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BEHAVIORAL INHIBITION: Linking Biology and Behavior within a Developmental Framework

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■ **Abstract** Behavioral inhibition refers to a temperament or style of reacting that some infants and young children exhibit when confronted with novel situations or unfamiliar adults or peers. Research on behavioral inhibition has examined the link between this set of behaviors to the neural systems involved in the experience and expression of fear. There are strong parallels between the physiology of behaviorally inhibited children and the activation of physiological systems associated with conditioned and unconditioned fear. Research has examined which caregiving behaviors support the frequency of behavioral inhibition across development, and work on the interface of cognitive processes and behavioral inhibition reveal both how certain cognitive processes moderate behavioral inhibition and how this temperament affects the development of cognition. This research has taken place within a context of the possibility that stable behavioral inhibition may be a risk factor for psychopathology, particularly anxiety disorders in older children. The current chapter reviews these areas of research and provides an integrative account of the broad impact of behavioral inhibition research.

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INTRODUCTION

Behavioral inhibition to the unfamiliar refers to "the child's initial behavioral reactions to unfamiliar people, objects, and contexts, or challenging situations" (Kagan et al. 1985, p. 53). The initial research reports on behavioral inhibition (Garcia-Coll et al. 1984, Kagan et al. 1988) described a group of toddlers who, by both parent report and observation in the laboratory, avoided unfamiliar events and people. When confronted with such challenges, these children ceased their play behavior and withdrew to the proximity of their caregivers. They remained vigilant of their surroundings during these situations and rarely approached novel objects or unfamiliar people.

Our goal in this chapter is to provide a broad overview of the work on behavioral inhibition. After a brief introduction, we begin with a review of the research identifying the biological underpinnings of behavioral inhibition. We next review the longitudinal studies of behavioral inhibition outlining the findings on continuity and discontinuity and identifying factors both within the child and in the environment that may affect these different developmental trajectories. In the third section, we focus on the role of attentional processes as an example of a within-child factor that contributes to patterns of reactivity and regulation among behaviorally inhibited children. Our fourth section details the findings from the developmental psychopathology literature on relations between behavioral inhibition and the heightened risk for general and specific anxiety disorders and more global problems in adjustment. In the final section of this review, we suggest future directions for the study of behavioral inhibition.

Research on behavioral inhibition has in many ways provided a model of interdisciplinary integration for other areas of developmental psychology that are now at the forefront of psychological science. Among these areas are the study of links between basic neuroscience and emotional development, examinations of the mutual influences of affect and cognition on behavior, and the identification of precursors to psychopathology in early childhood. There are a number of reasons why the work on behavioral inhibition has been successful in creating these links. First, unlike most previous research on temperament, this work has relied less on questionnaire data (e.g., parent report of temperament) and more on behavioral

description. The focus on behavioral observation and clear descriptions allowed scientists to identify certain responses (e.g., freezing, avoidance) that are similar to those described in animal models of fear or anxiety. The ability to relate behavioral descriptions of humans to descriptions of other animals provided an important initial link between temperament and the neurosciences. A second reason why the work on behavioral inhibition has had such a broad impact in psychology is the emphasis placed on the categorical nature of extreme temperamental behavioral inhibition, particularly by Kagan and colleagues (e.g., Kagan et al. 1984). Kagan appealed to notions in biology and medicine where categories serve an important function in identifying a species or a specific disease state (Kagan 1994). Correct or not, the idea of a categorical trait with its own unique biology and behavioral constellation forged a link with biologists and neuroscientists.

Kagan's reading of the then current work in behavioral neuroscience, including the studies of LeDoux and Davis (e.g., Davis 1986, LeDoux et al. 1988) enhanced his interest in describing the underlying biology of behavioral inhibition. In separate research programs, LeDoux and Davis focused on the amygdala as the brain structure responsible for the enhancement of fear conditioning and the potentiation of fear behaviors (Davis 1992, LeDoux et al. 1988). Building on the psychophysiological data that he and his colleagues had collected, Kagan suggested that individual differences in behavioral inhibition were the result, in part, of an overactive amygdala, creating an enhanced fear response to novelty and unfamiliarity. This attempt to bridge the behavior-neuroscience gap came at a time when the work of Davis and LeDoux was receiving widespread attention, and it facilitated a broader discussion of the ways in which the interplay of biology and behavior could be understood over time and within the context of human development.

The initial research on behavioral inhibition was also inherently developmental in approach and theory. Two key observations were highlighted in longitudinal studies of behavioral inhibition. First, across development, children developed a greater repertoire of behaviors in response to novel social situations. Second, while the behavioral manifestation changed somewhat over development, there was significant preservation of individual differences in inhibition. That is, behaviorally inhibited children displayed marked continuity in their distinctive pattern of responding to unfamiliar social and nonsocial stimuli. At the same time, variations in the developmental trajectories of behaviorally inhibited children necessitated broadening the model to include both endogenous and exogenous factors that might influence these different developmental paths, and merited examination of the contextual factors and cognitive processes that may mediate the expression of behavioral inhibition as children get older.

A primary source of hypotheses regarding factors influencing different developmental trajectories for behaviorally inhibited children is the model of temperament postulated by Rothbart and colleagues. Rothbart's model proposed two components: reactivity and self-regulation (Rothbart & Derryberry 1981). Reactivity reflects the infant's or child's physiological and behavioral responses to sensory stimuli, and is assessed in terms of the latency and intensity of responding. In the context

of behavioral inhibition, individual differences in reactivity are reflected by differences in the strength of the disposition to express particular discrete emotions to novel or unfamiliar stimuli or challenging situations. Regarding regulation, Rothbart's argument is twofold. First, certain cognitive processes such as voluntary attentional control and response inhibition that develop over infancy and early childhood serve to modulate reactive responses. Rothbart refers to these processes under the broad label of "effortful control." Second, the child's style of reactivity may influence the manner in which these processes emerge. Thus, temperament reflects individual differences not only in reactivity, but also in the manner in which effortful control processes are shaped by that reactivity (Derryberry & Rothbart 1997).

There are many implications of Rothbart's model of temperament for the study of behavioral inhibition. Individual differences in reactions to novelty may be identified early in the first year of life and may be described with respect to the disposition to express negative affect (fear or distress) when presented with novel, unfamiliar, or challenging events. Across early childhood, self-regulatory processes (voluntary attention, inhibitory control) will be influenced by this pattern of negative reactivity to novelty and may become biased to focus on negative affect or prevent disengagement from novel, unfamiliar, and often threatening stimuli. The manner in which the development of attention and other executive-function processes underlying effortful control either heighten or dampen the expression of behavioral inhibition in older children is thus of great interest.

