Bargh (1994; also Wegner & Bargh, in press).

Several suggestions have been offered regarding how associative network theories might be altered to reflect dissociative memories. Recall that in network theories such as those of Bower (1981), memories are stored as event nodes in an interconnected network of conceptual units. Included in these networks are the relevant emotion and situational

(context) nodes. Memory dissociations can be introduced into such systems in several ways. Any adequate theory simply needs some means for assigning and segregating sets of episodic memories into different "bins" or partitions of memory space depending on the person's mental state at the time of encoding, with later access to that bin dependent on reinstatement of that mental state.

As one example, Bower (1994) speculated that the cross-personality amnesias characterizing some multiple personality patients may be interpreted as an extreme form of mood state-dependent memory. Different personal roles and profound identities could become organized around specific, extreme mood states (e.g., the depressed persona or the aggressive or frightened or sexualized persona). Evidence strongly indicates that even nonclinical "normals" exhibit somewhat different "personalities"—different attitudes, preferences, behavioral styles, evaluations, moral standards, and self-concepts—depending on their temporary moods (Bower, 1995). Thus, events that occur while the person is in one mood-and-personality would become associated to that mood, but thereby relatively difficult to retrieve when the person's mood changes—leading to the partial amnesias across personalities.

A second framework for explaining multiple personalities would extend Claparède's ideas regarding the centrality of the cognitive self in recording episodic memories, but with the addition that one can adopt distinctly different "ego states" or selves (see also Kihlstrom, 1993, 1995). Thus, episodic events become associated to the "self" prevailing at the time of encoding. Voluntary retrieval of personal memories would begin with a cue or probe asking, "What happened to ME (my present ego) at this time?" If a stressful event produced dissociation during the initial experience, then its memory would be recorded in association with the fragmented or dissociated ego, not with the predominant ("normal") ego state. Thus, that memory would be less likely to be retrieved later when a different ego state prevailed—leading to the partial amnesias exhibited for traumatic events. Similar theories to explain the explicit memory disturbances across multiple personalities have been proposed by Yates and Nasby (1993) and by Morton (1991). However, all these theories are speculative, and await definitive tests with better data regarding memories following dissociative experiences.

Social Cognitive Theories of Trauma

Social cognitive theories of trauma response complement the explanations discussed so far by emphasizing the impact of the trauma in disrupting the victims' basic beliefs. These theories note that people operate on the basis of some unchallenged, unquestioned assumptions about themselves and the world. Trauma represents a major violation of these assumptions, threatening to completely undermine the bedrock on which people ground their existence. The psychic sequelae of trauma are viewed as resulting from the processes involved in dealing with (rejecting, accommodating, or integrating) the new information into existing belief structures (Brewin et al., 1996; Creamer, Burgess, & Pattison, 1992; Harber & Pennebaker, 1992; Janoff–Bulman, 1989).

Janoff–Bulman (1989) classified these core assumptions as beliefs that the world is basically a benevolent place in both impersonal and personal domains, that the world distributes good and bad outcomes according to a meaningful form of justice—that good people by their actions deserve to receive good outcomes, and vice versa for bad people, and that as individuals they are entitled to be treated with respect and justice, so they may achieve some measure of self-worth, dignity, and integrity. These beliefs presumably develop in very early childhood through interaction with and attachment to caregivers (Janoff–Bulman, 1992) and they continue to change and strengthen with experience thoughout life. Representationally, these assumptions are stored in memory as schemas, or abstract knowledge structures, composed of a rich network of information. Schemas provide an organization for storage and recollection of experience, as well as theories for predicting, interpreting, and reacting to the world. These

beliefs are postulated to be fundamental to psychological health.

A traumatic event upsets one or more of these basic beliefs. Natural disasters (fires, floods, earthquakes) tell us that the physical world is not always benevolent and predictable; random criminal assaults tell us that our cheerful assumptions about human benevolence, justice, and deservingness may be naive and terribly wrong. As Janoff–Bulman (1989) notes, the most common response to traumatic life events is an intense feeling of vulnerability, which is in stark contrast to the victim's former illusion of security. She states, "We may intellectually maintain that one out of four people gets cancer and that crimes and car accidents are common. Yet we truly do not believe that these events will happen to us" (p. 116).

