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# Mechanisms Linking Early Behavioral Inhibition to Later Social Functioning: The Role of Autobiographical Memory Biases

Laura Levin

University of Miami, llevin@psy.miami.edu

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UNIVERSITY OF MIAMI

MECHANISMS LINKING EARLY BEHAVIORAL INHIBITION TO LATER  
SOCIAL FUNCTIONING: THE ROLE OF AUTOBIOGRAPHICAL MEMORY  
BIASES

By

Laura Levin

A THESIS

Submitted to the Faculty  
of the University of Miami  
in partial fulfillment of the requirements for  
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A thesis submitted in partial fulfillment of  
the requirements for the degree of  
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Laura Levin

Approved:

---

Heather Henderson, Ph.D.  
Professor of Psychology

---

Terri A. Scandura, Ph.D.  
Dean of the Graduate School

---

Jutta Joormann, Ph.D.  
Professor of Psychology

---

Kyrsia Mossakowski, Ph.D.  
Professor of Sociology

LEVIN, LAURA  
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to Later Social Functioning: The Role of  
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This study examined the associations between behavioral inhibition in early childhood and patterns of social-emotional functioning in adolescence. As part of a larger longitudinal study on temperament and social development, adolescents who were recruited as infants completed two tasks to assess social-cognitive biases at follow-up: an information-processing task and an autobiographical memory task. The information-processing task assessed adolescents' interpretations of ambiguous situations. Next, adolescents completed an autobiographical memory task where they were exposed to both social and neutral-cued words, and recalled the first memory that came to mind. Memories were coded for specificity, affective tone, response latency, and emotional intensity. Afterwards, adolescents were also presented with a word recall task. In addition, shyness and socially anxious behaviors were observed as adolescents participated in a self-presentation speech task with an unfamiliar peer. Behavioral inhibition at age two was found to predict higher levels of observed anxious behaviors (*self-presentation anxiety*) during the peer interaction. This relation appears to be mediated by a pattern of blunted affect in response to socially-cued autobiographical memories. While the relation between temperament ratings of early behavioral inhibition and the blunted memory affect was content-specific to social-cued words, current self-presentation anxiety during the peer interaction was related to a more generalized bias

that was not content-specific. In addition to the blunted memory affect, adolescent self-presentation anxiety was associated with less affective interpretations on the story task, poorer word recall, slowed response times, decreased emotional intensity.

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## Chapter 1: Introduction

Striking differences appear, as early as the first few months of life, in the way children respond to their surroundings. For example, some infants are extremely fussy, difficult to soothe, and irritable, whereas others show high levels of activity and excitement. These initial individual differences in children's dispositional reactive tendencies broadly describe what is known as temperament. Temperament has been defined as early appearing patterns of physiological and behavioral reactivity that function to control motivated approach or withdrawal (Rothbart, 1991). Research on behavioral inhibition, one aspect of temperament, has attracted scientific attention because the relevant behaviors have a presumed biological basis, appear early in development, show a good deal of stability over time, predict variations in social and emotional functioning, and finally, are related to risk for psychopathology. The precise nature of the linkages between behavioral inhibition and later social-emotional and personality development, is however, an empirical question. The purpose of the current study is to examine the association between behavioral inhibition as assessed in early childhood and social-emotional functioning in adolescence, with an emphasis on social-cognitive factors that may affect this association.

### Behavioral Inhibition: Definition and Developmental Effects

One particularly salient aspect of temperament is variation in approach/withdrawal tendencies, which describe individuals' reactions to unfamiliar people, objects, or situations (Thomas & Chess, 1977). Variability along this dimension

is thought to reflect individual differences in susceptibility to reward and punishment in social situations (Gray, 1987). Kagan (1988) proposed that individuals falling on extreme ends of the distribution in their tendencies to avoid or approach novelty represented qualitatively distinct temperament types which he called behaviorally inhibited and uninhibited. In the face of novelty, inhibited children withdraw to the proximity of their caregivers, are shy, quiet, and timid, and consistently avoid unfamiliar people and events. Uninhibited children, by contrast, are described as sociable, talkative, and affectively spontaneous in response to the same novel stimuli (Kagan, Reznick, & Snidman, 1988).

Further research by Kagan, and by Fox and colleagues, found that behavioral inhibition could be predicted from patterns of reactivity to novel sensory stimuli, as indicated by the combination of affect and motor reactivity, that were present as early as four months of age (Calkins, Fox, & Marshall, 1996; Kagan & Snidman, 1991). Given behavioral parallels to conditioned fear reactions in animals, in which behavioral withdrawal has been linked to heightened fear response and amygdala excitability (Davis, 1992; LeDoux, 1996), Kagan (1994) hypothesized that inhibited individuals have lower thresholds for arousal in limbic-hypothalamic circuits. In support of this hypothesis, several researchers have found that when inhibited children encounter actual or perceived stress, there is an increase in heart rate, cortisol, right frontal EEG activity, startle eyeblink electromyographic (EMG) response (Schmidt & Fox, 1998), cooling of the index fingers (attributable to sympathetic constriction of anastomoses), papillary dilation, and norepinephrine levels (Kagan et al., 1988; Kagan, Snidman, & Arcus, 1995; Kagan et al., 1994; Snidman, Kagan, Riordan, & Shannon, 1995). Together these reactions imply

liable sympathetic and parasympathetic nervous systems. Functionally, increased reactivity and vigilance to novelty would have important implications for the way in which these individuals orient and process information in the social world. Specifically, over time, biases in information processing may place these individuals at risk for social anxiety and avoidance (Derryberry & Rothbart, 1997; Fox, Henderson, Marshall, Nichols, & Ghera, 2005).