A further area of study to which research on behavioral inhibition has contributed is the role of early temperament as a risk factor for the development of psychopathology. A number of studies have suggested that by middle to late childhood, socially withdrawn children are rejected and victimized by their peers (Boivin et al. 1995, Hanish & Guerra 2000). As well, by middle childhood, these children are more likely to report feelings of loneliness, low self-esteem, and even depression or anxiety (Hymel et al. 1993, Rubin 1993). Behavioral inhibition may be an antecedent of social withdrawal, which may lead to peer rejection, which in turn may exacerbate inhibited or isolated behavior. Recent evidence has found an increased prevalence of diagnosed anxiety disorders among children identified as behaviorally inhibited (Rosenbaum et al. 1993, Schwartz et al. 1999). Thus, the research on behavioral inhibition has been of great interest to child psychiatrists and clinical child psychologists as they identify early risk factors associated with the onset of anxiety and mood disorders in children.

THE BIOLOGY OF BEHAVIORAL INHIBITION

The contrast in behavioral reactions to novelty of inhibited and uninhibited children has been proposed to arise from variation in the excitability of neural circuits of the limbic system (Kagan & Snidman 1991). In particular, this model focuses on the amygdala, which has been implicated in the generation of fear (Davis 1992, 1998). Increased activity of the amygdala (especially the central nucleus)

would be expected to result in increased activity across response systems that have extensive connections with the central nucleus (see Marshall & Stevenson-Hinde 2001). The work examining this supposition is described below for the cardiac and neuroendocrine response systems, as well as for certain aspects of cortical processing.

Heart Rate

One prediction of the above model is that inhibited children should show consistently lower heart period (HP), corresponding to higher heart rate, and larger decreases in HP (i.e., heart rate acceleration) in response to unfamiliarity, compared with uninhibited children (Kagan 1994). Indeed, HP during quiet or active tasks was significantly negatively correlated with behavioral inhibition at assessments in toddlerhood up to 7.5 years of age (Kagan et al. 1984, Kagan et al. 1988, Reznick et al. 1986). In addition, inhibited children tended to show larger decreases in HP to stressors compared with uninhibited children (Kagan et al. 1988). Low baseline HP was associated with increased behavioral inhibition in an unselected sample of more than one thousand 3-year-old Mauritanian children (Scarpa et al. 1997). Other studies have found mixed results: Marshall & Stevenson-Hinde (1998) found no significant relation between behavioral inhibition and HP in a group of 4.5-year-olds who had been selected for high or low levels of inhibition. However, HP at 4.5 years predicted which of the children would remain inhibited when assessed 2.5 years later at 7 years of age: HP at 4.5 years was significantly lower for highly inhibited children who remained highly inhibited at 7 years, compared with those children who became less inhibited. In an unselected sample of 2-year-olds, Calkins & Fox (1992) found that behavioral inhibition was unrelated to baseline levels of HP, which suggests that large sample sizes or a focus on extremes via the use of selected samples are more likely to yield associations between behavioral inhibition and HP.

Cortisol

A perceived threat may activate the hypothalamic-pituitary-adrenal system, with the secretion of the stress hormone cortisol as one of the products of this activation. Salivary cortisol levels have been studied in relation to various aspects of child temperament, including behavioral inhibition (Stansbury & Gunnar 1994). Evidence for an association between cortisol levels and inhibited behavior has been mixed: Some researchers have found that high baseline cortisol levels are associated with behavioral inhibition (e.g., Kagan et al. 1987, Schmidt et al. 1997), but other studies examining the relations between behavioral inhibition and changes in adrenocortical activity in response to stress have been more equivocal. For instance, De Haan and colleagues (De Haan et al. 1998) found home cortisol levels to be associated with more anxious, internalizing behavior in 2-year-olds, but found that an increased cortisol response to starting preschool was associated with more assertive, angry, and aggressive behavior rather than with socially inhibited or anxious

behavior. Gunnar (1994) suggested that one reason inhibited children might not show elevated cortisol reactivity during such transitions is that unlike less fearful children, inhibited children tend to avoid the kinds of social and physical activities that would elicit elevations in cortisol. In addition, adrenocortical activity may not necessarily map onto fear-related constructs, but instead cortisol levels may be related to the maintenance or failure of coping strategies. Nachmias et al. (1996) examined cortisol responses of inhibited and uninhibited 18-month-olds to the Ainsworth Strange Situation as well as to a challenging coping episode. Infants who were highly inhibited and insecurely attached showed larger cortisol responses to the Strange Situation and the challenging coping episode compared with children who were highly inhibited but securely attached. The cortisol increase for inhibited-insecure infants was greater than that for the uninhibited infants, whether securely or insecurely attached. In this sense, mothers in secure dyads who have inhibited children may support their children's strategies for coping with an unfamiliar and/or stressful situation.

Electroencephalogram, Event-Related Potentials, and Functional Magnetic Resonance Imaging

A number of studies have examined the relation of behavioral inhibition to electrophysiological measures derived from the electroencephalogram (EEG). The majority of work in this domain has focused on hemispheric asymmetries in EEG activation, although event-related potentials (ERPs) more recently have been used to probe electrophysiological responses to stimuli in inhibited infants and children. In addition, a recent study has incorporated the use of functional magnetic resonance imaging (fMRI) into the study of inhibited temperament.

Several studies have related individual differences in approach or withdrawal behaviors in infancy and childhood to patterns of asymmetrical activation in EEG signals recorded over the frontal region of the brain. Fox (1991, 1994) and Davidson (1992) argue that the functional significance of frontal EEG asymmetry may be conceptualized in terms of motivational systems of approach and withdrawal. In this perspective, the left frontal region promotes appetitive, approach-directed emotional responses, while the right frontal region promotes withdrawal-directed responses to perceived aversive stimuli. Hemispheric asymmetries in EEG alpha band activity have been used to probe individual differences in the relative activation of these motivational systems. The use of EEG alpha power in this respect is driven by the fact that when sensory cortex receives incoming stimuli, EEG alpha power over the same part of the cortex is decreased in amplitude (desynchronized). In this sense, alpha power has been used as a proxy for cortical activation, being inversely related to cortical activation (see Marshall et al. 2002). A "right frontal" pattern of EEG asymmetry refers to a pattern of decreased alpha power in electrodes over the right frontal region, relative to the homologous electrodes in the left hemisphere. This right frontal pattern has been taken to indicate activation of the motivational system associated with withdrawal. Indeed, infants who

displayed a pattern of stable right frontal EEG asymmetry across the first two years of life tended to be more inhibited at both 14 and 24 months of age compared with infants who exhibited a pattern of stable left frontal EEG (Fox et al. 1994). Infants who went on to be consistently inhibited up to 4 years of age exhibited greater right frontal EEG asymmetry at 9 and 14 months of age than infants who were to become less inhibited (Fox et al. 2001). In addition, Calkins et al. (1996) found that infants who were selected at 4 months of age for high frequencies of motor behavior and negative affect in response to novel visual and auditory stimuli tended to show right frontal EEG asymmetry at 9 months of age. They also were more behaviorally inhibited at 14 months of age compared with infants who showed either high positive affect or low levels of either positive or negative reactivity at 4 months of age. The best predictor of the tendency to be socially reticent with unfamiliar peers in 4-year-old children was the combination of both temperamental negative affect and right frontal EEG asymmetry (Henderson et al. 2001).