As mentioned earlier, these belief systems are believed to develop through interaction with caretakers. Thus, of great interest to developmentalists is what happens when children are maltreated during their creation or even by the very individuals they depend on to develop the constructs. Not surprisingly, maltreated children often develop insecure attachments with caregivers, and are likely to be classified as disorganized and disoriented in their attachment relationships (Rogosch, Ciccheti, & Aber, 1995). Presumably, not only are these children less likely to be healthy, they are more vulnerable in the face of new stressors, perhaps because each additional stressor decreases their chances of ever being able to believe the world is just and benevolent, or believe in their own self-worth. On the other hand, additional traumas could conceivably have less immediate impact since they fail to conflict with the child's world beliefs.

When these assumptions are intact, their violation causes considerable emotional disturbance because that shakes the foundation on which one's life plans have been based. Pressures then arise to deal with the incongruent or dissonant information. This can be done by either distorting, suppressing, or denying the incongruent information so as to maintain one's prior beliefs, or by altering those core beliefs to take account of the new data. Problems arise whichever tactic is followed. First, core beliefs are difficult to alter substantially because the mind has strong conservation biases to maintain the status quo. Incongruent information may be initially discounted or misperceived. Considerable research illustrates, too, that over time schema-consistent information is remembered better, whereas schema-inconsistent information may be forgotten or distorted to be more in line with prior beliefs (e.g., Owens, Bower, & Black, 1979; Fiske & Taylor, 1991). These effects are particularly strong when the information concerns core assumptions about the self and the world. Greenwald (1980) coined the phrase "The Totalitarian Ego" to describe a collection of strategems that the cognitive system uses to preserve consistency in its beliefs, self-esteem, and the belief that one has good effects on his or her world.

The resistance of core assumptions to change is adaptive, as they are hypothesized to be essential for psychological health and functioning. On the other hand, the intense emotionality and significance of traumatic experiences does not permit the victim much leeway for their interpretation or dismissal. Thus, trauma victims are faced with the difficult task of integrating their horrifying experience while retaining the integrity of their beliefs.

Let us turn now to the second strategy for dealing with a traumatic event, namely, to somehow distort or reinterpret the information so that it no longer violates core beliefs. Three common responses to trauma that function in just this manner are denial, self-blame, and reinterpretation in a positive light (Janoff–Bulman, 1992). Denial can be temporary or long term with different consequences. Temporary denial reduces threatening information to tolerable doses and allows changes in beliefs to occur gradually, preserving the illusion that one's core beliefs have remained stable and coherent thoughout a minor adjustment process. On the other hand, long-term denial of the trauma information would keep integration from ever occurring, which often leads to the persisting symptoms of PTSD.

Blaming the victim ("She dresses so provocatively—she deserves what she got," or

"She should have locked her bedroom windows") is a common response of both those involved in the event and those not directly involved (Harber & Pennebaker, 1992). Blaming oneself and feeling guilty appears odd to observers until one notices that it allows victims and observers alike to dismiss a trauma as temporarily situational, so that it no longer needs to threaten core beliefs. Kulik (1983) found that when schema inconsistent information was attributed to situational factors it was more readily forgotten. Janoff–Bulman (1992) argued that victims who blame their own lack of protective behaviors for the traumatic event can then construe their future as controllable and even predictable. On the other hand, victims who blame their character or disposition for bringing on an event ("I just attract violent men") will not adjust well since their belief about self worth will be undermined, perhaps initiating continual cycles of self-recrimination and self-castigation. With rape victims (for example), the self-castigation often advances to intense feelings that one has been "contaminated" by the rape, has become "damaged goods," or has been "stigmatized" by her social group and is no longer attractive to men.

The third tactic, positive reintrepretation of a traumatic event, requires the victim to think about whatever positive gains or lessons can be gleaned from the horrific experience, and to focus on them in readjusting to the future. For example, victims of natural disasters often discover close community ties of which they were unaware, concentration camp survivors describe a renewed commitment to the value of life and family friendships, patients with terminal illnesses (or those who have recovered) often report that the foreshortened horizon of their lives has motivated them to develop closer friendships and extract more meaning and joy from the time that remains for them. Such positive reinterpretations are therapeutic since they allow victims to see meaning in the world and to improve their self image, feeling stronger and more capable of confronting adversity.

If trauma victims use the maladaptive tactics mentioned earlier, dismissing, suppressing, or denying the traumatic information for a long time, then the unfortunate sequelae of PTSD may result. The traumatic information is not processed, defused, habituated, assimilated, "worked through," or "laid to rest"; consequently, thoughts, emotions, and images associated with the trauma remain active in memory (Creamer, Burgess, & Pattison, 1992), resulting in the flashbacks, nightmares, avoidance, and hypervigilance of PTSD. The emotional dysfunction presumably continues until the new information is either assimilated into existing beliefs or those beliefs are altered to accommodate it (Harber & Pennebaker, 1992; Pennebaker, 1990).

