Consciousness and Cognition **10,** 259–293 (2001)
doi:10.1006/ccog.2001.0493, available online at http://www.idealibrary.com on IDEAL®

Toward an Etiology of Dissociative Identity Disorder: A Neurodevelopmental Approach

Kelly A. Forrest

University of Washington, Bothell, Washington

This article elaborates on Putnam's ''discrete behavioral states'' model of dissociative identity disorder (Putnam, 1997) by proposing the involvement of the orbitalfrontal cortex in the development of DID and suggesting a potential neurodevelopmental mechanism responsible for the development of multiple representations of self. The proposed ''orbitalfrontal'' model integrates and elaborates on theory and research from four domains: the neurobiology of the orbitalfrontal cortex and its protective inhibitory role in the temporal organization of behavior, the development of emotion regulation, the development of the self, and experience-dependent reorganizing neocortical processes. The hypothesis being proposed is that the experience-dependent maturation of the orbitalfrontal cortex in early abusive environments, characterized by discontinuity in dyadic socioaffective interactions between the infant and the caregiver, may be responsible for a pattern of lateral inhibition between conflicting subsets of self-representations which are normally integrated into a unified self. The basic idea is that the discontinuity in the early caretaking environment is manifested in the discontinuity in the organization of the developing child's self.

Key Words: dissociative identity disorder; orbitalfrontal; temporal organization; self; emotion regulation; inhibition.

INTRODUCTION

The relationship between amnesia and childhood trauma has been controversial since its discovery. Claims of false memories and suggestibility of patients have followed this literature since the initial links between the symptoms of ''hysteria'' and early trauma were made over a century ago (van der Kolk, Waiseath, & van der Hart, 1996). These early controversies presaged the current debate regarding dissociation in the current clinical and experimental literatures. This debate is particularly divisive surrounding the diagnosis of dissociative identity disorder (DID), formerly multiple personality disorder. The clinical literature supports the link between early trauma and dissociation based on over a century-and-a-half of reports by DID patients of extremely high incidences of physical, sexual, and other types of trauma in their childhoods. The credibility of this evidence, however, is challenged based on the retrospective, self-report nature of the patients' remembrances. Challenges to the ex-

The author is adjunct faculty at the University of Washington—Bothell, and has a private psychotherapy practice. The author acknowledges the many helpful discussions with Dr. Mark Biernbaum on developmental issues during preparation of this article. This article was supported in part by National Institute of Mental Health Grant MH11674-01A1 awarded to the author during graduate school.

Address correspondence and reprint requests to Kelly A. Forrest, 18210 73rd Ave. NE, Suite 104, Kenmore, Washington 98028. E-mail: forrestk@u.washington.edu.

1053-8100/01 $35.00

istence of the trauma-dissociation link are also fostered by the rather sketchy picture of the disorder's genesis provided by current trauma-based theories of DID. Alternative explanations view the disorder as based on iatrogenic or social construction processes (e.g., Spanos, 1994).

Despite these challenges, researchers in the past decade have begun to investigate DID from a developmental perspective based on the strength and consistency of clinical reports of massive childhood trauma of patients with DID, the neurobiological effects of trauma found in patients with posttraumatic stress disorder, the apparent developmental window of vulnerability for the emergence of the first alter personality in DID, and the development of reliable and valid diagnostic measures of dissociation (Putnam, 1995). Developmental constructs and theories, including psychobiological states, imagination and fantasy, attachment theory, and integrative self processes are theoretically linked to the development of DID. To date, however, relatively little is known about the neural and psychological developmental processes which underlie the disorder.

Currently, the most influential developmental model is the ''discrete behavioral states'' model of DID proposed by Putnam (1997). Based on studies of infant consciousness, Putnam suggests that traumatic environments are inadequate to allow children to complete the developmental task of consolidating an integrated sense of self from the discrete behavioral states which predominate in infancy. A ''state'' is defined as a condition of being and includes all mental and emotional functioning. Putnam proposes that normal caregiving environments facilitate the addition of behavioral states and transitions between states. This allows the naturally occurring discrete states to eventually coalesce, unify, and present as a continuous self across differing situations. In contrast, in environments characterized by trauma, the transitions between states are not regulated by appropriate interactions with the caregiver. Rather, there is deliberate desynchrony of the parent–child behavioral states which produces strong disruptive effects. Continuing maltreatment or other stress interferes with a child's acquisition of self control of behavioral states. Children create complementary behavioral states that embody attributes and behaviors reciprocally adaptive to the parental behavioral states. These parenting dysfunctions are hypothesized to impair the child's metacognitive integration functioning and impact the development of the consolidation of self and behavior. Putnam proposes that varying degrees of disruption in the task of integration of information across behavioral states probably underlie the larger failures of integration of self and behaviors seen in many victims of childhood trauma. The discrete behavioral states model hypothesizes that different identities seen in DID reflect the creation of a set of complex, enduring, identity-based, discrete dissociative states that evolve during childhood and adolescence.

Putnam's model leaves many unanswered questions. What are the brain structures or functions involved in the creation of multiple representations of self? What are the psychological and neural mechanisms of self-continuity or self discontinuity? What are the critical social interactions in the mother–infant dyad? Are there critical time periods within which these interactive experiences must occur? How do behavioral states and self-organizational processes relate?

The model of the etiological origins of DID proposed in this article integrates theory and research from the neurosciences, cognitive psychology, and developmental psychopathology to elaborate on Putnam's discrete behavioral states model and suggests answers to some of the questions left unanswered by that model. The proposed model also represents an application of the theoretical framework of developmental psychopathology introduced by Cicchetti and Tucker (1994), which advocates for the integration of psychological and neural mechanisms in etiological models of psychopathology. In accordance with this framework, the pathological development of DID is conceptualized to result from underlying self-organizing mechanisms which are common to normal development. These mechanisms include affect regulation, memory formation, and the regulation of goal-directed behaviors. In normal caregiving environments, a child's self-regulatory structures are postulated to organize the developing neural system by cohering to form an integrated self. The theoretical framework, however, allows for the possibility of varying degrees of self-fragmentation based on the particular environment in which the child develops. The proposed orbitalfrontal model seeks to explicate how these self-organizing mechanisms might function in an extremely abusive caretaking environment and result, not in the formation of a coherent sense of self, but in the emergence of segregated or dissociative ''selves.''

The article is integrative in nature. The first four sections review, synthesize, and elaborate on research primarily from four domains: the neurobiology of the orbitalfrontal cortex and its role in the temporal organization of behavior; attachment and emotion regulation; the development of the self, and experience-dependent neural reorganization. The fifth section presents the orbitalfrontal model. The last section concludes and offers suggestions for future research.

ORBITALFRONTAL CORTEX

The prefrontal lobes have attracted increasing attention as cognitive scientists and others have attempted to understand the neural substrates of episodic memory and consciousness (e.g., Wheeler, Stuss, & Tulving, 1995; Fuster, 1995). A review by Wheeler, Stuss, and Tulving (1997) synthesizes these findings and proposes that the prefrontal cortex ''underlie[s] a special kind of consciousness called *autonoetic* consciousness, which allows healthy human adults to both mentally represent and become aware of their subjective experiences in the past, present, and future'' (Wheeler et al., 1997, p. 331). Because the hallmark of DID is amnesia for, or splitting off of, subjective experiences, a plausible inference may be made that the prefrontal lobes are also involved in the development of DID. Viewed from this perspective, DID represents the fragmentation of autonoetic consciousness.

Focusing on the prefrontal lobes as a potential neural substrate for dissociative symptomology is also suggested by the theory that the prefrontal cortex is involved in the temporal organization of behavior (Fuster, 1997). In particular, Fuster's work provides support for the unelaborated suggestion by Spiegel (1996) that one region of the prefrontal cortex, the orbitalfrontal cortex, may be a possible brain region associated with dissociative states.

Fuster (1997) integrates information from neuroanatomy, chemical neurotransmission, animal and human neuropsychology, and neuromaging in formulating the three functions of the prefrontal lobes which are necessary for the organization of behavior over time: short-term memory, set or motor attention, and inhibitory control. These three functions are critical in the goal-directed formulation, planning, and execution of novel behavioral structures. There are three major subdivisions of the prefrontal cortex: the dorsolateral, the orbitalfrontal, and the medial cortices. Although there is some functional overlap between the regions, the dorsolateral cortex is primarily responsible for the first two functions. Short-term memory allows ''the provisional retention of information for prospective action'' (Fuster, p. 252). Set ''consists in the selection of particular motor acts and the preparation of the sensory and motor systems for them'' (Fuster, p. 252). Together, short-term memory and set allow the organism to organize behavior by selectively attending to relevant stimuli in the internal and external environments, establishing a goal, and planning for action.

The orbitalfrontal cortex (OFC) is primarily responsible for the third function, inhibitory control of information, which would otherwise detract from the current goal-directed organization of behavior. This inhibitory function protects and complements the integrative functions of memory and set and is therefore appropriately considered necessary for the temporal organization of behavior (Fuster, 1997).

Although the medial prefrontal region, which includes the anterior cingulate, also appears to be involved in the inhibitory control function, its role is less well understood and the disorders resulting from lesions in this area are relatively poorly defined, unless the lesions are large (Fuster, 1997; Cummings, 1985, 1993; Meador, Watson, Bowers, & Heilman, 1986; Verfaellie & Heilman, 1987; Ethelberg, 1950). The medial region has been connected with theory of mind issues involved in autism (e.g., Fletcher et al., 1995); however, autism, as a pathology of self, is conceptually distinguished from DID in the third section of this article. Given this distinction and for purposes of clarity, this article focuses on the orbitalfrontal region as the primary source of the protective inhibitory function required for the temporal organization of behavior being described in this section. This preliminary focus on the orbitalfrontal region may need to be reevaluated as empirical investigations continue and the functions of the medial/cingulate region are further delineated.

Fuster (1997) conceptualizes the protective inhibitory role of the orbital region in the temporal organization of behavior as follows:

> [I]nhibitory control . . . protects the structure of behavior, speech, or thought from interfering influences, external or internal, that may conflict with it and lead it astray. . . .
>
> A variety of interfering factors can disrupt a behavioral structure in progress. The interference may be external or internal. Either may disrupt the functions of short-term memory or motor set that support that structure. Extraneous sensory stimuli may distract the animal from the currently active memory or from the action in preparation. . . .
>
> Internal influences . . . can [also] interfere with memory or set. Included in this category are the mnemonic traces or previous behavioral structures with which the animal may be familiar and which may contaminate and distort ongoing behavior; old habits may also compete with it. Especially disruptive are the central representations of stimuli and motor reactions that have similar characteristics and, in the current context, equal probability of occurrence as the current stimuli and reactions. . . . Because the inappropriate stimuli and responses are similar to and just as probable as the appropriate ones, the former are likely to interfere with the latter; similarity and probability conspire to produce confusion. Traces of previous memories interfere with the present one (proactive interference). . . . (pp. 236–237)

The behavioral structures protected by the inhibitory function of the OFC are structures of the ‘‘highest level’’ involving ‘‘novel, usually complex, temporal gestalts’’ (Fuster, 1997, p. 228).

The inhibitory control exerted by the OFC on cortical and subcortical structures is like the exclusionary role of attention (Fuster, 1997). Active memory and motor set are protected from interference in the precise way that attention inhibits distracting influences. This inhibitory function heightens the attention the animal can direct to any behavioral structure by removing representations or motor tendencies that would disorganize current goal-directed behaviors.

The OFC is able to perform its protective inhibitory role through its unique placement between cortical and subcortical structures, interconnectivity, and dual catecholiminergic innervation. The OFC mainly comprises Brodman’s areas 11 and 13, is located on the ventral side of the prefrontal cortex just below the dorsolateral cortex, and is adjacent to subcortical limbic structures.

There is a substantial body of neurobiological research on the connectivity of the OFC based primarily on studies of mammals and nonhuman primates (Schore, 1994). Generally, the OFC monitors the external environment through extensive reciprocal connections with auditory, visual, olfactory, and somesthetic association cortices (Chavis & Pandya, 1976; Yarita et al., 1980). The OFC monitors the internal environment through its interconnections with subcortical drive and affective integration centers, including the amygdaloid central nucleus, the septal region, the lateral hypothalamus, and the ventral tegmental area (Kita & Oomura, 1981; Nauta, 1964, 1972; Saper, 1982; Sesack & Pickel, 1992; Valenstein, 1973). The OFC is also connected with the nucleus of the solitary tract in the medulla (Reep & Winans, 1982; Saper, 1982; Shipley, 1982; van der Kooy et al., 1984; Yasui et al., 1991) and the medial thalamus (Freeman & Watts, 1948; McLardy, 1950). The orbitalfrontal region is the only cortical structure with direct efferent connections to the hypothalamus, the amygdala, and the brainstem biogenic amine nuclei (Schore, 1994). It has been well established for the past 50 years that the OFC regulates the autonomic nervous system (Fulton, 1949; Kaada, Pribram, & Epstein, 1949) and there is general acceptance that this region is instrumental in the inhibition of subcortical drives, the regulation of body states, and the regulation of autonomic responses to affective environmental cues (Schore, 1994). Developmental neurobiological studies in nonhuman primates have shown that the orbitalfrontal region is also involved in attachment processes (Steklis & Kling, 1985).