Another recent study examined EEG asymmetry in a sample of 10- to 12-year-olds who had been followed since 4 months of age. Children who had exhibited high levels of behavioral inhibition to the unfamiliar in laboratory assessments at ages 14 and 21 months and who had shown high levels of emotional and motor reactivity at 4 months of age were more likely to show right frontal asymmetry in the late-childhood assessment (McManis et al. 2002). In addition to relations with baseline EEG asymmetry, behavioral inhibition is associated with changes in EEG asymmetry during tasks designed to elicit an anxious state. For example, Schmidt et al. (1999) examined changes in the EEG in inhibited and uninhibited children over a task in which the participants had to mentally prepare for giving a speech about their most embarrassing moments. In the end, they were not required to give such a speech, but the EEG patterns during anticipation of this event differed significantly between inhibited and uninhibited children. Relative to the uninhibited children, the inhibited children showed an increase in activation over the right frontal region over the course of the anticipation period. Interestingly, the EEG changes also were coupled with an increase in heart rate over the same period in the inhibited children.

We recently examined EEG asymmetries in relation to two different forms of nonsocial behavior in preschoolers during a play session with unfamiliar peers: social reticence and solitary-passive behavior (Henderson et al. 2004). In contrast to solitary-passive children, who occupy themselves with exploratory and constructive activities such as drawing and working on puzzles while in the company of unfamiliar peers, reticent children remain visually focused and oriented toward other children, yet do not join them in their activities. In this sense, reticence is related to behavioral inhibition: Indeed there is evidence for continuity between behavioral inhibition in toddlerhood and reticence in the preschool years (e.g., Rubin et al. 2002). Both reticent and solitary-passive children showed a pattern of resting right frontal EEG asymmetry, which suggests that these different forms of solitude may share a common withdrawal motivation. However, other physiological and

behavioral evidence from this study suggested that reticence is associated with a particularly aroused, vigilant physiological profile. For instance, reticent children showed a pattern of increased generalized EEG activation (decreased alpha-band power) across the scalp, which is consistent with Eysenck's model of increased generalized arousal in introverted individuals (Eysenck & Eysenck 1985), due to tonic differences in the ascending reticular activating system. It is also consistent with animal studies demonstrating that generalized cortical activation can reflect activity in the central nucleus of the amygdala (e.g., Kapp et al. 1994).

One promising line of research, which also uses electrophysiological techniques, is the examination of central nervous system responses to stimulation as indexed by ERPs. ERP techniques have the benefit of superlative temporal precision and can give insight into the nature and timing of mental events such as novelty detection and orienting. One relatively recent development in studies of behavioral inhibition is the use of auditory ERPs to examine individual differences in stimulus processing in inhibited and uninhibited children. One question of interest in this respect is the ability of descending projections from limbic structures such as the amygdala to influence stimulus processing at early stages of transmission and stimulus processing. Woodward and colleagues (Woodward et al. 2001) examined the brainstem auditory evoked response in 10- to 12-year-old children who had previously been selected on the basis of high or low affective reactivity in infancy. The high-reactive infants, who had gone on to become more inhibited young children, had a higher amplitude of a certain component of the brainstem auditory evoked response thought to originate in the inferior colliculus. Woodward et al. (2001) interpreted this finding as indicating that projections from the amygdala to the inferior colliculus are more excitable in children with an inhibited, fearful temperament. However, the precise origin of these effects has yet to be elucidated.

In a similar vein, we recently examined the mismatch negativity (MMN) in the auditory ERP of both socially withdrawn and more outgoing control children aged 7 to 12 years (Bar-Haim et al. 2003). The MMN indexes a change-detection mechanism in primary auditory cortex, and it is elicited using auditory "oddball" paradigms without specific task demands (Picton et al. 2000). The MMN usually is derived from a comparison of the ERPs to infrequent "deviant" and frequent "standard" auditory stimuli, although its characteristics in terms of morphology and latency vary over infancy and childhood (Cheour et al. 2001). We found that socially withdrawn children have reduced MMN amplitude compared with more outgoing children. Such individual differences in sensory processing either could be a consequence of "top-down" influences by higher affective centers such as the amygdala, or may reflect "bottom-up" differences in early processing that may feed forward to affect the later processing and evaluation of sensory information.

Other recent work on auditory ERP responses to novelty in infancy suggests that temperamentally different infants may show different degrees of electrophysiological reactivity to novelty. Infants who have a temperamental tendency to respond to stimulation with high levels of positive affect also show an enhanced ERP response to complex novel stimuli that are interspersed in a train of repetitive tonal

"standard" stimuli, but do not show elements of orienting to stimuli that are only mildly deviant from the standards. In contrast, temperamentally high-negative infants respond with an indication of an orienting response to the mildly deviant stimuli, but with a reduced response to the complex novel stimuli (PJ Marshall, MG Hardin, & NA Fox, in preparation). One explanation for these group differences is that the high-negative and high-positive infants may have differing optimal levels of novelty at which engagement with a novel stimulus is promoted (Berlyne 1960).

Although the use of functional neuroimaging techniques such as positron emission tomography (PET) and fMRI in infants and young children presents specific ethical and practical challenges, there is increasing interest in using these techniques, especially fMRI, to probe brain responses to sensory stimulation in older children. One recent study used fMRI to directly assess amygdala activity in response to novel face stimuli in young adults who had been classified as inhibited or uninhibited in the second year of life in Kagan's longitudinal studies (Schwartz et al. 2003). Participants were familiarized with a set of faces, and then were exposed to a stimulus set that interspersed novel, previously unseen faces among the previously seen, familiar faces. Analyses of the fMRI signal revealed that the adults who as toddlers had been more inhibited showed increased bilateral activation of the amygdala in response to the novel faces compared to adults who initially had been categorized as uninhibited. Although the contemporaneous behavioral profiles of the adults were not assessed, this study provides intriguing evidence of continuity in the reactivity of the physiological systems proposed to underlie an inhibited temperament.

