(Freud 1926), and the distinction between memory and fantasy has become unclear (see, e.g., de Saussure 1982).

From a behavioral/cognitive viewpoint, Foa, Steketee, and Rothbaum (1989) distinguished traumatic from other memories, using Lang's (1977) concept of "fear structures" that exist in memory. Such fear structures include information about the feared stimulus or situation, responses (including physiological), and interpretation of its meaning, especially danger, and form a program for escape or avoidance. Accordingly, PTSD fear structures differ from phobias in the persistence of intensity of responses, size and accessibility of the structure, high arousal, and low threshold for activation.

More recently, there has been renewed interest in the biological basis for stress (see the review in Chrousus and Gold 1992). A stressful experience can have profound effects on the organism mediated by the hypothalamic-pituitary-adrenal axis and the locus ceruleus/norepinephrine sympathetic system. These systems are activated with stress to restore adaptation and homeostasis but can malfunction when stress is overwhelming or chronic. Stress affects arousal, behavior, cognition, and physiological functioning of most body systems and can affect reproductive, growth, thyroid, and immune functions.

Stressful experiences are recorded in the brain via neuronal mechanisms. Evidence for the basis of memory in brain structure and function was offered by Penfield and Jasper (1954), who called the temporal cortex "memory records" after evoking memories from patients stimulated there. Horowitz, Adams, and Burton (1968) suggested a more complex and dynamic model that does not posit static localized memory engrams.

Mesulam (1990) summarized a modern model for the neurological foundations of memory, mapping the phenomena at the level of multifocal neural systems that give rise to brain-behavior relationships that are both localized and distributed. The widely distributed but tightly connected limbic network is critical in making new experiences storable and old experiences retrievable. Enabling association between multimodal sensory information and affective states related to fear and reward, the amygdala elicits the recall of emotionally charged memories. Furthermore, Mesulam notes that activation states of the entire cerebral cortex, modulating the tone and coloring of experience, can be shifted by five projection systems, each arising from a relatively small group of subcortical neurons using a single neurotransmitter. Li

and Spiegel (1992) offered a neural network model for dissociative disorders including PTSD.

Recent studies are providing empirical evidence that PTSD may be not only a psychological or a mind phenomenon but also a brain phenomenon (reviewed in Bremner, Southwick, and Charney 1991; Friedman 1991), involving catecholamine, benzodiazepine, and endogenous opioid systems. Recent reports (Brodsky, Doerman, Palmer, Slade, and Munasifi 1990; Ornitz and Pynoos 1989) link PTSD to neurophysiological disturbances, intimating the distinctiveness of traumatic memories. Additionally, studies (Pitman, Orr, Forgue, de Jong, and Claiborn 1987; Pitman, Orr, Forgue, Altman, de Jong, and Herz 1990; van der Kolk, Greenberg, Orr, and Pitman 1989) are showing that sounds and sights of battle combat–related stimuli evoke peripheral signs of physiological arousal, as well as analgesia, in combat veterans with PTSD but not in those without PTSD. Moreover, Bremner et al. (1991) discussed how the preference of PTSD patients for benzodiazepines might result from long-term alterations in benzodiazepine systems induced by trauma. Emotional numbing and analgesia may derive from release of endogenous opioids (Pitman, van der Kolk, Orr, and Greenberg 1990).

Sufficient stress may actually induce structural changes—changes in the "hard wiring"—of the brain. Studying children, Perry (in press) hypothesized that abnormal patterns of catecholamine activity associated with and induced by traumatic events may result in altered development in which a dysregulated brain stem results in permanently abnormal brain stem functioning. In abused and neglected children, he found altered cardiovascular regulation, affective lability, behavioral impulsivity, increased anxiety, increased startle response, and sleep abnormalities. Perry hypothesized that young children victimized by trauma are at risk for developing permanent vulnerabilities rooted in permanent changes in neuronal differentiation and organization. Perry's preliminary findings show that symptoms respond to clonidine, which attentuates noradrenergic-mediated arousal.

Malignant Memories and Adolescence

Following the school shooting, when comparing adults' to children's reactions, we found that developmental factors may play an important part in how an individual reacts to violence. For example, adults

needed more specific cues to trigger reexperiencing memories, while older children and adolescents were more angry in response to the shooting (Schwarz and Kowalski 1991), and younger children's reactions were more interactive with parental symptoms (Schwarz and Kowalski 1992a).

It is reasonable to ask how traumatic events affect individuals at differing stages of development. Adolescence is an important period in the developmental process. It is characterized by complex biopsychosocial shifts that include hormonal changes, stimulating sexual features, affects, and behaviors; cognitive shifts, enabling more abstract and moral thinking regarding the meaning of self in the world and in time; increases in affective coloring and intensity; shifts in personality organization and crystallization of identity; and shifts in relations with family and peers.

Adolescents are at high risk for exposure to violence. We know that adolescents are participants in, or witnesses of, family and street violence at least as much as younger children or adults. After all, many combatants in wars and victims of rape are adolescents. In the United States, twenty-nine adolescents, compared with nineteen children, out of a thousand are abused ("Teens Abused More Than Children" 1992).