The OFC is innervated by the catecholamines dopamine and norepinephrine (Schore, 1996; Levitt, Rakic, & Goldman-Rakic, 1984), which are known to regulate emotion, attention, movement, and visceral functioning. Dopaminergic innervation of the orbitalfrontal region arises from axonal projections from neurons in the A10 ventral tegmental midbrain (Oades & Halliday, 1987; Porrino & Goldman-Rakic, 1982). The dopaminergic limbic forebrain-midbrain circuit has been related to observed functional capacities of the OFC, such as the initiation of movements toward emotionally significant stimuli (Vertes, 1990); the regulation of affective responses (Tassin, 1987); the mediation of motivational reward effects (Rolls & Cooper, 1974); the pleasure qualities of social interactions (Panksepp, Siviy, & Normansell, 1985); and the delayed response function, the major cognitive contribution of the OFC which underlies representational processes (Simon, Scatton, & LeMoal, 1980). The delayed response function allows the individual to react on the basis of stored representations, not on the immediate context. Less is established regarding the norepinephrine innervation of the OFC. There is evidence that A2 noradrenergic neurons in the medulla relay interoceptive visceral information to the OFC and facilitate the integrative processing of somatosensory information (Cechetto & Saper, 1987; Nosaka, 1984; Ricardo & Koh, 1978).

The OFC hierarchically dominates the two limbic forebrain–midbrain circuits, one associated with the ventral tegmental area and the other with the lateral tegmental area (Schore, 1994; Nauta & Domesick, 1982). Schore (1994) suggests these two circuits are associated with the dual excitatory and inhibitory mechanisms of the limbic system. The ventral tegmental dopaminergic circuit is the ''energy-expending component of the sympathetic nervous system'' and the lateral tegmental noradrenergic circuit ''represents the energy-conserving component of the parasympathetic nervous system'' (Shore, 1994, p. 56).

Research on the cyto- and myeloarchitecture of the OFC suggests that this region matures earlier than the dorsolateral cortex. The cytoarchitecture of the OFC is substantially developed at birth, but there is an overproduction and parcellation of synapses that occurs in the first 2 years of life (Huttenlocher, 1990; Huttenlocher & De Courten, 1987). There is a critical period of growth between 10 and 12 months (Huttenlocher, 1979) which occurs at the same time attachment patterns are first able to be reliably measured. Complete myelination of this region is not achieved until about the age of 12, with a rapid growth period between the ages of 6 and 9 (Fuster, 1997). This accelerated increase in myelination is thought to underlie the functional gains in cognitive abilities occurring during this time period. The OFC is most developed in the right hemisphere, which is dominant in processing, expressing, and regulating emotional information and behavior.

The role of the OFC in the selective inhibition or release of motor behaviors is also consistent with the architectonic pattern of brain development. According to this theory, functional differentiation of ventral and dorsal areas of the cerebral cortex can be traced back to their phylogenetic origins (Sanides, 1964, 1969; Petrides & Pandya, 1994). Dorsal areas of the brain derive from archicortex: These regions, which include the prefrontal dorsolateral, visual, somatosensory, and motor cortices, play an important role in the production of behaviors. Ventral regions, such as the orbitalfrontal and basotemporal cortices, evolved from the paleocortex. These areas are involved in the inhibition or release of behaviors. The basic idea is that human behavior is the net result of competing excitatory and inhibitory responses to specific stimuli in a particular context.

There is substantial neuropsychological evidence that the OFC controls disorganizing interference through inhibitory processes. Primates with orbitalfrontal damage lack the inhibitory protection against internal and external interference, which results in measurable cognitive deficits. In monkeys, lesions to the OFC result in perseverative errors in discrimination, reversal, and delay tasks (Butter, 1969; McEnaney & Butter, 1969; Iversen & Mishkin, 1970, 1973; Jones & Mishkin, 1972; Passingham, 1972a,b; Oscar-Berman, 1975; Kowalska, Bachevalier, & Mishkin, 1991; Otto & Eichenbaum, 1992). These errors are postulated to result from the lack of inhibition of previously learned behavior. The animal is vulnerable to proactive interference from previous trials producing response perseveration. Previously established behavior is not being inhibited and therefore continues to control current behavior even though it is no longer appropriate.

Tasks which involve affective processing are particularly affected by orbitalfrontal damage (Fuster, 1997). Such damage impairs the ability to reverse previously established emotional associations in response to changes in the affective significance of stimuli in monkeys and humans (Cicerone & Tanenbaum, 1997; Starkstein & Robinson, 1997; Dias, Robbins, & Roberts, 1997). There is variability in the lesions of patients with orbitalfrontal damage and concomitant differences in cognitive functioning. Despite these differences, the literature supports the inhibitory role of the OFC in complex social and emotional functioning (Starkstein & Robinson, 1997; Baker, Frith, & Dolan, 1997; Damasio, 1995; Damasio, Tranel, & Damasio, 1991).

In a review of disinhibition syndromes, Starkstein and Robinson (1997) have proposed that lesions to the OFC may result in (a) instinctive disinhibition, due to its direct connections to the hypothalamus, amygdala, and brainstem bioamine nuclei; (b) intellectual and sensory disinhibition, through connections with temporo-parietal regions; and (c) emotional disinhibition, from its connections with paralimbic areas. Humans with orbitalfrontal damage show disinhibition, primarily in complex social situations which require the self-regulation of behavior based on an analysis and interpretation of verbal and nonverbal social and emotional cues. This has often been referred to as a deficit in social cognition, particularly when neuropsychological testing shows that attentional, memory, language, and intellectual functioning are otherwise relatively intact.

Disinhibited behavior of patients with bilateral orbitalfrontal damage does not result simply from the lack of an appropriate response, but from the failure to inhibit inappropriate behavioral schemata based on irrelevant stimuli in the immediate environment which had been emotionally salient for them in the past. The loss of response inhibition produces a loss of adaptive flexibility and is most readily apparent when the environment does not impose many constraints on the interpretation of social interactions and the selection of an appropriate behavioral response and when relevant stimuli in the immediate environment must be inferred from subtle social and emotional cues. In a case study presented by Cicerone and Tanenbaum (1997), a patient with bilateral orbitalfrontal damage could regulate her behavior ‘‘when presented with a single, well structured situation with well-defined response requirements,’’ but ‘‘she continued to have difficulty when she needed to analyze social situations containing multiple, hierarchical priorities and to guide her behavior according to a repertoire of potentially appropriate responses’’ (p. 184). Thus, patients with orbitalfrontal damage lose their ability to inhibit behavioral responses in complex social contexts.

DEVELOPMENT OF EMOTION REGULATION

The OFC is suggested to play a major role in both the temporal organization of behavior (Fuster, 1997) and in the development of emotion regulation (Shore, 1994, 1996). According to Schore (1996), the orbitalfrontal system ‘‘acts as a recovery mechanism that efficiently monitors and autoregulates the duration, frequency, and intensity of not only positive but negative affect states. This emergent function, in turn, enables the individual to recover from disruptions of state and to integrate a sense of self across transitions of state, thereby allowing for a continuity of experience'' (Schore, 1996, p. 74). The ability to regulate emotions across differing internal states and external environments is critical for the inner experience of continuity needed for the development of a coherent self-representation (Schore, 1994, 1996; Sroufe, 1989; Emde, 1983). Therefore, understanding the psychological and neural mechanisms underlying normal emotion regulatory processes should offer vital clues to the pathological development of dissociated representations of self. This section describes the socioaffective mother–infant interactions which characterize healthy and growth inhibiting environments in an effort to understand dyadic interactions which may underlie the development of dissociation as the primary strategy for emotion regulation in persons with DID. Schore's work (Schore, 1994, 1996) on the experience-dependent maturation of the orbitalfrontal system in optimal and nonoptimal environments is highlighted. The subsequent section focuses on the emergence of the sense of self.

The infant's reciprocal affective interactions with the caregiver are the experiences upon which the developing OFC depends to provide the internal representations necessary for regulating emotions (Schore, 1994). It is well established that infants as young as 3 months modify their affective displays depending on their evaluation of the caregiver's affective displays (Tronick, 1989). Infants have certain self-directed regulatory behaviors, such as turning away (gaze aversion), self-comforting, and self-stimulation. They also have other-directed regulatory behaviors, such as reaching or crying, which function as messages to the caregiver to aid the infant's strivings. The infant's immature affective regulatory system, however, is inadequate to cope with many internally and externally derived negative affects. Consequently, the infant's ability to regulate is dependent on the primary caregiver's capacity to attune to the self- and other-directed regulatory behaviors of the infant (Field, 1985). These dyadic interactions may be an ''evolutionarily based expectation . . . that the nervous system needs in order to select the appropriate subset of synaptic connections'' following the initial overproduction of synapses (Greenough & Black, 1992, p. 163; Schore, 1996).

The regulation of postnatal development by mother–infant interactions has been studied using an animal model and the premature human infant (Kuhn & Schanberg, 1991; Hofer, 1991). These studies show that early affective experiences alter the levels of trophic bioamines, peptides, and hormones which influence the parcellation of synapses in the developing cortex. Schore (1994) contends this experience-dependent pruning process results in each infant's unique excitation (sympathetic)–inhibition (parasympathetic) autonomic balance represented by the functioning of the OFC in regulating emotional responses. In this way, early socioaffective experiences with the primary caregiver are imprinted into the infant's developing corticolimbic circuits (Schore, 1996). Imprinting refers to ''a state of mutually entrained central nervous system propensities'' (Schore, 1996, p. 62) that, in this instance, are '' 'built into the nervous system, in the course of and as a result of the infant's experience of his transactions with the mother' '' (Schore, 1996, p. 62 quoting Ainsworth, 1967, p. 429).

The infant's history of dyadic interactions are imprinted or stored in the orbitalfrontal system, which is ''centrally involved in . . . the generation of affective-cognitive schemata that regulate the processing of emotional information'' (Schore, 1996, p. 73; Hofer, 1984; Goldman-Rakic, 1987; Freyd, 1987). These schemata are postulated to result in specific patterns or internal working models (Bowlby, 1969) of attachment (Schore, 1994, 1996). Attachment refers to the primary tie between the infant and the mother. Attachment behaviors can be reliably measured in infants and preschoolers using a paradigm developed by Ainsworth (1967), labeled the Strange Situation. This paradigm consists of a laboratory sequence of two separations and reunions between the infant and the mother which are designed to activate the infant's attachment system. Infants are classified as to their type of attachment based on their behavioral displays upon separation and reunion with the mother. The reunion behaviors, in particular, are reflective of the interaction history of the mother–infant dyad.

The internal representations associated with patterns of attachment behavior at 12 months of age, when internal working models are first measured, are viewed as presymbolic in nature (Schore, 1994). By the end of the 2nd year, these presymbolic representations are superceded by more highly complex representations that can be accessed by memory (Schore, 1994). These representations allow the infant to monitor and regulate the intensity, frequency, and duration of positive and negative affective states ''enabl[ing] the [infant] to recover from disruptions of state . . . thereby allowing for continuity of experience'' (Schore, 1996, p. 74). As such, the internal working models of attachment and the later maturing symbolic representations may be part of the self-regulatory structures, postulated by Cichetti and Tucker (1994), that provide continuity and consistency and serve as stabilizing forces within the developing neural networks.

Most infants have organized patterns of attachment behavior, categorized as secure, insecure-avoidant, or insecure-ambivalent (Main, 1996). Securely attached infants show signs of missing the parent on the first separation and cries during the second separation. They actively greet the parent on reunion and seek to be held. After briefly maintaining contact with the parent, the infant settles and returns to play. This adaptive activation of the attachment system and reactivation of exploration following contact on reunion is the result of a history of dyadic interactions with a responsive, caring mother. These interactions downregulate overarousal, minimize negative affect, and assist the child to transition from a negative miscoordinated/misattuned dyadic interaction (interactive error) to a positive, coordinated, attuned interaction (interactive repair) Tronick (1989). These infants develop an internal representation of a self-in-relation-with-a-regulating-other and show consequent persistence to overcome interactive stress. This internal representation allows the infant to tolerate increasing levels of affect by ''evok[ing] an image of a comforting other [even] when the other is not physically present,'' thereby self generating a transition from a negative to a positive affect state in response to emotionally stressful events (Schore, 1996, p. 74). According to Schore (1994, 1996), the internalization of this homeostatic regulatory capacity is the result of the maturation of orbitalfrontal involvement in the two limbic forebrain–midbrain circuits and its hierarchical dominance of the excitatory and inhibitory functions of the limbic system. The orbitalfrontal system ''modulate[s], under stress, an adaptive pattern of a coupled reciprocal autonomic mode of control, in which increases in the activity of one ANS [autonomic nervous system] division are associated with decreases in the other'' (Schore, 1996, p. 72). The dyadic experiences which give rise to regulated and unregulated affect are imprinted and stored as dynamic interactive representations in the orbitalfrontal system. These representations ''generate cognitive expectations[,] . . . program information about state transitions . . . [, and] encode reciprocal modes of ANS control that allow for more efficient regulation of energy dissipation in subsequent sociaffective transactions'' (Schore, 1996, p. 73). Further,

> These enduring prototypical interactive representations can be accessed and regenerated in the future to trigger psychobiological state transitions and thereby discrete affective states in response to different types of emotionally stressful challenges in the social environment. Due to orbitalfrontal connections with both cortical sensory and motor systems and subcortical limbic and autonomic centers, the mature orbitalfrontal system performs an essential adaptive motivational function–the relatively fluid switching of internal bodily states in response to changes in the external environment that are appraised to be personally meaningful. (Schore, 1996, p. 73)

In infants who are insecurely attached, the developing orbitalfrontal system is met with nonoptimal dyadic interactions. According to Main and Weston (1982), the mothers of insecure-avoidant children present a pattern of interaction with their infants characterized by withdrawal, hesitancy, and a reluctance to regulate and organize their infants' attention and behavior. These interactions do not assist the infants to modulate environmentally induced stress, nor regulate the negative affect aroused by parental aversion to infant-initiated contacts. As a result of this interactive history, the insecure-avoidant infant exhibits little motivation to seek contact with the caregiver upon reunion in the strange situation, instead withdrawing and utilizing gaze aversion (looking away) as the method to modulate negative arousal. Schore (1996) contends these infants, who utilize withdrawal as the primary mechanism for maintaining organismic homeostatis, develop a bias toward the parasympathetic-dominant state, characterized by lower levels of autonomic activity. A parasympathetically biased, inhibitory, orbitalfrontal system could become permanent through the selective pruning of its innervation by the sympathetic ventral tegmental circuit and the expansion of its connections with the parasympathetic lateral tegmental circuit. An infant with such a regulatory system would have trouble shifting out of low arousal states and in regulating high arousal states and manifest a predominance of overcontrolled or internalizing behavioral tendencies.