CONTINUITY AND DISCONTINUITY IN BEHAVIORAL INHIBITION OVER DEVELOPMENT

Behavioral inhibition and shyness are among the most stable individual differences in the personality development literature, with continuities found throughout early childhood, middle childhood, and adulthood. Despite this relatively high degree of continuity across samples, examination of individual differences in patterns of behavior over time reveals that many children show markedly changed patterns of behavior across the course of childhood. Understanding these patterns of continuity and change has become a vital focus of behavioral inhibition research.

Longitudinal Studies of Behavioral Inhibition

More than four decades ago, Kagan focused on the temperamental quality of fearfulness, noting that it showed a remarkably high degree of continuity from toddlerhood through adulthood (Kagan & Moss 1962). Using data from the Fels longitudinal study, Kagan & Moss (1962) reported that the behavioral tendency to express fear and avoidant behaviors to novelty and challenge in the first three years

of life showed the highest degree of continuity through adolescence compared to all other behavioral tendencies. Into young adulthood, a remarkable number of the children displaying fearful behaviors at younger ages were described as introverted. In Kagan's later studies, two cohorts of toddlers were selected based on their extreme reactions to novelty in order to try to tap into these individual differences (e.g., Kagan et al. 1984). These children were followed up later in childhood, when they were observed in play sessions with an unfamiliar peer, and in different unfamiliar situations including a "risk room" in which children's willingness to engage in mild risk-taking behaviors was measured.

The major finding from these longitudinal studies was that the expression of behavioral inhibition, although elicited in different contexts, showed a moderate degree of continuity. Inhibited toddlers who were quiet and restrained tended to be quiet, cautious, and socially reticent children at 7.5 years of age. Conversely, uninhibited toddlers who were social remained talkative and interacted easily with unfamiliar adults and children at 7.5 years (Kagan et al. 1988). The behavioral inhibition index at 7 years correlated significantly with indices of behavioral inhibition at 21 months (Pearson $r = 0.67$), 4 years ($r = 0.54$), and 5.5 years ($r = 0.57$) (Kagan et al. 1988). Other researchers have noted that continuity in behavioral inhibition is lower in samples that are unselected for early patterns of reactivity compared to the selected samples reported on in this original work by Kagan and colleagues. For instance, Stevenson-Hinde & Shouldice (1995) found lower consistency in inhibition toward an unfamiliar adult in an unselected sample from 4.5 to 7 years of age (Pearson $r = 0.24$) than in a selected sample over the same age range ($r = 0.46$; Marshall & Stevenson-Hinde 1998).

Fox and colleagues (Fox et al. 2001) found similar results in a study of an extreme group of infants who displayed high negative affect and motor reactivity in response to unfamiliar visual and auditory stimuli at 4 months and who were followed up from 9 to 48 months. Approximately half of the infants in this high negative reactivity group continued to show high levels of behavioral inhibition through 24 months of age, and approximately one third of these infants continued to show extreme social reticence during interactions with unfamiliar peers at 48 months (Fox et al. 2001).

In the Australian Temperament Project, Sanson and colleagues studied nearly 500 randomly selected infants who were assessed initially at 4 to 8 months of age and followed until they were 5 to 6 years old (Sanson et al. 1996). Maternal reports of shyness showed moderate continuity from infancy to childhood, with continuity being higher at older ages. In addition, similar to Kagan et al. (1988), they found that children at the behavioral extremes showed the greatest degree of continuity in behavior over time.

These results have also been replicated in both European and Asian samples. Broberg et al. (1990) used maternal reports and observational measures of temperament in a study of firstborn children in Sweden. An inhibition composite was created that aggregated maternal reports of fear, observer-rated peer noninvolvement in play, and the reversed observer-rated sociability with a stranger score.

Toddlers who were inhibited at 16 months were more likely to be inhibited at 28 and 40 months of age than were uninhibited toddlers. In another unselected Swedish sample, inhibition ratings showed continuity from 21 months to 6 years only in children at the behavioral extremes (Kerr et al. 1994). Reports of continuity have also been found in Chinese studies of temperament (Zhengyan et al. 2003) and in Asendorpf's (1994) longitudinal study of behavioral inhibition in German children from 4 to 10 years. In a study of Mauritanian children, Scarpa et al. (1995) found that inhibited children at age 3 and age 8 had higher inhibition scores at age 8 and age 11, using questionnaire measures and brief observational ratings.

The set of studies finding moderate continuity of inhibition across early and middle childhood has led researchers to assess whether such continuity follows into adulthood. Caspi and colleagues (Caspi et al. 1989) identified shy and reserved children using archival data from the Berkeley Guidance Study (Eichorn 1981). Although there was evidence for continuity of shyness into adulthood, the psychosocial outcomes associated with shyness differed by sex. Shy girls were more likely to follow conventional patterns of marriage, homemaking, and motherhood whereas shy boys were more likely to delay marriage, parenthood, and stable careers, and attain less achievement in their careers. Adults who were previously shy children described themselves as nonassertive and overcontrolled; they reported experiencing few positive emotions and had little desire to influence others. An informant who knew them well described them as less affiliative and less interested in engaging in their surroundings (Caspi et al. 2003). A similar profile of characteristics was reported in young adults who had been behaviorally inhibited as 8- to 12-year-olds (Gest 1997). These young adults reported a less active social life and were less likely to move away from family; men reported experiencing greater emotional distress and negative emotionality.

These studies and others have established that behavioral inhibition shows at least moderate continuity across childhood and to a certain extent is also associated with aspects of adult personality. However, given the multitude of influences on development, detailed models are needed that allow for the investigation of specific factors affecting continuity and discontinuity in temperamental tendencies over time. As such, there has been much theoretical discussion regarding the moderating effects of environmental factors on the associations between temperament and outcomes (e.g., Bates 2001, Rothbart & Bates 1998). To date, however, there have been few empirical investigations of these moderating effects. In the following sections, we discuss the possible moderating effects of parenting behaviors and nonparental care environments on patterns of continuity and change in behavioral inhibition.

The Role of Caregiving Behaviors and Environments

In early childhood, the most salient environmental influence on the child is the caregiving environment. However, only a few studies have investigated the specific parenting behaviors or styles associated with continuity and discontinuity

in behavioral inhibition. The parenting characteristics that have been examined in relation to continuity and discontinuity are acceptance, warmth, sensitivity, responsiveness, control, and overprotection (Park et al. 1997, Wood et al. 2003).

Some evidence suggests that parental sensitivity can reduce emotional negativity and perhaps behavioral inhibition by enhancing feelings of self-worth. For example, infants who became less negative from 3 to 9 months of age had interaction patterns with their mothers at 3 months that were more complementary and harmonious (Belsky et al. 1991). Similar findings were observed in a study involving preterm infants (Washington et al. 1986).