By following an avoidance strategy, trauma victims apparently are missing out on exactly the experiences they need for their recovery. Integration requires that both information about the trauma event and information incompatible with it be activated for modification (Foa, Steketee, & Rothbaum, 1989). Activation of the trauma memory promotes recovery in several ways. First, the victim habituates the emotional responses caused by the event's recollection. Second, the stimuli can become associated with more adaptive responses of "safety," where the individual feels in control or capable of managing his or her surroundings. Third, repeated exposures provide opportunities for the victim to address issues regarding self-blaming, guilt over being a victim, and pursue more positive reinterpretions of the events.

One commonly investigated method of integration is narration, often in a support group of similar victims. The victims' ability to turn their story into a coherent narrative appears to be directly related to their recovery. Foa, Molnar, and Cashman (1995) investigated the narrative accounts that rape victims gave of their traumatic episode. Initially, the accounts were fairly disorganized, disjointed, repetitive, with many fragmentary, unfinished thoughts. These characteristics of the narration presumably reflect unprocessed snapshots of the assault as well as disruptive influences of the emotional upset caused by remembering the scene. During subsequent sessions of prolonged exposure therapy, the

patients' narratives became progressively more organized and coherent. The narrations contained a beginning, middle, and end, had fewer disorganized fragments, and included increasingly logical and causal sequencing of events. The reductions in the patients' percentages of fragmentary thoughts in their narratives proved to be correlated .73 with their reduction in indices of trauma-related anxiety.

These results suggest that as fears of the trauma extinguish, patients are able to convert more of the emotional feelings and sensory images into coherent verbal form, an ability hypothesized to be necessary for physical and psychological health (Pennebaker, 1990; Brewin et al., 1996). One's ability to sensibly narrate an event may reflect the extent to which the event has been integrated into schematic meaning networks and has lost its emotional impact. The event is given a beginning, middle, and end, and organized according to casual and temporal connections as well as goals. Perhaps it is not until the event is represented in this manner that it can be reinterpreted in such a way as to maintain the integrity of core beliefs.

Concluding Comment

This paper has attempted to use traditional cognitive psychological research to understand the impact of traumas on mental processes. A considerable range of the behavioral effects of trauma can be understood in these terms. Even more of the phenomena of PTSD can be understood by including the further distinction between explicit, episodic memory and implicit memory. This distinction applies well to emotional memories which can be stored in both ways or only in the implicit form. Rearousal of implicit memories of trauma provide the substrate for flashbacks and re-experiencing episodes; subthreshhold activation of fear memories provide the substrate for the victims' continuing hypervigilance and avoidance of threatening stimuli. Memories stored in the implicit system are outside the person's voluntary control: He or she can neither voluntarily retrieve them nor voluntarily prevent their intrusion once the environment rearouses them. We have given special prominence in our account of explicit memories to the role of the experiencing ego or self in the storage and retrieval of such memories. Disturbances in consciousness and the sense of selfhood during the traumatic episode can thus create major disturbances in the way trauma memories are stored and accessed.

These considerations of self in explicit memory have led us to an interest in victims' reports of dissociation during trauma. Although a popular, long-standing, concept in the psychiatric literature and in hypnosis theories, dissociation has no counterpart in conventional theories within cognitive psychology. Cognitive psychologists may have devoted a lifetime to laboratory research on cognitive processes without having seen the dissociative phenomena which trauma victims (or their clinicians) routinely report. As a result, there remains a considerable disparity in the descriptions of mental processes in trauma victims provided by psychiatrists and clinicians compared to those commonly used by cognitive psychologists. We have felt acutely this disparity in our own reading of the literature and in our attempt to understand laboratory analogues of dissociation such as hypnosis. We confess to being still somewhat perplexed by the difficulty of drawing firm conclusions regarding what is clearly an important topic. We nominate understanding dissociative phenomena as a high priority item on the research agenda of cognitive psychologists in the 21st century.

Finally, we briefly mentioned a social cognitive approach to understanding trauma sequelae. The brevity of our review reflects a need to develop the theory further. While such theories seem to offer much promise in integrating various approaches to trauma research, they are in need of exploration developmentally and cross-culturally. Any social psychological theory of psychopathology should be extendible to all cultures in which the pathological behavior is found. Furthermore, as the assumptions are presumably based upon secure attachment, then tracking their development in individuals of various attachment styles across the life span should prove of appreciable interest.

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