In contrast, mothers of insecure-ambivalent infants are unpredictable in their emotional availability across situations. Thus, insecure-ambivalent infants organize their behavior around fixation on the caretaker in order to anticipate or gage the caregiver's present affective state and the likely interaction behavior. In the strange situation, these infants show high levels of distress at separation and are extremely difficult to comfort on reunion. Schore (1996) contends this interactive pattern results in a homeostatic regulatory system which is biased toward the sympathetic, excitatory, and ventral tegmental circuit and a child who is susceptible to undercontrolled, impulsive, and externalizing behavioral expressions.

For both the insecure categories, the orbitalfrontal system cannot adaptively shift between internal states in response to environmental stresses. Instead, the ''frontolimbic switching mechanisms . . . are inefficient or incapable of uncoupling and recoupling the sympathetic and parasympathetic components of the autonomic nervous system in response to changing environmental circumstances'' (Schore, 1996, p. 82). Rather, the child maintains a biased strategy of regulation which, though adaptive at the time of development, does not allow the child to shift states appropriately across environmental contexts.

Main and Solomon (1986) have identified another category of attachment, disorganized/disoriented (D), which is characterized by an apparent lack of organization by the infant upon reunion with the mother in the strange situation. These infants display conflicting behaviors in the presence of the parent and usually have been maltreated (Carlson, Cicchetti, Barnett, & Braunwald, 1989). Main and Hesse (1990) linked the D attachment pattern to the interjection of fear into the infant's interactions with the caregiver. Liotti (1992, 1999) has suggested that a dyadic interaction history with predominant frightened/frightening parental behavior may be, at least, partly responsible for dissociative symptomology.

A subset of the descriptions of D attachment behavior in the strange situation are remarkably reminiscent of switching behaviors in adult DID patients. These D attachment behaviors are characterized by sequential displays of contradictory behavior patterns, incomplete or interrupted movements and expressions, stilling or freezing behaviors, or direct indices of confusion (Main & Solomon, 1990). Because attachment behaviors in the strange situation are reflective of the interaction history of the caregiver–infant dyad, the discontinuous behavior observed in a subset of the D infants reflects a history of interactions which contain discontinuities in how the caregiver related to and treated the infant.

Such discontinuity has been found in the caregiving environment of children with disorganized attachment (George, 1996). Mothers of children with disorganized attachment, labeled ''Helpless,'' showed representational models of disorganized caregiving in which the caregiving system appears to be disabled (George & Solomon, 1996). These mothers described themselves as ineffective and as being unable to care for or protect their children. They described being out of control, inflicting harsh punishments, being hysterical, and feeling depressed. In such circumstances, the child must deal with the conflict between his need for attachment to and fear of the caregivers, the unpredictable sudden changes in parental affect within situations, the imbalance in the parent–child relationship, and the general chaotic nature of the environment.

DEVELOPMENT OF THE SELF

Contemporary knowledge and issues of the self derive in large measure from the early work of William James (1890, 1892) and symbolic interactionists, such as Cooley (1902) and Mead (1934). Among James's many contributions, the self was posited to have a dimensional and hierarchical structure. Of primary importance was his fundamental distinction between the ''I'' as subject, as organizer and interpreter of experience concerned with one's continuity over time, and the ''Me'' as object, containing all that the ''I'' possessed, including the body, material goods, and the self characteristics recognized by others. The symbolic interactionists introduced a developmental perspective which placed primary emphasis on the importance of social interactions in shaping the self.

From these beginnings, a multitude of issues regarding the self have been explored. Should the self be viewed as a global (Coopersmith, 1967; Piers, 1977), multidimensional (Bracken, 1992; Damon & Hart, 1988; Harter, 1983, 1985, 1990; Hattie, 1992; Marsh, 1986, 1987, 1993; Muellener & Laird, 1971; Oosterwegel & Oppenheimer, 1993; Shavelson & Marsh, 1986), or hierarchical structure (i.e. Epstein, 1973; Shavelson, Hubner, & Stanton, 1976; Kelly, 1955; Rosenberg, 1979). Are there differences between real and ideal self-images (i.e., Rogers & Dymond, 1954; Achenbach & Zigler, 1963; Rosenberg, 1979; Higgins, 1987, 1989) and between true and false selves (i.e., Broughton, 1981; Selman, 1980)? Is the self best viewed in terms of its multiplicity or its unity (i.e., Allport, 1955, 1961; Horney, 1950; Jung, 1928; Lecky, 1945; Maslow, 1954, 1961, 1971; Rogers, 1950; Gergen, 1968; Mischel, 1968, 1973; Vallacher, 1980)? How does the self develop in infancy, childhood, and adolescence (i.e., Lewis & Brooks-Gunn, 1979; Harter, 1983; Stern, 1985; Damon & Hart, 1988; Sroufe, 1989; Sugarman & Jaffe, 1990; Oosterwegel & Oppenheimer, 1993)?

A meaningful integration of the above issues and models concerning the self is beyond the scope of this article. Therefore, what this section seeks to achieve is a coherent framework for understanding how the sense of self develops which is consistent with the neurodevelopmental approach taken in this article. A model of cognition (Forrest & Jensen, in preparation) is proposed which views the self, as subject, as arising from the activity of thinking (Fig. 1). The ''Cognition Model'' elaborates on the constructivist viewpoint taken by Piaget (Piaget, 1954; Beth & Piaget, 1966). First, I describe this model, defining relevant terms, and then apply it to the development of the ''I'' and the ''Me.'' The philosophical, mathematical, and logical foundations for the Cognition Model are not addressed herein. At this point, it is presented as a stand-alone model which has value in understanding the development of the self. The application of this model to the development of dissociated selves is be taken up in the fifth section of this article.

The Cognition Model characterizes cognition as the combined ongoing activities of projecting, assimilating, accommodating, and dissociating. In this model, a ''percept'' is defined as the object of observation. These objects can be thoughts, feelings, or a material structure, like a tree. A ''concept'' is difficult to describe in words, but may be thought of as the capacity to make a distinction. One's concept of an object is not synonymous with one's mental picture, however. The mental representation of an object is a linking between a concept and a *particular* percept. For example, the concept tree can be applied to both the percept of an oak or a willow, but my mental representation of that linking will be particularized by the individual percept. ''Thinking'' is the activity which produces concepts and links concepts and percepts together, here defined as assimilating and accommodating.

Human consciousness can be thought of as the stage upon which percepts and

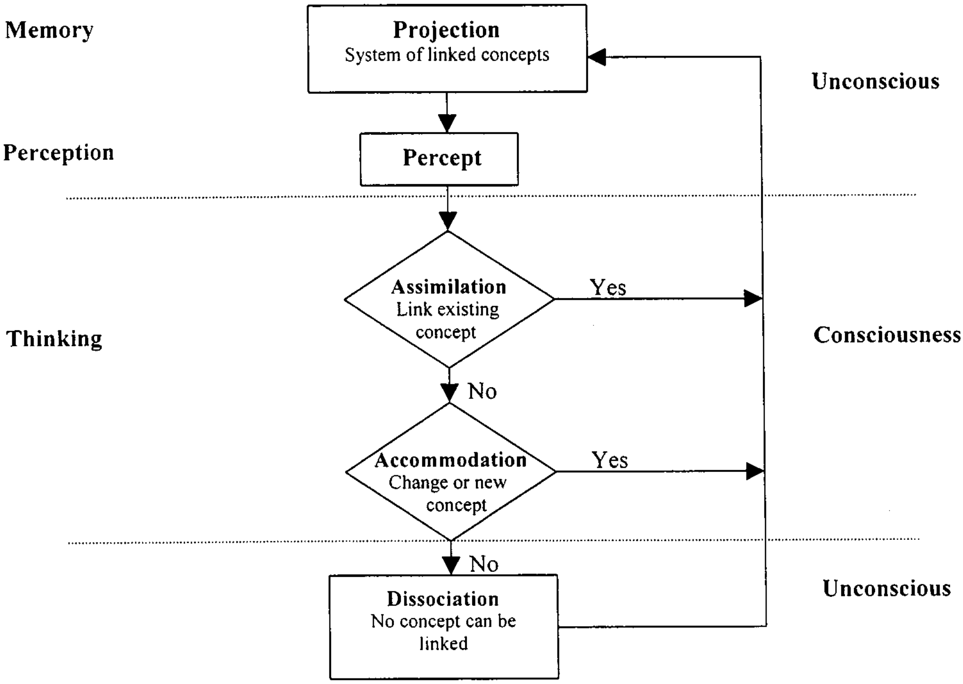

FIG. 1. Cognition Model (Forrest & Jensen, in preparation). Cognition constitutes the combined ongoing activities of projection, assimilation, accommodation, and dissociation.

concepts meet and become linked to one another. It can also be characterized as mediating between thinking and observing. This model also proposes that pure observation is unconscious. For us to be conscious of a percept, it must be linked with a concept through thinking. As adults, we have a system of connected concepts that we have built up through experience which we ''project'' onto the world. Our projection can be viewed as the system of linked concepts which we have gained over the course of life. Any concept contained within our projection can be used to link with a percept during thinking. In this way, our projection organizes our experience and behavior. The phrase ''seeing the world through rose colored glasses'' reflects our understanding of this process. When a percept arises, we attempt to assimilate it, or link it with an existing concept. This includes things like, I know what this is, this is irrelevant, or I will get back to this later. If this fails, we must then attempt to accommodate it by changing an existing concept or producing a new concept to which it can be linked. Through this process, we build up a conceptual system that is consistent within a projection. If we do not have an existing concept and we cannot produce a concept to which this can be linked, then we dissociate the percept and we are not conscious of it.

This model also suggests why we have the phenomenal experience of having an ''I'' and possessing multiple ''Me's'' in the Jamesian sense. Thinking is an activity. When we think, we appear as active agents ''doing'' the thinking, we appear to ourselves as subject. However, the only way we know we are a subject is because we have the concept of ‘‘subject.’’ We gain this concept only through the process of thinking. Cognitive (Piaget, 1954) and psychoanalytic (Mahler, Pine, & Bergman, 1975) researchers agree that infants gradually learn to distinguish the internal from the outer world, the subjective from the objective. As the child becomes aware that something changes once an object is removed from view (a mental picture is retained) and becomes aware that what is changed is stable in relation to the changing individual pictures which come and go in everyday experience, the child begins, through thinking, to distinguish the subjective from the objective or, in other words, to produce the concepts of subject and object. Once they have a concept of subject, they can then direct their thinking to this concept as a percept. This is proposed to be the origin of the sense of self, the ‘‘I,’’ the capacity to *direct one's thinking* to the self as percept. When we can do this, we become self-conscious.

Importantly, the ‘‘I’’ does not think. We only become aware of our ‘‘I’’ through our activity of thinking. When thinking is directed to the concept ‘‘I’’ as a percept, the subject becomes object and is experienced as ‘‘Me.’’ The different Me's noted by James, the ‘‘material me,’’ the ‘‘social me,’’ and the ‘‘spiritual me,’’ can be viewed as clusters of Me concepts. In this way, the concept ‘‘Me’’ gradually becomes built up, fuller, and richer as this concept is linked with other concepts through experience. This fuller, richer constellation of concepts combine to form a conceptual system, a ‘‘Global Me.’’

Initially, a child's ‘‘projection’’ can be thought of as innately structured by discrete states. States are manifestations of the child's internal world (Putnam, 1997). As the child interacts with the world and forms early concepts from these interactions, the child's concepts are context dependent (e.g., Hayne, Greco-Vigorito, & Rovee-Collier, 1993; Shields & Rovee-Collier, 1992; Boller & Rovee-Collier, 1992; Amabile & Rovee-Collier, 1991; Rovee-Collier & DuFault, 1991). Context includes state, but is not synonymous with it because context includes aspects from both the internal and external worlds.