In contrast to these findings suggesting that sensitive parenting functions to reduce negative reactivity in temperamentally prone infants, Kagan (1994) hypothesized that sensitive parenting behaviors may increase negative reactivity in temperamentally distress-prone infants. He suggested that a firm parenting style including limit setting might help the child cope and lead to reduced inhibition. Consistent with this hypothesis, Park and colleagues (Park et al. 1997) found that more intrusive parenting by mothers across the second and third year led to less inhibited behavior at age 3, after controlling for early emotionality. Less inhibited behavior was also more likely when fathers were less sensitive and affectionate in the second year, and more intrusive and expressive of negative affect in the third year. Park et al. (1997) suggest that sensitive parenting sends the message to the child that it is fine to be who you are, while negative and intrusive controlling behavior sends the message to change. Because Park et al. used global ratings of parenting, it is not possible to discern the specific circumstances or contexts surrounding the parenting behavior. Under certain circumstances, pushing a child to control his anxieties may actually reflect a sensitive awareness instead of a controlling intrusive parenting style (Park et al. 1997).

Rubin and colleagues (Rubin et al. 2002) investigated whether the interaction of parenting behaviors and behavioral inhibition at age 2 years explained child characteristics at 4 years of age, either directly or through the moderation of earlier inhibition. A maternal parenting style that consists of overly warm, intrusive, unresponsive, and derisive behavior moderated the concurrent association between shyness and behavioral inhibition at 2 years (Rubin et al. 1997). These associations remained two years later when children were reassessed at 4 years of age (Rubin et al. 2002). Inhibition at 2 years only predicted reticence with unfamiliar peers at 4 years when mothers behaved in a psychologically controlling or derisive manner.

Wood and colleagues (Wood et al. 2003) suggest two heuristics for guiding research focused on refining and extending models of parenting and childhood anxiety, including clarifying issues of timing and direction of effects. One heuristic, based on the work of Rubin and colleagues, suggests that parents who are solicitous and overresponsive (in situations in which the child does not need help) may reinforce child anxiety or shyness by rewarding their child's initial signs of anxiety or distress with parental warmth, and by preventing the child from using and developing self-regulatory skills. In contrast, parents who encourage children to engage in social activities may help prevent their child from developing greater

distress related to social interactions. The other heuristic suggested involves ideas of control and mastery: Children whose parents provide them with opportunities to excel and master their environment are less likely to feel dependent on their parents.

The ideas set forth in these heuristics are not inconsistent with the idea that sensitive parenting leads to reduced negative affect. Sensitive and responsive parents are aware that sensitivity and responsiveness needs to change with development and they will encourage their children to explore their world because they are sensitive and responsive to their child's burgeoning independence. The studies by Park and colleagues, Rubin and colleagues, and others are a good first step to understanding what types of parenting behaviors are associated with maintaining inhibition.

Nonparental caregiving may also influence patterns of continuity and discontinuity in behavioral inhibition. Fox and colleagues (Fox et al. 2001) found that infants who showed high negative emotionality at 4 months were more likely to change their behavior and become less inhibited over toddlerhood when they were placed in nonparental caregiving environments for at least 10 hours per week. They suggested several ways that the caregiving environment could lead to different patterns of continuity and discontinuity. For example, children in nonparental care may receive less responsive and sensitive caregiving and/or they may gain more experience interacting with unfamiliar peers at an earlier age compared to their peers who remained inhibited over time. Ahnert & Lamb (2003) have noted that mothers may be less sensitive than care providers in quality day care settings when interacting one-on-one with a child. Even though children may be competing for caregiver attention and be limited in the amount of time they have to interact with the caregiver, this does not necessarily affect the quality of the relationship formed or the quality of the care.

The personality of parents who choose to keep their infant at home may explain the higher degree of continuity because a parent's own anxious or fearful personality may lead to both the decision to keep a child at home and to an overprotective parenting style that contributes to the continuity of inhibition. Alternatively, a working mother may have stress at work above and beyond the stress related to responsibilities in her home, and this stress may affect her parenting style and interactions with her child. Some evidence suggests that mothers of children in childcare took longer to respond to their toddlers' signals of distress compared to mothers who stay at home. Other observations suggest that toddlers in daycare display more negative behaviors when interacting with their parents outside of daycare (Nelson & Garduque 1991). Taken together, these may explain some of the observed differences in continuity and discontinuity of behavioral inhibition between young children who are in the exclusive care of their parents versus those who spend time in nonparental care. Children who stay at home may be more likely to receive parenting that is more overcontrolling and oversolicitous, whereas children who go to daycare may be more likely to receive parenting that fosters independence.

Yet another reason experiences in out-of-home care could promote discontinuity is that children in out-of-home care may simply gain experience and practice

interacting with unfamiliar people, therefore reducing their fears. Furman et al. (1979) found that socially withdrawn preschoolers who were given the opportunity to interact with other preschoolers showed an increase in the amount of peer interactions they engaged in compared to preschoolers who were not given an opportunity to interact with others. Greco & Morris (2001) reviewed peer-based interventions for childhood shyness and related behaviors and found that peer-mediated and peer-pairing approaches seem to be effective in treating internalizing behaviors that are related to low social status. Experience with other children combined with mother-child conversations about peers may be especially associated with children's competence. Laird et al. (1994) studied mother-child conversations about the child's peers and found that children's competence was associated with the frequencies of conversations, maternal advice giving, and the presence of emotional themes in conversations.

COGNITION-EMOTION INTERACTIONS IN BEHAVIORAL INHIBITION

The tendency to display behavioral inhibition is associated with the experience and expression of moderately high levels of negative emotions including fear, anxiety, and distress (Eisenberg & Fabes 1992). Thus, one of the biggest challenges for children with a history of behavioral inhibition is to learn to modulate or regulate these relatively intense emotional reactions. At both behavioral and neural levels of analysis, a gradual transfer of control over regulation has been described in which infants' behaviors and emotions are initially governed by their reactive tendencies, thus making them relatively dependent on external sources, such as their caregivers, for regulation (Kopp 1982, Rothbart & Derryberry 1981). Based on an anatomical argument, Panksepp (1998) paralleled the views of Rothbart and Kopp that early in development, infant emotional responses are governed primarily by upward controls from the limbic system. However, with age and cortical development, cognitive control capacities (i.e., response inhibition and attentional control) increase, allowing for greater downward or top-down control over initial reaction tendencies (Panksepp 1998, Rueda et al. 2004).

The Effects of Emotion on Attentional Orienting

One of the adaptive functions of the behavioral inhibition system is that it functions to increase vigilance and orienting to environmental cues that could be indicative of threat (LeDoux 2000). This is an example of a bottom-up influence of emotional biases on information processing, where emotional tendencies guide the direction and patterns of engagement/disengagement of attention (Ochsner & Gross 2004). Individual differences in sensory orienting are attributed to the functioning of the posterior attention system, which includes the superior parietal cortex, the

temporal parietal junction, frontal eye fields, and superior colliculus (Corbetta & Shulman 2002). The posterior attention system is functional early in life, and relates to individual differences in orienting responses to novelty, early attentional persistence, duration and latency of orienting, and early state control (Derryberry & Rothbart 1997, Eisenberg et al. 2004).