In the poignantly tragic song "Next" (from *Jacques Brel Is Alive and Well and Living in Paris*), a veteran remembers his traumatic battlefield initiation into sex as an adolescent: "I was still just a kid when my innocence was lost in a mobile army whorehouse, gift of the army free of cost. . . . next, next. . . . I would always recall the brothel truck, the flying flags. . . . Me, I really would have liked a little bit of tenderness, maybe a word, a smile. . . . It is the voice of nations, it is the thick voice of blood. . . . And since then, each woman I have taken to bed seems to laugh in my arms, to whisper through my head . . . next, next. . . . Oh, the naked and the dead should hold each other's hands as they watch me scream at night in a dream no-one understands . . . next . . . next. . . ."

Yet a search of the Medline data base, cross-referencing rape or trauma with adolescence, showed relatively few studies of how trauma affects adolescents as a group or the adolescent process. Reports are anecdotal, retrospective, and uncontrolled and lump adolescents together with children or do not discuss in detail how adolescents respond differently from younger children, from adults, or from each other.

Many authors have noted that exposure to extreme stress in adolescence or childhood produced symptoms later. Klein (1971) described social adjustment and families of Holocaust survivors currently living in a kibbutz. Kahana (1981) discussed the effect on an adolescent boy of his father's traumatic experiences in the Holocaust. Jackson (1982) described arrested moral development in adolescent combatants. Glover (1984) highlighted the development of profound mistrust in adolescent Vietnam veterans. Gidycz and Koss (1989) reported that sexually victimized adolescent girls later scored higher on the Trait Anxiety Inventory and the Beck Depression Scale. Beck and van der Kolk (1987) reported incest as a risk factor for intractable psychosis in chronically hospitalized adult women. Burgess, Hartman, and McCormack (1987) showed that sexual abuse was associated with higher risk for later drug use and sociopathy. Edwards and Donaldson (1989) and Lindberg and Distad (1985) showed that adult victims of childhood and adolescent incest showed PTSD symptoms. Stoddard, Norman, Murphy, and Beardslee (1989) noted that children and adolescent burn victims suffered posttraumatic enuresis and phobic and overanxious disorders. Kinzie, Sack, Angell, Manson, and Rath (1986) and Kinzie, Sack, Angell, Clarke, and Rath (1989) followed a group of Cambodian adolescents exposed as children to the Pol Pot atrocities and found continuing PTSD and depressive symptoms in a substantial number. Herman, Perry, and van der Kolk (1989) suggested a link between early abuse and later development of borderline personality disorder. Terr (1987) explored how early trauma influenced the creative product of writers and artists.

In contrast, Leon, Butcher, Kleinman, Goldberg, and Almagor (1981) questioned the intergenerational transmission of psychopathology in Holocaust survivors. Elder and Clipp (1989) reported that adolescents exposed to heavy combat in World War II and the Korean War displayed more resiliency as adults, and Saigh (1985) reported that traumatized adolescents did not differ from nontraumatized Lebanese adolescents.

Several authors reported on the treatment of traumatized adolescents: Stocking (1989) described the psychotherapy of an adolescent girl who witnessed parental murder-suicide. Van der Kolk (1985) noted the vulnerability of adolescent combatants to battle loss of a buddy—they suffered narcissistic injury and threat to group cohesion that motivated revenge but responded to group therapy aimed at restoring group

TABLE 2
TRAUMA DURING CHILDHOOD REACTIVATED IN ADOLESCENCE

Traumatic event
Sexual abuse/physical abuse/neglect/multiple foster placements and moves
Malignant memory
Cognition: repression, cognitive constriction, inattention
Affect: shame, dysphoria, guilt, lability
Arousal: anxiety/panic, flashbacks, intrusive imagery, insomnia
Behavior: avoidance, overcompensation, dependency, pseudomaturity, superficial cheerfulness
Somatic: headaches, fatigue
Regressed states: splitting, indiscriminate attachments, idealizing or caretaking transference
Triggers/cues
Molestation at age thirteen
Puberty, particularly development of secondary sexual characteristics
Heterosexual contacts

identity. Saigh (1988) used flooding therapy to treat adolescents with PTSD. Deblinger et al. (1990) noted improvement with treatment in sexually abused children and adolescents.

Case A: Childhood Trauma Reactivated in Adolescence

Miss A (see table 2) was hospitalized at age thirteen because she left a suicide note describing vague sexual advances by a male household member and intense feelings of fear and shame that prevented her from telling her adoptive mother, therapist, or teachers. Reportedly a single incident, this event precipitated a serious depression. During hospitalization, Miss A exhibited behavioral disorganization, dissociation, sleep disturbance, hypervigilance, and diffuse fear reactions suggesting more serious prolonged abuse. She began to verbalize strong wishes to reunite with her father, now absent many years, and guiltily blamed herself and feared rejection by her adoptive mother.

The little developmental history that was available included early neglect, physical abuse, and multiple moves. She was removed from her parents at age six after sexual abuse by a stepsibling. She began psychotherapy at the age of eight as part of planning for a permanent adoptive home with few reported behavioral or psychological difficul-