Through dyadic interactions which are experienced moment to moment within particular contexts over the 1st year of life, the infant forms interactive concepts of Me-in-relation-to-the-caretaker which, by around 12 months of age, has formed a relatively stable conceptual system termed an internal working model of attachment (Schore, 1994, 1996; Bretherton, 1991). This conceptual system is then projected onto the world and represents the child's initial movement away from behavioral organization which is context bound toward a more context-independent organization. Now, the child can anticipate an interaction and organize his or her behavior accordingly. The remnants of the normative context- and state-dependent behavioral organization may be reflected in the continued existence of state- and mood-dependent effects observed in the general population (e.g., Eich, 1989; Ucros, 1989; Mandler, 1992).

Through the accumulation and coordination of the different Me concepts, including the Me-in-relation concepts, these Me's become more integrated and elaborated into an increasingly complex and integrated Global Me. This higher level Global Me has its origins in and consists of the linkages between the multiple different Me concepts. The level of integration of a person's self is then dependent on the capacity of the person to assimilate and/or accommodate their different Me concepts as percepts into their current projection. What this requires is a level of consistency between the different Me concepts which were established across a variety of differing contexts.

From a neuroscientific point of view, the various Me concepts are each mediated through the activation of relatively stable neural networks (Grigsby & Stevens, 2000). The Global Me would be mediated through overlapping activation of the networks containing the Me concepts. Both Putnam (1997) and Grigsby and Stevens (2000) agree that, absent a relatively consistent and predictable dyadic environment, the brain's capacity for such integrative functioning is diminished.

What are the key environmental factors which are needed by the brain to allow these integrative capacities to consolidate a Global Me? How can I link a concept of Me that was produced yesterday in one context with another Me concept which was created today in a different context so my projection can organize my current behavior? To explore this question, one needs to investigate how organisms synthesize behavior in the temporal domain. Researchers interested in this question have postulated the critical necessity of a mechanism for mediating cross-temporal contingencies (Fuster, 1997; Lashley, 1951). This is particularly true in the case of novel behavioral structures as follows:

> The enactment of the structure takes time, and some components are necessarily dependent on events that are temporally separated from them, either in the past or in the future. For one thing, they are contingent on the schema of the plan; for another, they are contingent on the expected goal . . . Furthermore, some acts are contingent on previous or anticipated events, whether they be sensory stimuli or other acts. A neural involvement in the temporal construction of behavior without mechanisms for mediating those contingencies is difficult to conceive . . . such mechanisms are necessary to bridge temporally separate elements of action and sensorium. (Fuster, 1997, p. 227)

As discussed above, Fuster contends the prefrontal cortex mediates these cross-temporal contingencies by supporting the integrative functions of memory, set, and inhibitory control.

With particular regard to the self-system, researchers contend that the continuity of experience necessary for the development of a coherent and integrated sense of self derives from the emergent ability for affective regulation across discrete schema states which characterize infancy (Wolff, 1966; Schore, 1996; Sroufe, 1989; Emde, 1983). There is evidence for the specific association between patterns of affect regulation, operationalized in terms of attachment category, and the structure and content of self-representations (Mikulincer, 1995). Although the study by Mikulincer (1995) does not include the disorganized category of attachment, persons with insecure attachment styles exhibited less integrated self-structures than persons with secure attachments.

Thus, concepts regarding social relationships, concepts regarding expectations of response to behavioral expressions, and concepts related to the behavioral goals of attachment and survival will be important contingencies which must be mediated by the infant in order to consolidate a Global Me. The needed concepts are built up and integrated based on the quality of the moment-to-moment dyadic interactions between the infant and the caregiver (Tronick, 1989). The history of dyadic engagements emerges as supremely important in facilitating the infant's attempts to mediate cross-temporal contingencies and project an increasingly unified Me.

The conceptual framework of the Me and the I proposed herein ascribes the origin of the pathology in DID as arising, not in the initial cognitive process of differentiating the internal from the external world, but rather in the ability to assimilate and accommodate different Me concepts into a more Global Me which occurs over time. This view allows the theoretical distinction of DID from other pathologies of the self, such as schizophrenia and autism. From the work of Scharfetter (1976, 1980, 1981, 1986) on ego psychopathology in schizophrenia, it appears that, unlike DID, the pathology arises in the initial differentiation of the internal from the external world. The three basic reaction patterns or structures of psychotic experience in schizophrenia seem to arise from the erroneous exclusion of bodily, affective, or cognitive processes from those perceptions which are normally given an internal origin and viewed as Me. If sensations from the body or thoughts were perceived as arising from the outer world, then agency and ownership would not attach to these experiences, but rather result in the exclusion of these experiences from Me experiences and manifest as the psychotic ego fragmentation observed in schizophrenics. In autism, there also may be a breakdown in the initial differentiation of internal from external experience. In autism, however, experiences which are normally attributed to the external world may be experienced as having an internal origin, giving rise to theory of mind difficulties observed in this disorder (e.g., Fletcher et al., 1995). Although these distinctions are speculative and require further conceptual and empirical exploration, the pathologies of the self in schizophrenia and autism appear to have their etiological origins in the initial cognitive distinction between internal and external experiences and not in the elaboration of these experiences in the temporal domain as is here proposed for DID.

EXPERIENCE-DEPENDENT NEURAL REORGANIZATION

There is empirical support for the dynamic nature of developing neural networks. Merzenich and colleagues have extensively investigated cortical plasticity in monkeys (Merzenich, Recanzone, Jenkins, & Grajski, 1990; Nudo, Milliken, Jenkins, & Merzenich, 1996). Results from these studies provide convincing evidence that cortical representations are dynamic and altered by experience. Importantly, plasticity is not limited to Hebbian changes in afferent input effectiveness (Hebb, 1949), but includes changes in neural networks as well (Merzenich et al., 1990).

The most detailed evidence in support of experience-dependent cortical plasticity comes from a series of studies investigating the effects of behavioral training on the cortical somatic sensory (Merzenich et al., 1990) and motor maps (Nudo et al., 1996) of monkeys. In these studies, the receptive fields of cortical neurons in behaviorally trained and untrained monkeys are compared.

Receptive fields of neurons are defined as the area in the environment or in the body to which that neuron responds (Kandel, 1991). For example, cortical neurons in the somatosensory system respond only to stimulation of a specific area of skin. Any point on the skin is cortically represented by a population of cells, with similar receptive fields, that are connected to afferent fibers which innervate that point on the skin. Receptive fields of cortical neurons have excitatory and inhibitory components. When a stimulus is applied to the excitatory center of the receptive field, a peak of excitation in the responding population of cells is produced which is surrounded by a population of inhibited cells. This spatial distribution subserves fine tactile discrimination. If two points on the skin are represented by two different receptive fields, the stimulation of those points will produce excitatory gradients of activity in two neuronal populations. Each population of cells has a receptive field with a central peak of excitation surrounded by an inhibitory zone. The inhibitory surrounds sharpen the distinctions between the two peaks. If the two stimuli are brought closer together, the lateral inhibition produced by each summates resulting in more effective inhibition and preservation of the spatial separation of the stimuli. Without such lateral inhibition, the activity of the two populations would overlap and the distinction between the two peaks would become blurred.

In a review of 5 years of studies, Merzenich et al. (1990) summarizes the properties and mechanisms of the dynamic process of experience-dependent alteration of receptive fields. In one study, behaviorally important stimuli were moved across a monkey's hand; applied to inconstant skin locations; or discretely applied to a small, unchanging skin location (Merzenich et al., 1990; Jenkins et al., 1990). When stimuli are moved across the hand or are applied to inconstant skin locations, the receptive fields of engaged cortical neurons are reduced in size. In contrast, applying a stimulus to a small constant skin area results in an enlargement of the receptive field. In another study, cocontracting muscles involved in movement combinations generated in motor skill learning in monkeys came to be represented together in the motor cortex (Nudo et al., 1996). Nudo and colleagues postulate the combined use of particular motor movements during a motor task ''enhances intracortical connections'' between the neuronal populations subserving those movements (Nudo et al., 1996, p. 805). A mechanism similar to long term potentiation may be responsible for this process (Kandel & Hawkins, 1992). Recent studies suggest use-dependent cortical reorganization also occurs in human motor cortex following motor skill learning (Nudo et al., 1996).

Based on these and other studies, Merzenich et al. (1990) conclude that changing the temporal distribution of inputs alters cortical representations of the engaged neural network. Thus, representational discontinuities can be removed and representational overlap created by greatly reducing temporally independent inputs. Likewise, increasing temporal independence between inputs enhances representational discontinuities.

Importantly, for purposes of this article, this type of experience-dependent alteration of cortical representations has been postulated to occur in higher cortical centers in humans and may be a major determinant of idiosyncratic neurobehavioral development (Kandel, 1991; Merzenich et al., 1990). This line of thinking has been taken up by Grigsby and Stevens (2000) and applied to representations of the self. The authors contend that there are relatively independent modules (neural networks) which contain many different self representations and that these representations must be integrated for individuals to experience a unified sense of self. ''[W]hile there are myriad quasi-independent modules operating throughout the brain, each is closely integrated with various other neuronal groups. As a consequence, brain (and psychological) functioning, despite its modular character, emerges as a synthetic, coherent whole'' (p. 59). They postulate that continuity of experience is required for the relatively independent modules of different self representations to integrate or overlap. In addition, they note that ''[e]xcessive variability or unpredictability [in the early interactions with one's parents]. . .may encourage the organization of rather different self-representations that are *relatively* independent of one another. To a large extent, consistency may reflect the degree of similarity or overlap existing between the various self-networks'' (Grigsby & Stevens, 2000, p. 335).

PROPOSED "ORBITALFRONTAL MODEL" OF DID

The proposed ''Orbitalfrontal Model'' of DID hypothesizes that the OFC plays a critical role in the development of dissociated identities through its protective inhibitory function in the temporal organization of behavior. When children arrive in the world, their projection is organized by discrete states. This model views the normative process of the child's experience-dependent regulation of affective states through the development of concepts of Me-in-relation (internal working model of attachment) and an increasingly integrated Global Me as serving the child's overarching function of organizing behavior in the temporal domain. The normal development of the concepts of Me-in-relation and later the increasingly integrated Global Me provide an internal basis of organization, one which allows the child increasing freedom to move beyond the immediate context, to anticipate, to plan, and to carry out goal-directed behaviors in the midst of novel contingencies. In terms of the Cognition Model described in the third section of this article, the child can maintain the linking between concepts of Me-in-relation and the conceptual system of the increasingly Global Me within their projection across different contexts. It is my contention that in normal environments, conscious access to and integration of the child's different Me concepts facilitates the temporal organization of behavior. However, in abusive environments when the Me or Me-in-relation concepts are sufficiently contradictory such that their integration would disorganize immediate goal-directed behaviors, the developing OFC inhibits the integration into the current projection of any conflicting Me or Me-in-relation concept when it arises as a percept. However, the Me concept as percept that was inhibited in one context cannot be dissociated in contradictory contexts in which that Me concept is needed to organize current behavior. In this situation, contradictory Me conceptual systems are needed which are maintained through lateral inhibition of conflicting Me concepts.

The implication of this theory is that orbitalfrontal functioning gives priority to the temporal organization of goal-directed behaviors in the immediate context over the integration of concepts which allow a more context-independent organizational strategy. In other words, when a more cohered or Global Me would be disorganizing in the routinely entered contexts or series of contexts in which the child is developing, the OFC protects the integrity of the organization of behavior within the immediate context and ''sacrifices'' full coherence of higher level organizational concepts and functioning across contexts.

The orbitalfrontal model extends Putnam's discrete states model of DID (Putnam, 1997) by introducing the Cognition Model (Forrest & Jensen, in preparation), integrating the work of Fuster (1997) on the temporal integration of behavior and Schore on the relationship between the development of the OFC, emotion regulation, and attachment, and placing this within the framework of developmental psychopathology provided by Cicchetti and Tucker (1994). In accord with the integrative nature of the orbitalfrontal model, it will be more specifically described within a broader neurodevelopmental framework, summarized in Table 1.

Schore (1994, 1996) provides a persuasive description of the role of the OFC in the regulation of states based on the dyadic history between the developing infant and the caregiver and the concomitant development of an internal working model for secure and insecure attachment. The critical importance of some form of consistency in the dyadic environmental context which can serve as the foundation for the orbitalfrontal's hierarchical regulation of autonomic states emerges from Schore's work. The essential experiences of consistency which initially allow the infant to assimilate and accommodate percepts and increasingly organize their behavior in the temporal domain are the moment to moment interactions in the caregiving environment. These experiences are provided by a caregiver who facilitates positive arousal, downregulates overarousal, and repairs experiences of negative miscoordinated interactions with transitions to positive, mutually coordinated states (Tronick, 1989). Thus, in securely attached infants, the mother is responsive to the child's needs and, as such, the context adapts to the infant, resulting in the development of Me concepts and concepts of Me-in-relation which can be linked and maintained within the child's projection across different contexts.

In insecurely attached infants, the dyadic environment is not responsive to the child's needs. Importantly, however, the dyadic environmental context still provides an underlying nonoptimal *pattern* of unresponsiveness. This pattern allows the child to build a Me-in-relation conceptual system which can be maintained in the child's projection across contexts. The child's projection provides the child a context-independent way to organize behavior, but in a more constrained manner, either through chronic avoidance or fixation on the caregiver. The OFC facilitates the creation and maintenance of this more limited Global Me conceptual system with the experience-dependent weakening of the coupling of the two limbic forebrain–midbrain circuits, resulting in biased OFC functioning, either tending toward high arousal or low arousal states (Schore, 1994, 1996). The more limited Global Me conceptual systems later manifest as rigid behavioral patterns, with increased OFC inhibition (parasympathetic bias) resulting in internalizing disorders or decreased OFC inhibition (sympathetic bias) resulting in externalizing disorders.