Related to the study of fear and behavioral inhibition, numerous studies have evaluated the effect of extraversion and neuroticism, in combination with anxiety, on various aspects of cognitive functioning. Such studies generally adopt a bottom-up approach to studying emotion-cognitive interactions, as it is hypothesized that individual differences in emotional tendencies will influence the quality of functioning or the ability to implement specific cognitive functions, including attention focusing and shifting.

It has long been known that anxiety and stressful states promote attentional narrowing (Easterbrook 1959). Specifically, it has been theorized that attention selectivity facilitates early processing of potential threat, influencing subsequent cognitive and emotional processing (Mathews 1990). However, the exact mechanisms and the direction of these emotion-attention relations are still unclear.

Beck et al. (1985) noted that emotional dysfunctions co-occur with activation of a cognitive schema biased toward mood-congruent information. This biased information processing, brought about by anxiety-related schema, leads to better encoding of threat-related information. Consistent with this, when anxious individuals perform an emotional Stroop task, they tend to take longer to report the color of threatening words compared to nonthreatening words. This pattern of performance is thought to be due to increased attention to the threatening word itself, thereby leading to distraction from the color-naming task (Williams et al. 1996). Studies of individual differences on a dot-probe paradigm have led to similar conclusions. Specifically, anxious individuals are quick to detect targets in threatening word locations, possibly due to attention being drawn covertly to the location of the threatening word (MacLeod & Mathews 1988, Wells & Matthews 1994).

In detailed analyses of the processes of attentional engagement and disengagement in anxious individuals, recent studies have found that compared to nonanxious individuals, anxious individuals may not attend more quickly or intensely to threatening stimuli, but rather have difficulty disengaging their attention from such stimuli (Derryberry & Reed 1994; E. Fox et al. 2001, 2002). Derryberry and Reed hypothesized that previous findings of differences in performance on emotional Stroop and dot-probe tasks can be attributed to the fact that anxious individuals cannot disengage from the threatening stimuli to attend to other aspects of the task (i.e., word or color), thereby perpetuating the attentional bias to negatively biased, threatening cues (see Derryberry & Reed 2002). Thus, children with a bias toward anxious, fearful reaction tendencies face the challenge of learning to intentionally control their attention at several different levels including the shifting of visual attention away from distressing stimuli and situations and cognitively reappraising stimuli and situations that elicit distress.

Voluntary Attentional Control

Whereas individual differences in attentional orienting have been related to the functioning of the posterior attention system, voluntary control of attention is considered a higher-order cognitive process associated with the functioning of a more anterior system of attention including the anterior cingulate cortex and the lateral prefrontal cortex (Posner & DiGirolamo 2000). The emergence of voluntary control over attention, and specifically the ability to flexibly focus and shift attention, contributes to the developing system of behaviors or responses that allow for greater self-regulation of thought, behavior, and emotion (Posner & Rothbart 1998). The relation between the flexible and intentional employment of attention and the regulation of emotion is apparent early in life and characterizes many of the early interactions that take place between caregivers and infants. During adult-infant interactions, adults engage and disengage infants' attention in order to manage the infants' levels of arousal. States of engaged attention between infants and their caregivers tend to be associated with play, states of joy, and general states of positive affect (Gottman et al. 1997). In addition to engaging infants' attention, adults also tend to be sensitive to infants' needs to disengage their attention in order to dampen or reduce levels of arousal. When attention is engaged, arousal is heightened, and by disengaging attention, adults give infants the opportunity to dampen their levels of arousal. Early on, infants learn to use such strategies to manage their own levels of arousal. When parents respond contingently to their infants' needs to disengage and re-engage interactions, infants learn about the efficacy of attentional control as a means of self-regulation (Gottman et al. 1997). The relation between attentional control and self-regulation is supported by the fact that these individual differences have been associated with differences in temperamental reactivity and regulation (Johnson et al. 1991, Rothbart et al. 1994). These findings suggest that the development of attentional control over the first several years of life may provide children with an important source of regulation over their reactive temperamental tendencies. For temperamentally fearful children, the shifting of attention to a different aspect of a situation, or distracting oneself, may provide an effective means of regulating emotional distress.

Our observations suggest that disengaging attention from aspects of unfamiliar situations may be particularly challenging for behaviorally inhibited children. In unfamiliar social situations, temperamentally fearful children face the competing challenges of managing feelings of anxiety and interacting with peers. These challenges are particularly salient for a subtype of socially withdrawn children referred to as socially reticent, who spend their time primarily watching other children when put in a group of unfamiliar peers (Coplan et al. 1994, Henderson et al. 2004). These children tend to hover on the fringe of social activity, display behavioral signs of anxiety, carefully watch the other children, and remain unengaged in any other activities. These children appear to be unable to disengage their attention from the other children and make few attempts to join group activities. This fixation appears to be not only ineffective in reducing wariness, but it also

may increase wariness over the course of the play period. These observations are consistent with others' hypotheses that across the life span, individuals who are biased toward the experience of high levels of negative emotion, including fear and anxiety, and who are unable to employ attentional mechanisms in order to regulate their emotions, would be easily overwhelmed by negative emotion (Derryberry & Rothbart 1988; Eisenberg et al. 1998; Rothbart et al. 1992, 2004).

Aspects of attentional control that contribute to the regulation of negative emotional states include attention shifting, attention focusing, and cognitively manipulating one's assessment of a situation (Eisenberg et al. 1998, Ochsner & Gross 2004). Shifting attention away from a fear-inducing stimulus, or cognitively reframing environmental stimuli that might be interpreted as distressing, appear particularly important for the regulation of shyness (Eisenberg et al. 1998). Adults who report high levels of shyness also report being poor at shifting and focusing attention (Eisenberg et al. 1995). Similarly, in children, Eisenberg et al. (1998) found that teachers' reports of shyness are negatively correlated with attention shifting at school.

In adult populations, it has been found that anxious individuals with good attentional control were better able to shift their attention away from threatening stimuli compared with anxious individuals with poor attentional control, thereby showing that skilled control of voluntary attention may provide anxious individuals with an important form of self-regulation (Derryberry & Reed 2002). Similarly, for children, Eisenberg et al. (1998) reported a significant interaction effect between shyness and attention shifting in the prediction of internalizing emotions, such that internalizing emotions were positively related to parent reports of shyness, but only for children who were relatively low in attention shifting. Shyness was not predictive of internalizing emotions for children who were moderate or high in attention-shifting abilities. Therefore, the ability to shift attention may moderate the associations between shyness and the development of social anxiety and more global internalizing difficulties.

Attention and the Development of Social Cognition in Behaviorally Inhibited Children

Social-cognitive models of social adjustment emphasize the cognitive processes or mental steps children engage in before enacting a social behavior. These steps are (*a*) the encoding of situational cues, (*b*) the representation and interpretation of those cues, (*c*) a mental search for possible responses to the situation, and (*d*) the selection of a response. Individual differences in the processing of information at any of these stages are believed to provide a mechanism through which individual differences in social adjustment develop (Dodge 1989, Ladd & Mize 1983, Rubin & Krasnor 1986). Given the effects of temperament or emotional biases on the direction and control of children's attention, over time these biases may influence several stages of social information processing, including the encoding and interpretation of social and emotional cues. In turn, differences in social

information processing may affect patterns of continuity and discontinuity in behavioral inhibition across childhood and into adolescence.

Behaviorally inhibited children interact with others in relatively ineffective ways, and others' reactions to them likely influence their social cognitions over time. Although behaviorally inhibited children tend to use nonassertive strategies during interactions with peers, they are more likely than are their peers to have their requests refused (Rubin & Borwick 1984). Such findings suggest that in early childhood, social withdrawal is associated with the experience of poor peer relationships (e.g., Rubin 1985). Over time, the experience of social failure may influence children's perceptions of social situations and their attributions with regard to social success and failure. Specifically, children may begin to interpret otherwise ambiguous social situations as threatening and believe that poor social outcomes are a result of internal causes (Goetz & Dweck 1980, Rubin et al. 1998).

The relations between emotional biases and social information processing have been demonstrated in studies of clinical populations. Emotional disorders including depression, anxiety, and phobias are associated with cognitive biases, or the selective processing of emotion-relevant information (Mineka & Tomarken 1989). Attentional biases, as reviewed above, appear to affect the nature of the information that initially is attended to among anxious children and adults. However, emotions, and anxiety in particular, appear to influence later stages of information processing as well, including the interpretation of otherwise ambiguous situations. Specifically, anxious children and adults tend to interpret ambiguous stimuli or situations as disproportionately negative or threatening (Vasey & MacLeod 2001). For example, in a sample of 7- to 9-year-old children, self-reported trait anxiety was positively associated with the number of threatening interpretations children gave for a series of homophones with both a threatening and neutral meaning (Hadwin et al. 1997).

Beyond the interpretation of single words or images, anxiety is associated with more global interpretive biases in the context of scenarios involving social interactions. Negative or anxious social schemas have been evaluated by presenting children or adults with ambiguous social scenarios and asking for their interpretations. For example, Chorpita et al. (1996) assessed 9- to 13-year-old children's interpretations and behavioral plans regarding ambiguous situations. Children's trait anxiety scores significantly predicted the total proportion of both anxious interpretations and anxious plans. Similarly, socially anxious adolescents predict more socially threatening outcomes for hypothetical social scenarios compared to their nonanxious peers (Magnusdottir & Smari 1999).

BEHAVIORAL INHIBITION AND PSYCHOPATHOLOGY

The pattern of anxious behaviors, social withdrawal, negative affect, and low self-esteem, all reported in the developmental literature as characteristic of behavioral inhibition, are symptoms also used to diagnose certain anxiety and mood

disorders. A good deal of work on the relation between behavioral inhibition and psychopathology has been done by Biederman, Rosenbaum, and their colleagues. In their first study, Rosenbaum et al. (1988) assessed 56 Caucasian children ages 2 to 7 whose parents were undergoing treatment for one of three possible diagnoses: (*a*) panic disorder with or without agoraphobia (PD-AG), (*b*) comorbid PD with major depressive disorder (PD-MDD), or (*c*) major depressive disorder alone (MDD). These groups were compared to a "control" group of children whose parents did not have PD or MDD. This control group consisted of siblings of children in treatment for attention deficit disorder or children of parents in treatment for other disorders (i.e., tobacco dependence, obesity, or generalized anxiety disorder). Researchers found that children of parents with PD, with or without comorbid MDD, had longer latencies to speak and fewer spontaneous comments than did children from the control group, whereas children of MDD parents did not differ from either group. Results also indicated a higher incidence of behavioral inhibition in children of parents with PD-AG, with or without MDD, compared to children from the control group. The authors suggested that the increased prevalence of behavioral inhibition in children of parents with PD (i.e., anxiety disorders) suggests a familial or biological tie between psychopathology and inhibition.

Additional studies by this research group examined the prevalence and familial loadings of psychopathology in children with and without behavioral inhibition in nonclinical samples. Biederman et al. (1990) used a subset of the sample from their 1988 study whose parents were being treated for PD-AG (classified as the Massachusetts General Hospital high-risk sample) and compared these children to inhibited and uninhibited Caucasian children (ages 7 to 8 years) from Kagan's longitudinal study of behavioral inhibition. Both groups were also compared to healthy controls (ages 4 to 10 years) who were not classified into temperament categories. Results revealed that behaviorally inhibited children in the Massachusetts General Hospital high-risk sample were significantly more likely to have multiple diagnoses (>4), two or more anxiety disorders, overanxious disorder, and oppositional disorder when compared to healthy controls, although comparisons to not-inhibited children failed to reach statistical significance. Additionally, although not statistically significant, rates of major depression and attention deficit disorder were also higher in inhibited children as compared to not-inhibited children or healthy controls. In Kagan's sample that had been selected for comparison as a nonclinical group, rates of oppositional disorder were found to be significantly lower in inhibited children as compared to uninhibited children, whereas rates of phobic disorder were higher in inhibited versus uninhibited children. Based on these results, the authors concluded that behavioral inhibition was associated with childhood anxiety disorders.

Other studies also have found links between inhibition in adolescents and young adults and various disorders. Using behavioral assessments, Schwartz et al. (1999) assessed a group of adolescents who had been previously classified as inhibited or uninhibited at 2 years of age. At 13 years of age, participants were observed in a laboratory battery of physiological, behavioral, and cognitive procedures.

Participants were also interviewed directly by a psychologist to assess past and current anxiety symptoms. No differences were found between inhibited and uninhibited teens with respect to specific fears, separation anxiety, or performance anxiety, although the two groups did differ in respect to social anxiety: Sixty-one percent of teens who had been inhibited as toddlers reported social anxiety symptoms, compared to 27% of adolescents who had been uninhibited earlier in life.