The question then becomes what type of experience-dependent development would occur if there were a decreasing level of consistency or pattern in the child's dyadic experiences. In children categorized as disorganized, attachment researchers have observed freezing or stilling behaviors which have been theorized to represent the transition between conflicting representational (internal working) models of attachment (Putnam, 1995; Liotti, 1999). Disorganized children also have a difficult time integrating behavior, showing a unique juxtaposition of inhibited and disinhibited behavior when they enact doll play stories about attachment related themes. ''The abrupt shift from constricted to chaotic doll-play . . . suggested that 'a system which is parallel and segregated from consciousness' (Bowlby, 1980, p. 59) had suddenly become disinhibited'' (Solomon et al., 1995, p. 460). Thus, unintegrated behavior is

TABLE 1
Summary of Proposed Orbitalfrontal Model within a Broader Neurodevelopmental Framework Integrating the Work of Schore (1994, 1996), Fuster (1997), and Forrest and Jensen (in Preparation)

Dyadic Environmental Context	Orbitalfrontal Development	State Regulation	Attachment Status	Internal working model of attachment	Me concepts	Development trajectory	OFC functioning
Pattern of continuity in maternal responsiveness	Reciprocally coupled dual ANS functioning based on context-independent anticipated responsiveness	Flexible strategy of state regulation	Secure	Me in relation with regulating other	Integration of Me concepts assists temporal organization of behavior; Global Me	Healthy—flexible and stable behavior	Normal
Pattern of continuity found of low arousal, withdrawing other	Weakening of bidirectional connections resulting in a bias toward parasympathetic circuit and low arousal states	Inflexible—minimizes emotional expression, susceptible to overcontrolled, internalizing disorders	Insecure—avoidant	Me in relation with withdrawing, unavailable other	Global, limited Me based on low self worth	Rigid behavior, possibly OCD, anxiety	Hyperactive increased inhibition

Pattern of continuity in environment based on fixation on the caregiver	Weakening of bidirectional connections resulting in bias toward sympathetic circuit and high arousal states	Inflexible—heightened emotional expression, susceptible to undercontrolled, externalizing disorders	Insecure—ambivalent	Me-in-relation with limited available other	Global, limited Me dependent on value to others	Rigid behavior, possibly conduct disorder	Hypoactive disinhibition
Reduced levels of continuity	Beginning of lateral inhibition between states	Pathologically flexible—immediate context triggers state changes	D—not antecedent to DID	Context dependent representations of Me-in-relation	Less integration of feelings assists temporal organization. Integrates identity-based Me concepts, isolates feeling based concepts	More context-dependent feelings, possibly borderline pathology	Alterations between hypoactive and hyperactive based on current context
No pattern of environmental continuity	More rigid development of lateral inhibition between circuits and associated states	Pathologically flexible—immediate context triggers state changes	D—antecedent to DID	Context-dependent representations of Me-in- relation	Integration disrupts temporal organization. Contradictory Me conceptual systems	Context-dependent, dissociated identities	Increased differences in OFC functioning across identities.

either released or inhibited. These behaviors can be viewed as resulting from less integrated conceptual systems. It is proposed that these disorganized behaviors reflect the beginnings of a trajectory of development which retains a more context-dependent organization of behavior. If these children do not go on to develop DID, the model proposes that their environment allows them to maintain identity-based Me concepts in their projection across differing contexts, but that feeling- and/or relationship-based concepts are more context dependent. They can maintain basic Me concepts (name, age, basic attributes, etc.) across contexts, but subsets of their feeling concepts about themselves and others are contradictory and their assimilation, accommodation, or dissociation is more context dependent. The result may manifest as borderline pathology.

In the subset of disorganized children who are hypothesized to develop DID, the contradictions, conflicts, and negative affect experiences are magnified because of the severity and chronicity of abuse. Adult women with DID report significantly more severe sexual abuse beginning at an earlier age, more physical abuse, and significantly less maternal attention and nurturance than non-DID survivors of incest (Anderson & Alexander, 1996). Chronic experiences of this type do not allow the child to experience even their basic Me concepts as consistent or their relationships as continuous. What the child experiences is a world which is unpredictable, behavioral responses from attachment figures which are inconsistent, and intense negative affect which must be self-regulated. In addition, the child must mediate his or her goals of maintaining attachment to his or her caregivers to ensure survival. The child's sensations, memories, and goals are in conflict.

In dyadic environments characterized by heightened levels of discontinuity and negative affect, the orbitalfrontal system cannot bias toward sympathetic high arousal states because during abuse episodes when negative affect would be very intense and disorganizing, the abusive parent may demand organized behavior from the child. Feeling fear or pain, fighting back, or even crying may exacerbate the abuse and make it harder for the child to survive the abuse and maintain an attachment with that parent. The orbitalfrontal system also cannot bias toward the parasympathetic, low arousal states because a level of hypervigilance is required due to the high levels of unpredictability/discontinuity in the caregiver responses to the child. The high degree of unpredictability in the dyadic environment also makes it impossible for the orbitalfrontal system to organize a context-independent regulatory system which anticipates parental responsiveness, such as is organized in securely attached infants. The only remaining option for organizing behavior available to the orbitalfrontal system in these circumstances is to organize state and then later self-functioning according to the immediate context. My contention is that the orbitalfrontal system resorts to regulating autonomic functioning based predominately, if not solely, on the immediate context. Later, the OFC inhibits the assimilation and/or accommodation of even basic Me concepts which would normally facilitate the organization of behavior across contexts. The Me and Me-in-relation concepts cannot consolidate into a consistent conceptual system. Contradictory concepts cannot be consistently dissociated because they would be needed by the child to organize behavior within an otherwise disorganizing context (abuse). The only available accommodation is to create contradictory Me conceptual systems within the projection which operate relatively independently based on the requirements within particular contexts. These conflicting Me conceptual systems need not be delimited along Jamesian lines. The idiosyncratic conflicting demands across contexts in the child's environment would determine the boundaries between these contradictory Me conceptual systems. These conflicting conceptual systems are maintained within the child's projection, but only one can be active at a time, the others being dissociated when they arise as percepts. Each conflicting conceptual system is theorized to be mediated through the activation of separate neural networks (Grigsby & Stevens, 2000).

The orbitalfrontal model hypothesizes that the development of amnesia barriers in persons with DID results from the OFC isolating subsets of Me concepts and in turn results in multiple, conflicting, context-dependent Me conceptual systems. Although this issue must be addressed empirically, the neural mechanism postulated to be responsible for this isolation is the lateral inhibition between neural networks subserving these conflicting conceptual systems. Based on a substantial body of neuropsychological research, Fuster (1997) contends that it is plausible that the high-level behavioral structures, which allow the organism to synthesize behavior in the temporal domain, here suggested to include Me conceptual systems, are protected through ''a form of *lateral inhibition* on neural representations that detract from current behavior'' (Original emphasis, Fuster, 1997, p. 238). The orbital region has access to the diverse cortical and subcortical areas to inhibit neural networks or functional modules containing conflicting Me concepts. Me concepts associated with particular sensory and memory representations could be suppressed through orbitalfrontal inhibitory impulses on posterior cortical areas, possibly through the medial thalamus. Me concepts related to motor representations could be suppressed by inhibition of cortical and subcortical motor structures, including the basal ganglia. Drives and other internal influences associated with Me concepts could be suppressed through inhibitory efferents to the hypothalamus and other limbic areas.

Research in cognitive neuroscience has shown that damage to or isolation of domain-specific memory systems results in amnesia for information normally processed by that system (Schacter, 1997). Depending on the affected system, amnesia results from a deficit in the encoding, storage, or retrieval of information. It is proposed that, unlike domain-specific memory systems, the amnesia in DID does not represent a deficit in encoding, storage, or retrieval of information per se. Rather, the aberrant development of the lateral inhibition between complex neural networks subserving higher order organizational functions fragments the *behavioral structures* (Me conceptual systems) which are composed of information provided by and to the domain-specific systems. The resultant amnesia, rather than being *domain* specific, is *context* specific. Affective, cognitive, sensory, and/or behavioral information or processes accessible in one context or a series of noncontradictory contexts are not as accessible in other conflicting contexts and, thus, cannot be integrated into the active Me conceptual system. Instead, the Me conceptual system is determined by and limited to the subset of concepts which can be assimilated and/or accommodated by that system. The result is dissociable, context-dependent Me conceptual systems which are subjectively experienced by and observed in persons with DID.

This model does not suggest that Me conceptual systems are topographically organized as are areas of the skin in the somatosensory system. These systems are more appropriately conceptualized as mediated through different patterns of complex cortical activation. Different patterns of cortical activation have been found across personalities in persons with DID using a variety of neurophysiological measures (topographic brain mapping, Hughes, Kuhlman, Fichtner, & Gruenwald, 1990; evoked response potentials, Dick-Barnes, Nelson, & Aine, 1987; EEG scans, Coons, Milstein, & Marley, 1982). Nor is it proposed that lateral inhibition between these conflicting Me conceptual systems occurs in an absolute fashion. Such a proposal is too simplistic to account for the complexities of implicit and explicit memory functions found between alter personality states in DID (Forrest & Ross, in preparation; Peters, Uyterlinde, Consemulder, & van der Hart, 1998; Eich, Macauley, Loewenstein, & Dihle, 1997; Nissen et al., 1988; Dick-Barnes, Nelson, & Aine, 1987; Silberman et al., 1985; Ludwig et al., 1971). Rather, it is postulated that the orbitalfrontal region, based on chronic experiences of extreme environmental discontinuity, idiosyncratically develops a pattern of increased lateral inhibition sufficient to create relative isolation between conflicting, context-driven subsets of Me concepts such that dissociated Me concepts emerge. Recent research on DID suggests that inhibition of about half of memory retrievable by coconscious identities on explicit testing is sufficient to establish an amnesia barrier between identities (Forrest & Ross, in preparation).

What is being argued is that the *process* of experience-dependent neural isolation or overlap of engaged neural networks found to occur by Merzenich and his colleagues in sensory and motor cortices, based on the temporal independence or temporal contiguity of inputs, also operates on higher order behavioral structures when *contextual discrimination,* rather than tactile discrimination, is needed to organize behavior. At a higher level of organization, information which does not convey a conflicting meaning would not need to be inhibited. One can view the currently engaged neural networks containing active Me concepts, and associated affects and memories, as constituting the functional excitatory ‘‘center’’ and the neural networks containing conflicting Me concepts and their associated affects and memories, as constituting the functional inhibitory ‘‘surround.’’ Here, the terms center and surround are not as appropriate because the activated or inhibited networks are diversely located throughout cortical and subcortical regions. It is the *process* of neural network overlap or isolation based on contiguity of relevant socioemotional input which is being compared. Clinical observations of fusion and integration of alter personalities following psychotherapy is consistent with this hypothesis. When there is sufficient contiguity of dyadic input, the areas of overlap between neural networks containing conflicting Me concepts should increase with the concomitant integration of a sense of self on a psychological level.

To the extent there remains a distinction between structure and function, it is not suggested that persons with DID have structural orbitalfrontal damage. Rather, I am arguing that an experience-dependent alteration in the pattern of orbitalfrontal inhibitory processes occurs which results in the relative isolation of subsets of conflicting Me conceptual systems. The few case studies investigating the amnesia barriers in persons with DID are consistent with this view. Those studies have found that information which is open to multiple interpretations has the highest level of compartmentalization between alter personalities (Eich, Macauley, Loewenstein, & Dihle, 1997;

Nissen et al., 1988; Dick-Barnes, Nelson, & Aine, 1987; Silberman et al., 1985; Ludwig et al., 1971).

This proposal allows for different levels of prefrontal inhibition across identities. The critical neural inhibition necessary for discontinuity of identity is the lateral inhibition which sufficiently isolates the conflicting subsets of Me concepts.

The neuromodulatory effects of emotion (e.g., Cahill & McGaugh, 1996; McGaugh, 1992; Reisberg & Heuer, 1995) and stress (e.g., Bremner, Krystal, Southwick, & Charney, 1995) on memory, as well as the role of the thalamus in modulating responsivity to environmental stimuli (Krystal et al., 1995), which have been increasingly investigated in patients with posttraumatic stress disorder (Krystal, Bremner, Southwick, & Charney, 1998), may play a role in dissociative symptomology, but these models have not directly addressed DID or its etiology. The neuromodulatory effects of stress and the gating role of the thalamus appear primarily to play a critical role in what Fuster (1997) describes as the first two functions of the prefrontal lobes: short-term memory and set. As described above, together these functions allow the organism to selectively attend to internally and externally relevant stimuli, establish a goal, and plan for action. Research of persons with DID, however, has not shown significant decrements in attention or short-term memory within a single identity as compared with controls (Silberman et al., 1985; Eich et al., 1997; Peters et al., 1998). If deficits in attention and short-term memory were primarily responsible for DID, then one would also expect to find *intra*personality decrements in these areas. The neuromodulatory effects may play a more primary role in the production of adult onset dissociative and dissociativelike features.