Additional studies have relied on self-report measures in an attempt to further elucidate the relationship between inhibition and psychopathology. The Australian Temperament Project data revealed associations between shyness and internalizing problems at 5 to 6 years (Sanson et al. 1996) and anxiety at 13 to 14 years of age (Prior et al. 2000). In the latter study, participants who were rated as shy from infancy onward had a higher incidence of later anxiety problems, with persistently shy children being at increased risk compared to children who were never shy or whose shyness rating had changed over time. Forty-two percent of children rated at the higher end on a shyness scale had anxiety problems in adolescence, compared to 11% who never were rated as shy.

Muris et al. (1999; see also Muris et al. 2001) conducted a study that examined the relation between self-reported behavioral inhibition and psychopathology symptoms in high school students. Adolescents who rated themselves high on inhibition also reported increased symptoms of anxiety, worry, and depression. In a similar study, Hayward et al. (1998) administered a retrospective self-report of inhibition (in childhood) to high school students. Results indicated social avoidance in childhood to be predictive of the onset of social phobia during high school, but unrelated to depression. Fearfulness in childhood also was found to increase the risk for later diagnoses of social phobia and depression.

Research has demonstrated that stable behavioral inhibition is a risk factor in the development of anxiety disorders. Existing research has focused on the link between inhibition and the development of anxiety; however, the relation between inhibition and externalizing behaviors has not been as extensively investigated. It has been hypothesized that behavioral inhibition may actually have a protective effect against externalizing disorders (Hirshfeld-Becker et al. 2003, Kerr et al. 1997). Indeed, not only does anxiety protect children from becoming delinquent adolescents (Tremblay et al. 1994), but behavioral inhibition also has been proposed to be a protective factor against the development of delinquency (Kerr et al. 1997).

FUTURE DIRECTIONS

With the approach of 20 years of study of behavioral inhibition, a number of issues present challenges to current researchers in this area. These include enhanced characterization of the early manifestations of the inhibited temperament pattern, an increased understanding of the role of cognitive processes in moderating

behavioral inhibition, and an expanded understanding of the manner in which behavioral inhibition is displayed in older children and adolescents. This latter point is critical for understanding possible mechanisms to the etiology of psychopathology among behaviorally inhibited children. Indeed, the boundary between risk and disorder may be apparent in the behavior of behaviorally inhibited older children.

The assessment of behavioral inhibition has differed for infants, young children, and older children. The infant temperament pattern has been identified by presenting novel auditory and visual stimuli to infants and selecting those infants who reflect the top 10% to 15% of the population in motor arousal and negative affect to these stimuli. Behavioral inhibition has been assessed in toddlers by observing their reactions to novel objects (e.g., a moving robot or car) or unfamiliar adults. Aggregate measures of inhibition have included wariness and avoidance of both the nonsocial novel objects and social situations. As children get older, there has been a shift in focus of the assessment, with a greater emphasis on the child's response to unfamiliar peers. Indeed, much of the work on behavioral inhibition in preschool and older children has been in situations with unfamiliar (and sometimes familiar) peers. Only one study examined the difference in response to novel social and nonsocial stimuli in young children (Rubin et al. 1997). There is a need to characterize the specific stimuli that challenge the young child and elicit behavioral inhibition reliably (Stevenson-Hinde 1989). It may be that there are different subgroups of children: some who show overall avoidance or wariness to any novel event (social or nonsocial) and others who show responses to a distinct class of stimuli. These fine distinctions will be helpful in understanding and characterizing early in life the multiple trajectories that behavioral inhibition may take over the life span.

There has been a growing recognition of the importance of the role of specific cognitive processes in the control or modulation of emotion. The interface of cognition and emotion is salient for understanding the different developmental trajectories seen with behaviorally inhibited children. For example, there is great interest in the manner in which both inhibitory control and attentional processes facilitate emotion control. Recent work by Henderson (2004) demonstrates the manner in which inhibitory control interacts with child temperament in a somewhat counterintuitive fashion. She found that behaviorally inhibited children who demonstrated heightened inhibitory control in a delay task were more likely to exhibit heightened social reticence than those inhibited children who did not demonstrate heightened inhibitory control. Because inhibitory control is often viewed as a positive facilitative process for emotion regulation, these results at first appear counter to expectations. Upon further reflection, though, they signal the manner in which certain cognitive processes may actually enhance temperamental dispositions. Future studies of the interaction of temperament and these cognitive processes will further elucidate the importance of certain individual differences in understanding social behavior.

Most of the work in behavioral inhibition has focused on young or school-age children. However, children who are avoidant of social interaction may be at risk

for social isolation during the critical years of adolescence. The consequences of this social isolation may result in increased feelings of loneliness, low self-worth, and perhaps the emergence of behavior patterns leading to psychopathology. At the moment, there are preciously few data on the role of temperament as a predictor of adolescent psychological development. Such studies would be highly informative for understanding the dramatic increase in anxiety and mood disorders found during this period of development.

Finally, the importance of understanding the role that culture plays in behavioral inhibition has become increasingly recognized. The notion that there might be differences in the distribution of certain temperaments as a function of ethnicity, or that certain cultures might hold different perceptions of these temperamental dispositions, only recently has been explored. For example, Rubin (1998) has suggested that behavioral inhibition in North American and Western European countries is different from behavioral inhibition in Chinese culture because the cultural meaning of shyness and the social responses to children with shyness differ in the two areas. Chen et al. (1995, 1999) found that inhibited behavior is related to positive adolescent adjustment, including teacher-assessed competence, academic achievement, and leadership, and that behavioral inhibition is not seen as maladaptive in China. In a related study, in which toddlers from China and Canada were observed, Chen et al. (1998) found that Chinese children were more inhibited than Canadian children. They used observational methods that focused on the child's latencies to approach novel objects and unfamiliar individuals, and durations of behaviors such as the child's proximity to his or her mother.

Differences in parenting behaviors have been used to explain some of the differences in behavioral inhibition between cultures. Parenting practices and child-rearing beliefs are important factors that may mediate cultural influences on child development (Super & Harkness 1986). Chen et al. (1998) found that in the Chinese sample, mothers' warmth and acceptance was positively associated with inhibition, and maternal rejection and punishment was negatively associated with inhibition. The opposite was found in the Canadian sample. Rubin (1998) suggests that the meaning associated with a social behavior is a function of the context where the behavior is produced. If a behavior is perceived as maladaptive in a culture, then parents will discourage its development, while encouraging the development of adaptive behaviors.

EPILOGUE

The study of behavioral inhibition in some ways is like a complex puzzle. Each of the pieces by themselves tells an interesting story, but together they provide a broad view of the phenomenon. Study of behavioral inhibition has ranged from understanding the underlying biology of the fear system, to the effects of this temperament on parenting behavior, and to research on the development of certain forms of psychopathology. Each piece of this puzzle or area related to this

phenomenon has provided rich data on the psychology of behavioral inhibition. Ultimately, however, the union of these pieces will afford the greatest explanatory power.

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