CONCLUSIONS AND SUGGESTIONS FOR FUTURE RESEARCH

The orbitalfrontal model focuses attention on the protective inhibitory role of the OFC in the temporal organization of behavior as critical to the developmental outcome of dissociated identities. State/emotion regulation and attachment status are viewed as reflections of the child's capacity for context-independent organization within the constraints of particular environments. The history of moment to moment dyadic engagements, whether optimal or non optimal, must provide the developing prefrontal cortex sufficient consistency across diverse contexts to mediate cross-temporal contingencies in the highly complex socio-emotional domain. The orbitalfrontal model also suggests that lateral inhibition between neural networks containing subsets of conflicting Me conceptual systems are responsible for the amnesia effects observed in DID. Although the model is speculative, current theories and findings from the four research domains have strong empirical support. The strength of the model lies in its synthesis of converging evidence from different domains to provide a coherent integration of neural and psychological processes which can plausibly account for the development of DID.

There is relatively little research on DID and there remain many questions regarding the nature of disorganized attachment in the developmental literature (Vondra & Barnett, 1999), including the validation of the developmental pathway from disorganized attachment to DID. Therefore, rather than attempt the delineation of specific hypotheses, it seems more appropriate at this time to suggest areas of research which could prove useful in validating aspects of the orbitalfrontal model.

Retrospective research on adults currently diagnosed with DID offers the most direct approach for testing orbitalfrontal involvement in DID. Brain imaging techniques, such as positron emission tomography, could be used to measure orbitalfrontal functioning in prominent identities and, at the beginning and at intervals throughout therapy. These scans could be correlated with measures of adult attachment across identities (Main, 1991). Measures of autonomic functioning which take advantage of the relationship between skin conductance and inhibition (Dozier & Kobak, 1994) could also be useful in indirectly measuring OFC functioning in DID patients. Measuring differences in self-representation across identities would also be useful to correlate with OFC functioning and adult attachment status. Current instruments that could be used in this regard include the Multidimensional Self Concept Scale (MSCS; Bracken, 1992), the Adult Self-Perception Scale (ASPS; Messer & Harter, 1986), the Coopersmith Self-Esteem Inventories (CSEI; Coopersmith, 1981); the Rosenberg Self-Esteem Scale (RSES; Rosenberg, 1979), and the Selves Questionnaire (Higgins, Klein, & Strauman, 1985).

Longitudinal research on children with disorganized attachment would also be fruitful to begin to validate the orbitalfrontal model. One suggestion is a time series analysis which could look at children's temporal organization of behavior by observing them in a laboratory setting when exposed to a series of new environmental contingencies. One important issue would be whether these children become disorganized after each contingency. These studies could draw from the work of Rovee-Collier and colleagues, who have studied infants' expectancies (Fagen, Morrongiello, Rovee-Collier, & Gekoski, 1984; Mast et al., 1981), context-specific memory (e.g., Hayne, Greco-Vigorito, & Rovee-Collier, 1993; Shields & Rovee-Collier, 1992), and time windows for integration of information (Rovee-Collier, Evancio, & Earley, 1995; Rovee-Collier, 1995). Children's cardiac and adrenocortical responsiveness could be monitored throughout the time series study to measure the physiological correlates of autonomic functioning during their exposure to different contextual contingencies (Spangler & Grossman, 1999).

The orbitalfrontal model would also predict higher variability in emotion regulatory strategies across successive testing in disorganized children in comparison with children who are securely or insecurely attached. In this regard the research by Cramer (1988, 1997, 2000) on the use of defense mechanisms in children could be utilized. Measures of self-coherence and self-continuity in preschool and early elementary school-age children should be developed to track self-integrative processes with such variables as attachment, emotion regulatory strategies, and patterns of inhibited and disinhibited behavior. Current instruments of self-concept and self-esteem that might be useful for assessing the degree of self-coherence in young children are the Joseph PreSchool and Primary Self-Concept Screening Test (Joseph, 1979) and the Inferred Self-Concept Scale (McDaniel, 1986).

The neural mechanism, lateral inhibition, proposed to be responsible for amnesia in DID is more difficult to test *in vivo.* A cognitive science approach may offer more hope of testing the validity of this mechanism. To date, only two network models have been advanced which attempt to simulate dissociative processes (Li & Spiegel, 1992; Yates & Nasby, 1993; Nasby & Yates, 1996). Both models offer interesting suggestions regarding the effect of heightened negative affect on network functioning, and the model proposed by Nasby and Yates emphasizes the role of inhibition. The models, however, should be elaborated and further developed within a broader neurodevelopmental framework. Future models need to be guided by information from the neurosciences regarding the functions of the prefrontal cortex, particularly related to the temporal organization of behavior, and by the relevant literature from developmental psychopathology. The proposed Cognition Model may offer a starting point for such a model.

The effects of early trauma and abuse on the development of human beings are currently more accessible to study due to technological, methodological, and theoretical advances in cognitive psychology, the neurosciences, and developmental psychopathology. It is hoped that new research and theories which take advantage of these advances may move professional debate from the divisive controversy over the existence of dissociated identities to an integrative exploration of the etiology of this phenomenon.

REFERENCES

Achenbach, T., & Zigler, E. (1963). Social competence and self-image disparity in psychiatric and nonpsychiatric patients. *Journal of Abnormal and Social Psychology,* **67,** 197–205.

Ainsworth, M. D. S. (1967). *Infancy in Uganda: Infant care and the growth of love.* Baltimore, MD: Johns Hopkins Univ. Press.

Allport, G. W. (1955). *Becoming.* New Haven, CT: Yale Univ. Press.

Allport, G. W. (1961). *Pattern and growth in personality.* New York: Holt, Rinehart & Winston.

Amabile, T., & Rovee-Collier, C. (1991). Contextual variation and memory retrieval at six months. *Child Development,* **62**(5), 1155–1166.

Anderson, C. L., & Alexander, P. C. (1996). The relationship between attachment and dissociation in adult survivors of incest. *Psychiatry,* **59,** 240–254.

Baker, S. C., Frith, C. D., & Dolan, R. J. (1997). The interaction between mood and cognitive function studied with PET. *Psychological Medicine,* **27,** 565–578.

Beth, E., & Piaget, J. (1966). *Mathematical epistemology and psychology.* Dordrecht, The Netherlands: D. Reidel.

Boller, K., & Rovee-Collier, C. (1992). Contextual coding and recoding of infants' memories. *Journal of Experimental Child Psychology,* **53**(1), 1–23.

Bowlby, J. (1969). *Attachment and loss: Vol. 1. Attachment.* New York: Basic Books.

Bowlby, J. (1980). *Attachment and loss: Vol. 3. Loss.* New York: Basic Books.

Bracken, B. A. (1992). *Multidimensional Self Concept Scale.* Austin, TX: Pro-Ed.

Bremner, J. D., Krystal, J. H., Southwick, S. M., & Charney, D. S. (1995). Functional neuroanatomical correlates of the effects of stress on memory. *Journal of Traumatic Stress,* **8**(4), 527–553.

Broughton, J. (1981). The divided self in adolescence. *Human Development,* **24,** 13–32.

Butter, C. M. (1969). Perseveration in extinction and in discrimination reversal tasks following selective frontal ablations in *Macca mulatta. Physiology of Behavior,* **4,** 163–171.

Cahill, L., & McGaugh, J. L. (1996). Modulation of memory storage. *Current Opinion in Neurobiology,* **6,** 237–242.

Carlson, V., Cicchetti, D., Barnett, D., & Braunwald, K. (1989). Finding order in disorganization: Lessons from research on maltreated infants' attachments to their caregivers. In D. Cicchetti & V. Carlson (Eds.), *Child maltreatment: Theory and research on the causes and consequences of child abuse and neglect,* pp. 494–528. New York: Cambridge Univ. Press.

Cechetto, D. F., & Saper, C. B. (1987). Evidence for viscerotopic sensory representation in the cortex and the thalamus of the rat. *Journal of Comparative Neurology,* **262,** 27–45.

Chavis, D. A., & Pandya, D. N. (1976). Further observations on corticofrontal connections in the rhesus monkeys. *Brain Research,* **117,** 369–386.

Cicchetti, D., & Tucker, D. (1994). Development and self-regulatory structures of the mind. *Development and Psychopathology,* **6,** 533–549.

Cicerone, K. D., & Tanenbaum, L. N. (1997). Disturbance of social cognition after traumatic orbitalfrontal brain injury. *Archives of Clinical Neuropsychology,* **12**(2), 173–188.

Cooley, C. H. (1902). *Human nature and the social order.* New York: Scribner's.

Coons, P. M., Milstein, V., & Marley, C. (1982). EEG studies of two multiple personalities and a control. *Archives of General Psychiatry,* **39,** 823–825.

Coopersmith, S. (1967). *The antecedents of self-esteem.* San Francisco: Freeman.

Coopersmith, S. (1981). *Coopersmith Self-Esteem Inventory.* Palo Alto, CA: Consulting Psychologists Press, Inc.

Cramer, P. (1988). The defense mechanism inventory: A review of research and discussion of the scales. *Journal of Personality Assessment,* **52**(1), 142–164.

Cramer, P. (1997). Evidence for change in children's use of defense mechanisms. *Journal of Personality,* **65**(2), 233–247.

Cramer, P. (2000). Defense mechanisms in psychology today: Further processes for adaptation. *American Psychologist,* **55**(6), 637–646.

Cummings, J. L. (1985). *Clinical neuropsychiatry.* Grune & Stratton, Orlando, FL.

Cummings, J. L. (1993). Frontal-subcortical circuits and human behavior. *Archives of Neurology,* **50,** 873–880.

Damasio, A. (1995). On some functions of the human prefrontal cortex. In J. Grafman, K. J. Holyoak, & F. Boller (Eds.), *Structure and functions of the human prefrontal cortex,* pp. 241–251. New York Academy of Sciences, New York.

Damasio, A., Tranel, D., & Damasio, H. (1991). Somatic markers and the guidance of behavior: Theory and preliminary testing. In H. S. Levin, H. M. Eisenberg, & A. L. Benton (Eds.), *Frontal lobe function and dysfunction,* pp. 218–229. New York: Oxford Univ. Press.

Damon, W., & Hart, D. (1988). *Self understanding in childhood and adolescence.* New York: Cambridge University Press.

Dias, R., Robbins, T. W., & Roberts, A. C. (1997). Dissociable forms of inhibitory control within prefrontal cortex with an analog of the Wisconsin Card Sort Test: Restriction to novel situations and independence from ''on-line'' processing. *Journal of Neuroscience,* **17**(23), 9285–9297.

Dick-Barnes, M., Nelson, R. O., & Aine, C. J. (1987). Behavioral measures of multiple personality: The case of Margaret. *Journal of Behavioral Therapy & Experimental Psychiatry,* **18**(3), 229–239.

Dozier, M., & Kobak, R. (1994). Psychophysiology in attachment interviews: Converging evidence for deactivating strategies. *Annual Progress in Child Psychiatry and Child Development,* 1993, 80–92.

Eich, E., Macaulay, D., Loewenstein, R. J., & Dihle, P. H. (1997). Memory, amnesia, and dissociative identity disorder. *Psychological Science,* **8**(6),417–422.

Eich, E. (1989). Theoretical issues in state dependent memory. In H. L. Roediger & F. Craik (Eds.), *Varieties of memory and consciousness,* pp. 331–354. New Jersey: Erlbaum.

Emde, R. N. (1983). The pre-representational self and its affective core. *Psychoanalytic Study of the Child,* **38,** 165–192.

Epstein, S. (1973). The self-concept revisited or a theory of a theory. *American Psychologist,* **28,** 405–416.

Ethelberg, S. (1950). Symptomatic ''cataplexy'' or chalastic fits in cortical lesion of the frontal lobe. *Brain,* **73,** 499–512.

Fagen, J. W., Morrongiello, B. A., Rovee-Collier, C., & Gekoski, M. J. (1984). Expectancies and memory retrieval in three-month-old infants. *Child Development,* **55**(3), 936–943.

Field, T. (1985). Attachment as psychobiological attunement: Being on the same wavelength. In *The psychobiology of attachment and separation,* pp. 415–454. New York: Academic Press.

Fletcher, P. C., Happe, F., Frith, U., Baker, S. C., Dolan, R. J., Frackowiak, R. S. J., & Frith, C. D. (1995). Other minds in the brain: A functional imaging study of ''theory of mind'' in story comprehension. *Cognition,* **57,** 109–128.

Forrest, K. A., & Jensen, J. J. Notes on contextual logic. Manuscript in preparation.

Forrest, K. A., & Ross, C. A. Explicit memory and dissociative identity disorder: Investigating the function of one-way amnesia barriers. Manuscript in preparation.

Freeman, W., & Watts, J. W. (1948). The thalamic projection to the frontal lobe. *Research Publication Associates Research of Nervous and Mental Disease,* **27,** 200–209.

Freyd, J. J. (1987). Dynamic mental representations. *Psychological Reviews,* **94,** 427–438.

Fulton, J. F. (1949). Cerebral cortex: The orbitalfrontal and cingulate regions. In *Physiology of the nervous system* (3rd ed.), pp. 447–467. New York: Oxford Univ. Press.

Fuster, J. M. (1995). *Memory in the cerebral cortex.* Cambridge, MA: MIT Press.

Fuster, J. M. (1997). *The prefrontal cortex: Anatomy, physiology, and neuropsychology of the frontal lobe (3rd ed.).* Philadelphia: Lippincott–Raven.

George, C. (1996). A representational perspective of child abuse and prevention: Internal working models of attachment and caregiving. *Child Abuse & Neglect,* **20**(5), 411–424.

George, C., & Solomon, J. (1996). Representational models of relationships: Links between caregiving and attachment. *Infant Mental Health Journal,* **17,** 198–216.

Gergen, K. J. (1968). Personal consistency and the presentation of the self. In C. Gordon & J. Gergen (Eds.), *The self in social interaction,* pp. 299–308. New York: Wiley.

Goldman-Rakic, P. S. (1987). Circuitry of the primate prefrontal cortex and regulation of behavior by representational memory. In F. Plum & V. Mountcastle (Eds.), *Handbook of physiology,* Vol. 5, pp. 373–418. Bethesda, MD: American Physiological Society.

Greenough, W. T., & Black, J. E. (1992). Induction of brain structure by experience: Substrates for cognitive development. In M. Gunnar & C. Nelson (Eds.), *Developmental behavioral neuroscience, Minnesota Symposia on Child Psychology,* Vol. 24, pp. 155–200. Hillsdale, NJ: Erlbaum.

Grigsby, J., & Stevens, D. (2000). *Neurodynamics of personality.* New York: Guilford.

Harter, S. (1983). Developmental perspectives on the self-system. In E. M. Hetherington (Ed.), *Handbook of child psychology: Vol. 4. Socialization, personality, and social development,* pp. 275–386. New York: Wiley.

Harter, S. (1985). *The Self-Perception Profile for Children.* Denver, CO: University of Denver.

Harter, S. (1990). Causes, correlates and the functional role of global self-worth: A life-span perspective. In J. Kolligian & R. Sternberg (Eds.), *Perceptions of competence and incompetence across the life-span,* pp. 67–98. New Haven, CT: Yale Univ. Press.

Hattie, J. (1992). *Self-concept.* Hillsdale, NJ: Erlbaum.

Hayne, H., Greco-Vigorito, C., & Rovee-Collier, C. (1993). Forming contextual categories in infancy. *Cognitive Development,* **8(1),** 63–82.

Hebb, D. O. (1949). *Organization of behavior.* New York: Wiley.

Higgins, E. T. (1987). Self-discrepancy: Theory relating self and affect. *Psychological Review,* **94,** 319–340.

Higgins, E. T. (1989). Self-discrepancy theory: What patterns of self-beliefs cause people to suffer? In L. Berkowitz (Ed.), *Advances in experimental social psychology,* Vol. 22. New York: Academic Press.

Higgins, E. T., Klein, R., & Strauman, T. J. (1985). Self-concept discrepancy theory: A psychological model for distinguishing among different aspects of depression and anxiety. *Social Cognition,* **3,** 51–76.

Hofer, M. A. (1984). Relationships as regulators: A psychobiologic perspective on bereavement. *Psychosomatic Medicine,* **46,** 183–197.

Hofer, M. A. (1991). Hidden behavioral regulators in development. In B. J. Carrroll & J. E. Barrett (Eds.), *Psychopathology and the Brain* (pp. 113–132). New York: Raven Press.

Horney, K. (1950). *Neurosis and human growth.* New York: Norton.

Hughes, J. R., Kuhlman, D. T., Fichtner, C. G., & Gruenfeld, M. J. (1990). Brain mapping in a case of multiple personality. *Clinical Electroencephalography,* **21**(4), 200–209.

Huttenlocher, P. R. (1979). Synaptic density in human frontal cortex–developmental changes and effects of aging. *Brain Research,* **163,** 195–205.

Huttenlocher, P. R. (1990). Morphometric study of human cerebral cortex development. *Neuropsychologica*, **28,** 517–527.

Huttenlocher, P. R., & De Courten, C. H. (1987). The development of synapses in striate cortex of man. *Human Neurobiology,* **6,** 1–9.

Iversen, S. D., & Mishkin, M. (1970). Perseverative interference in monkeys following selective lesions of the inferior prefrontal convexity. *Experimental Brain Reserach,* **11,** 376–386.

Iversen, S. D., & Mishkin, M. (1973). Comparison of superior temporal and inferior prefrontal lesions on auditory and nonauditory tasks in rhesus monkeys. *Brain Research,* **55,** 355–367.

James, W. (1890). *Principles of psychology.* Chicago: Encyclopedia Britannica.

James, W. (1892). *Psychology: The briefer course.* New York: Henry Holt & Co.

Jenkins, W. M., Merzenich, M. M., Ochs, M., Allard, T., & Guic-Robles, E. (1990). Functional reorganization of primary somatosensory cortex in adult owl monkeys after behaviorally controlled tactile stimulation. *Journal of Neurophysiology,* **63,** 82.

Jones, B., & Mishkin, M. (1972). Limbic lesions and the problem of stimulus–reinforcement associations. *Experimental Neurology,* **36,** 362–377.

Joseph, J. (1979). *Joseph Pre-School & Primary Self-Concept Screening Test.* Wood Dale, IL: Stoelting Company.

Jung, C. G. (1928). *Two essays on analytical psychology.* New York: Dodd, Mead.

Kaada, B. R., Pribram, K. H., & Epstein, J. (1949). Respiratory and vascular responses in monkeys from temporal pole, insular orbital surface, and cingulate gyrus: A preliminary report. *Journal of Neurophysiology,* **12,** 347–356.

Kandel, E. R., & Hawkins, R. D. (1992). The biological basis of learning and individuality. *Scientific American,* **Sept.** 79–86.

Kandel, E. R. (1991). Cellular mechanisms of learning and the biological basis of learning and individuality. In E. R. Kandel, J. H. Schwartz, & T. M. Jessel (Eds.), *Principles of neural science (3rd Ed.),* pp. 1009–1031. Norwalk, CT: Appleton & Lange.

Kelly, G. A. (1955). *The psychology of personal constructs.* New York: Norton.

Kita, H., & Oomura, Y. (1981). Reciprocal connections between the lateral hypothalamus and the frontal cortex in the rat. *Brain Research*, **213,** 1–16.

Kowalska, D. M., Bachevalier, J., & Mishkin, M. (1991). The role of the inferior prefrontal convexity in performance of delayed nonmatching-to-sample. *Neuropsychologica,* **29,** 583–600.

Krystal, J. H., Bennett, A. L., Bremner, J. D., Southwick, S. M., & Charney, D. S. (1995). Towards a cognitive neuroscience of dissociation and altered memory function in post-traumatic stress disorder. In M. J. Friedman, D. S. Charney, & A. Y. Deutch (Eds.), *Neurobiological and clinical consequences of stress: From normal adaptation to post-traumatic stress disorder*, pp. 239–269. Philadephia: Lippincott–Raven.

Krystal, J. H., Bremner, J. D., Southwick, S. M., & Charney, D. S. (1998). The emerging neurobiology of dissociation: Implications for treatment of posttraumatic stress disorder. In J. D. Bremner & C. R. Marmar (Eds.), *Trauma, memory, and dissociation,* pp. 321–363. Washington, DC: American Psychiatric Press, Inc.

Kuhn, C. M., & Schanberg, S. M. (1991). Stimulation of infancy and brain development. In B. J. Carrroll & J. E. Barrett (Eds.), *Psychopathology and the brain,* pp. 97–111. New York: Raven Press.

Lashley, K. S. (1951). The problem of serial order in behavior. In L. A. Jeffress (Ed.), *Cerebral mechanisms in behavior* (pp. 112–146). New York: Wiley.

Lecky, P. (1945). *Self-consistency: A theory of personality.* New York: Island Press.

Levitt, P., Rakic, P., & Goldman-Rakic, P. (1984). Region-specific distribution of catecholamine afferents in primate cerebral cortex: A flourescence histochemical analysis. *Journal of Comparative Neurology,* **227,** 23–36.

Lewis, M., & Brooks-Gunn, J. (1979). *Social cognition and the acquisition of self.* New York: Plenum Press.

Li, D., & Spiegel, D. (1992). A neural network model of dissociative disorders. *Psychiatric Annals,* **22**(3), 144–147.

Liotti, G. (1992). Disorganized/disoriented attachment in the etiology of dissociative disorders. *Dissociation,* **5**(4), 196–204.

Liotti, G. (1999). Disorganization of attachment as a model for understanding dissociative psychopathology. In J. Solomon & C. George (Eds.), *Attachment disorganization,* pp. 291–317. New York: Guilford.

Ludwig, A. M., Brandsma, J. M., Wilbur, C. B., Bendfelt, F., & Jameson, D. H. (1971). The objective study of a multiple personality. *Archives of General Psychiatry,* **26,** 298–310.

Mahler, M., Pine, F., & Bergman, A. (1975). *The psychological birth of the human infant.* New York: Basic Books.

Main, M. (1991). Metacognitive knowledge, metacognitive monitoring, and singular (coherent) vs. multiple (incoherent) models of attachment. In C. M. Parkes, J. Stevenson-Hinde, & P. Marris (Eds.), *Attachment across the life cycle.* Routledge.

Main, M. (1996). Introduction to the special section on attachment and psychopathology: 2. Overview of the field of attachment. *Journal of Consulting and Clinical Psychology,* **64**(2), 237–243.

Main, M., & Hesse, E. (1990). Parents' unresolved traumatic experiences are related to infant disorganized attachment status: Is frightened and/or frightening behavior the linking mechanism? In M. T. Greenberg, D. Cicchetti, & E. M. Cummings (Eds.), *Attachment in the preschool years,* pp. 161–182. Chicago: Univ. of Chicago Press.

Main, M., & Solomon, J. (1986). Discovery of a new, insecure-disorganized/disoriented attachment pattern. In T. B. Brazelton & M. Yogman (Eds.), *Affective development in infancy* (pp. 95–124). Norwood, NJ: Ablex.

Main, M., & Solomon, J. (1990). Procedures for identifying infants as disorganized/disoriented during the Ainsworth Strange Situation. In M. T. Greenberg, D. Cicchetti, & E. M. Cummings (Eds.), *Attachment in the preschool years,* pp. 121–160. Chicago: Univ. of Chicago Press.

Main, M., & Weston, D. R. (1982). Avoidance of the attachment figure in infancy: Descriptions and interpretations. In C. M. Parkes & J. Stevenson-Hinde (Eds.), *The place of attachment in human behavior.* New York: Basic Books.

Mandler, G. (1992). Memory, arousal and mood: A theoretical integration. In S. A. Christianson (Ed.), *The handbook of emotion and memory,* pp. 93–110. Hillsdale, NJ: Erlbaum.

Marsh, H. W. (1986). Global self-esteem: Its relation to specific facets of self-concept and their importance. *Journal of Personality and Social Psychology,* **51,** 1224–1236.

Marsh, H. W. (1987). The hierarchical structure of self-concept and the application of hierarchical confirmatory factor analysis. *Journal of Educational Measurement,* **24,** 17–19.

Marsh, H. W. (1993). Academic self-concept: Theory, measurement, and research. In J. Suls (Ed.), *Psychological perspectives of the self,* Vol. 4. Hillsdale, NJ: Erlbaum.

Maslow, A. H. (1954). *Motivation and personality.* New York: Harper & Row.

Maslow, A. H. (1961). Peak-experience as acute identity-experiences. *American Journal of Psychoanalysis,* **21,** 254–260.

Maslow, A. H. (1971). *The farther reaches of human nature.* New York: Viking.

Mast, V. K., Fagen, J. W., Rovee-Collier, C., & Sullivan, M. W. (1981). Immediate and long-term memory for reinforcement context: The development of learned expectancies in early infancy. *Child Development,* **51**(3), 700–707.

McDaniel, E. L. (1986). *Inferred Self-Concept Scale.* Los Angeles, CA: Western Psychological Services.

McEnaney, K. W., & Butter, C. M. (1969). Perseveration of responding and nonresponding in monkeys with orbital frontal ablations. *Journal of Comparative Physiological Psychology,* **68,** 558–561.

McGaugh, J. L. (1992). Affect, neuromodulatory systems, and memory storage. In S. A. Christianson (Ed.), *The handbook of emotion and memory,* pp. 245–268. Hillsdale, NJ: Erlbaum.

McLardy, T. (1950). Thalamic projection to frontal cortex in man. *Journal of Neurological Neurosurgery Psychiatry,* **13,** 198–202.

Mead, G. H. (1972). *Mind, self, and society.* Chicago: Univ. of Chicago Press. [Original work published 1934]

Meador, K. J., Watson, R. T., Bowers, D., & Heilman, K. M. (1986). Hypometria with hemispatial and limb motor neglect. *Brain,* **109,** 293–305.

Merzenich, M. M., Recanzone, G. H., Jenkins, W. M., & Grajski, K. A. (1990). Adaptive mechanisms in cortical networks underlying cortical contributions to learning and nondeclarative memory. *Cold Spring Harbor Symposium on Quantitative Biology,* **55,** 873–887.

Messer, B., & Harter, S. (1986). *Adult Self-Perception Profile.* Denver, CO: Univ. of Denver Press.

Mischel, W. (1968). *Personality and assessment.* New York: Wiley.

Mischel, W. (1973). Toward a cognitive social learning reconceptualization of personality. *Psychological Review,* **80,** 252–283.

Mikulincer, M. (1995). Attachment style and the mental representation of the self. *Journal of Personality and Social Psychology,* **69**(6), 1203–1215.

Muellener, N., & Laird, J. D. (1971). Some developmental changes in the organization of self-evaluations. *Developmental Psychology,* **5,** 233–236.

Nasby, W., & Yates, J. L. (1996). Toward a network model of dissociative mechanisms. In I. G. Sarason & G. R. Pierce (Eds.), *Cognitive interference: Theories, methods and findings,* pp. 379–395. Mahwah, NJ: Erlbaum.

Nauta, W. J. H. (1964). Some efferent connections of the prefrontal cortex in the monkey. In J. M. Warren & K. Akert (Eds.), *The frontal granular cortex and behavior,* pp. 397–407.

Nauta, W. J. H. (1972). Neural associations of the frontal cortex. *Acta Neurobiologiae Experimentalis,* **32**(2), 125–140.

Nauta, W. J. H., & Domesick, V. B. (1982). Neural associations of the limbic system. In A. L. Beckman (Ed.), *The neural basis of behavior,* pp. 175–206. New York: SP Medical and Scientific Books.

Nissen, M. J., Ross, J. L., Willingham, D. B., Mackenzie, T. B., & Schacter, D. L. (1988). Memory and awareness in a patient with multiple personality disorder. *Brain and Cognition,* **8,** 117–134.

Nosaka, S. (1984). Solitary nucleus neurons transmitting vagal visceral input to the forebrain via a direct pathway in rats. *Experimental Neurology,* **85,** 493–505.

Nudo, R. J., Milliken, G. W., Jenkins, W. M., & Merzenich, M. M. (1996). Use-dependent alterations of movement representations in primary motor cortex of adult squirrel monkeys. *Journal of Neuroscience,* **16**(2), 785–807.

Oades, R. D., & Halliday, G. M. (1987). Ventral tegmental (A10) system: Neurobiology. 1. Anatomy and connectivity. *Brain Research Reviews,* **12,** 117–165.

Oosterwegel, A., & Oppenheimer, L. (1993). *The self-system: Developmental changes between and within self-concepts.* Hillsdale, NJ: Erlbaum.

Oscar-Berman, M. (1975). The effects of dorsolateral-frontal and ventrolateral-orbitalfrontal lesions on spatial discrimination learning and delayed response in two modalities. *Neuropsychologia,* **13,** 237–246.

Otto, T., & Eichenbaum, H. (1992). Complementary roles of the orbital prefrontal cortex and the perihinal-entorhinal cortices in an odor-guided delayed-nonmatching-to-sample task. *Behavioral Neuroscience,* **106,** 762–775.

Passingham, R. E. (1972a). Non-reversal shifts after selective prefrontal ablations in monkeys (*Macaca mulatta*). *Neuropsychologia,* **10,** 41–46.

Passingham, R. E. (1972b). Visual discrimination learning after selective prefrontal ablations in monkeys (*Macaca mulatta*). *Neuropsychologia,* **10,** 27–39.

Peters, M. L., Uyterlinde, S. A., Consemulder, J., & van der Hart, O. (1998). Apparent amnesia on experimental memory tests in dissociative identity disorder: An exploratory study. *Consciousness and Cognition,* **7,** 27–41.

Petrides, M., & Pandya, D. N. (1994). Comparative architectonic analysis of the human and macaque frontal cortex. In J. Grafman & F. Boller (Eds.), *Handbook of neuropsychology,* pp. 17–58. Amsterdam: Elsevier.

Piaget, J. (1954). *The construction of reality in the child.* New York: Basic Books.

Piers, E. V. (1977). *The Piers-Harris Children's Self-Concept Scale* (Research monograph No. 1). Nashville, TN: Counselor Recordings and Tests.

Porrino, L. J., & Goldman-Rakic, P. S. (1982). Brainstem innervation of prefrontal and anterior cingulate cortex in the rhesus monkey revealed by retrograde transport of HRP. *Journal of Comparative Neurology,* **205,** 63–76.

Putnam, F. W. (1995). Development of dissociative disorders. In D. Cicchetti & D.J. Cohen (Eds.), *Developmental psychopathology. Vol. II: Risk, disorder, and adaptation,* pp. 581–608. New York: Wiley.

Putnam, F. W. (1997). *Dissociation in children and adolescents: A developmental approach.* New York: Guilford.

Reep, R. L., & Winans, S. S. (1982). Afferent connections of dorsal and ventral agranular insular cortex in the hamster, *Mesocricetus auratus. Neuroscience,* **7,** 1265–1288.

Reisberg, D., & Heuer, F. (1995). Emotion's multiple effects on memory. In J. L. McGaugh, N. M. Weinberger, & G. Lynch (Eds.), *Brain and memory,* pp. 84–92. New York: Oxford Univ. Press.

Ricardo, J. A., & Koh, E. T. (1978). Anatomical evidence of direct projections from the nucleus of the solitary tract to the hypothalamus, amygdala, and other forebrain structures in the rat. *Brain Research,* **153,** 1–26.

Rogers, C. R. (1950). The significance of the self-regarding attitudes and perceptions. In M. L. Reymert (Ed.), *Feelings and emotions: The Mooseheart Symposium, pp. 78–79. New York: McGraw–Hill.*

Rogers, C. R., & Dymond, R. (1954). *Psychotherapy and personality change.* Chicago: Univ. of Chicago Press.

Rolls, E. T., & Cooper, S. J. (1974). Anesthetization and stimulation of the sulcal prefrontal cortex and brain-stimulation reward. *Physiology and Behavior,* **12,** 563–571.

Rosenberg, M. (1979). *Conceiving the self.* New York: Basic Books.

Rovee-Collier, C. (1995). Time windows in cognitive development. *Developmental Psychology,* **31**(2), 147–169.

Rovee-Collier, C., Evancio, S., & Earley, L. A. (1995). The time window hypothesis: Spacing effects. *Infant Behavior and Development,* **18**(1), 69–78.

Rovee-Collier, C., & DuFault, D. (1991). Multiple contexts and memory retrieval at three months. *Developmental Psychology,* **24**(1), 39–49.

Sanides, F. (1964). The cyto-myeloarchitecture of the human frontal lobe and its relation to phylogenetic differentiation of the cerebral cortex. *Journal Hirnforsch,* **6,** 269–282.

Sanides, F. (1969). Comparative arachitectonics of the neocortex of mammals and their evolutionary interpretation. *Annals of New York Academy of Science,* **167,** 404–423.

Saper, C. B. (1982). Convergence of autonomic and limbic connections in the insular cortex of the rat. *Journal of Comparative Neurology,* **210,** 163–173.

Schacter, D. L. (1997). *Searching for memory: The brain, the mind, and the past.* HarperCollins.

Schore, A. N. (1994). *Affect regulation and the origin of the self: The neurobiology of emotional development.* Hillsdale, NJ: Erlbaum.

Schore, A. N. (1996). The experience-dependent maturation of a regulatory system in the orbital prefrontal cortex and the origin of developmental psychopathology. *Development and Psychopathology,* **8,** 59–87.

Selman, R. (1980). *The growth of interpersonal understanding.* New York: Academic Press.

Sesack, S. R., & Pickel, V. M. (1992). Prefrontal cortical efferents in the rat synapse on unlabeled neuronal targets of catecholamine terminals in the nucleus accumbens septi and on dopamine neurons in the ventral tegmental area. *Journal of Comparative Neurology,* **320,** 145–160.

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Validation of construct interpretations. *Review of Educational Research,* **46,** 407–441.

Shavelson, R. J., & Marsh, H. W. (1986). On the structure of self-concept. In R. Schwarzer (Ed.), *Anxiety and cognition.* Hillsdale, NJ: Erlbaum.

Shields, P. J., & Rovee-Collier, C. (1992). Long-term memory for context-specific category information at six months. *Child Development,* **63**(2), 245–259.

Shipley, M. T. (1982). Insular cortex projection to the nucleus of the solitary tract and brain stem visceromotor regions in the mouse. *Brain Research Bulletin,* **8,** 139–142.

Silberman, E. K., Putnam, F. W., Weingartner, H., Braun, B. G., & Post, R. M. (1985). Dissociative states in multiple personality disorder: A quantitative study. *Psychiatry Research,* **15,** 253–260.

Simon, H., Scatton, B., & LeMoal, M. (1980). Dopaminergic A10 neurons are involved in cognitive function. *Nature* (*London*), 286, 150–151.

Solomon, J., George, C., & De Jong, A. (1995). Children classified as controlling at age six: Evidence of disorganized representational strategies and aggression at home and at school. *Development and Psychopathology,* **7,** 447–463.

Spangler, G., & Grossman, K. (1999). Individual and physiological correlates of attachment disorganization in infancy. In J. Solomon & C. George (Eds.), *Attachment disorganization,* pp. 95–124. New York: Guilford.

Spanos, N. P. (1994). Multiple identity enactments and multiple personality disorder: A sociocognitive perspective. *Psychological Bulletin,* **116**(1), 143–165.

Spiegel, D. J. (1996). Cognition, memory, and dissociation. *Child and Adolescent Psychiatric Clinics of North America,* **5**(2), 509–536.

Sroufe, L. A. (1989). Relationships, self, and individual adaptation. In A. J. Sameroff & R. N. Emde (Eds.), *Relationship disturbances in early childhood* (pp. 70–94). New York: Basic Books.

Starkstein, S. E., & Robinson, R. G. (1997). Mechanism of disinhibition after brain lesions. *The Journal of Nervous and Mental Disease,* **185**(2), 108–114.

Steklis, H. D., & Kling, A. (1985). Neurobiology of affiliative behavior in nonhuman primates. In M. Reite & T. Field (Eds.), *The psychobiology of attachment and separation,* pp. 93–134. Florida: Academic Press.

Stern, D. N. (1985). *The interpersonal world of the infant: A view from psychoanalytic developmental psychology.* New York: Basic Books.

Sugarman, A., & Jaffe, L. S. (1990). Toward a developmental understanding of the self schema. *Psychoanalysis and Contemporary Thought,* **13,** 117–138.

Tassin, J. P. (1987). Dopamine and mental illness: And what about the mesocortical dopamine system? *Behavioral and Brain Sciences,* **10,** 224–225.

Tronick, E. Z. (1989). Emotions and emotional communication in infants. *American Psychologist,* **44**(2), 112–119.

Ucros, C. G. (1989). Mood state dependent memory: A meta-analysis. *Cognition and Emotion,* **3**(2), 139–167.

Valenstein, E. S. (1973). *Brain control.* New York: Wiley.

Vallacher, R. R. (1980). An introduction to self-theory. In D. M. Wegner & R. R. Vallacher (Eds.), *The self in social psychology,* pp. 3–30. New York: Oxford Univ. Press.

van der Kolk, B. A., Weisaeth, L., & van der Hart, O. (1996). History of trauma in psychiatry. In B. A. van der Kolk, A.C. MacFarlane et al. (Eds.), *Traumatic stress: The effects of overwhelming experience on mind, body, and society,* pp. 47–74. New York: Guilford.

van der Kooy, D. McGinty, J. F., Koda, L. Y., Gerfen, C. R., & Bloom, F. E. (1982). Visceral cortex: A direct projection from prefontal cortex to the solitary nucleus in rat. *Neuroscience Letters,* **33,** 123–127.

van der Kooy, D., Koda, L. Y., McGinty, J. F., Gerfen, C. R., & Bloom, F. E. (1984). The organization of projections from the cortex, amygdala, and hypothalamus to the nucleus of the solitary tract in the rat. *Journal of Comparative Neurology,* **224,** 1–24.

Verfaellie, M., & Heilman, K. M. (1987). Response preparation and response inhibition after lesions of the medial frontal lobe. *Archives of Neurology,* **44,** 1265–1271.

Vertes, R. P. (1990). Fundamentals of brain stem anatomy: A behavioral perspective. In W. R. Klemm & R. P. Vertes (Eds.), *Brainstem mechanisms of behavior,* pp. 33–103. New York: Wiley.

Vondra, J. I., & Barnett, D. (Eds.) (1999). Atypical attachment in infancy and early childhood among children at developmental risk. *Monographs of the Society for Research in Child Development,* **64**(3), 258.

Wheeler, M. A., Stuss, D. T., & Tulving, E. (1995). Frontal lobe damage produces episodic memory impairment. *Journal of the International Neuropsychological Society,* **1,** 525–536.

Wheeler, M. A., Stuss, D. T., & Tulving, E. (1997). Toward a theory of episodic memory: The frontal lobes and autonoetic consciousness. *Psychological Bulletin,* **121**(3), 331–354.

Wolff, P. H. (1966). The causes, controls, and organization of behavior in the neonate. *Psychological Issues,* **5,** 1–105.

Yarita, H., Iino, M., Tanabe, T., Kogure, S., & Takagi, S. F. (1980). A transthalammic olfactory pathway to orbitalfrontal cortex in the monkey. *Journal of Neurophysiology,* **43,** 69–85.

Yasui, Y., Itoh, K., Kaneko, T., Shigemoto, R., & Mizuno, N. (1991). Topographical projections from the cerebral cortex to the nucleus of the solitary tract in the cat. *Experimental Brain Research,* **85,** 75–84.

Yates, J. L., & Nasby, W. (1993). Dissociation, affect, and network models of memory: An integrative proposal. *Journal of Traumatic Stress,* **6**(3), 305–326.

Received September 3, 1999
Published online May 15, 2001