Longitudinal studies demonstrate that behavioral inhibition shows a good deal of stability over time; infants high on negative reactivity were more likely to display behavioral inhibition as toddlers (Calkins et al., 1996; Rubin et al., 1997) and exhibit social reticence as preschoolers (Fox, Henderson, Rubin, Calkins, & Schmidt, 2001), and were observed to be more cautious, subdued, and socially avoidant in a variety of unfamiliar contexts at age seven (Kagan, Snidman, Zentner, & Peterson, 1999). In Kagan's studies, children who continued to display this shy behavioral profile into middle childhood were classified by parent questionnaire as possessing higher rates of anxious symptoms. By adolescence, approximately a third of children classified as behaviorally inhibited in earlier years were judged by psychiatrists to be clinically impaired by generalized social anxiety, and were also observed in the laboratory to make fewer spontaneous comments to the examiner (Schwartz, Snidman, & Kagan, 1999). Similar patterns of linkage between early temperament and later development have been demonstrated by parent and teacher reports of childhood shyness in the Australian Temperament Project (ATP; Prior, Smart, Sanson, & Oberklaid, 2000). Specifically, children with shy temperaments, especially those who were persistently assessed as shy between infancy and middle childhood, had a higher incidence of later anxiety problems

in adolescence. In the Dunedin Longitudinal study, inhibited children who were observed as shy and fearful at age 3 were studied over a longer period. Caspi and colleagues (1995) found that children at age 3 who were shy and fearful (inhibited) were lacking in social potency at age 18 (characterized as overcontrolled, cautious, and nonassertive). At age 21, these individuals had more introverted personality styles—reporting fewer desires for leadership roles, a lack of interest and engagement in the social world, and fewer sources of social support, and were described by others as less affectionate, less confident, less popular, and less affiliative (Caspi, 2000). Although children classified as inhibited at age 3 were not found to be at risk for anxiety at age 21, they were more likely to be depressed (Caspi, 2000). These studies, taken together, suggest potential links between approach/withdrawal tendencies in early childhood and later social-emotional functioning and personality development.

Although the consistency of these associations between early temperament and later adjustment across studies is striking, it is important to note that the magnitude of association within each study is modest at best. For example, Fox and colleagues (2001) found that not all infants classified as highly reactive in early infancy went on to display high levels of shyness later on, implying a degree of openness, or discontinuity, exists. Similarly, although persistently high levels of inhibited behavioral style may foreshadow anxiety problems later on, most inhibited children will not develop a profile serious enough to be characterized as a clinically significant anxiety disorder (Kagan, 1998). In addition, not all studies have related this temperamentally inhibited profile to later anxiety (e.g., Caspi, Moffitt, Newman, & Silva, 1996). As such, it is important to

understand intervening factors that may serve as risk or protective factors for behaviorally inhibited children.

### Social-Cognitive Processing Biases

Our interest is in social-cognitive processes that may link early patterns of temperamental reactivity to later functioning. We believe temperament biases attention and influences the way individuals perceive, process, store, and retrieve information about their social worlds. Over time, biases toward processing social information as threatening may (1) result in individuals forming biased interpretations of social information and (2) facilitate memory storage for negative social events. In the current study, we suggest that early behavioral inhibition may contribute to biased social information processing and memory biases, and these biases may in turn leave these individuals vulnerable to the development of social anxiety. This theoretical model is depicted in Figure 1.

#### *Temperament, Personality, and Social Information Processing Biases*

It has been suggested that the exaggerated amygdala fear response (seen in behaviorally inhibited children) may predispose these children to develop cognitive working models to expect fear and anxiety when facing novelty (Rubin & Burgess, 2001). Consistent findings of temperamental biases of enhanced attention toward threat or negative information have been proposed to influence more elaborative processes such as the way individuals respond and interpret events (Derryberry & Reed, 1996). For example, in their review article, Daleiden and Vasey (1997) speculate that even minor threat cues may readily trigger subsequent processing and consequently anxiety

responding. Evidence of such threat perception bias in anxious children was provided by Muris and colleagues (2000). In that study, normal children ranging in levels of anxiety were exposed to stories which reflected potentially anxiety provoking situations. They were told that some of these stories were not scary, i.e., these stories would have a happy end. Children were instructed to find out as quickly as possible whether the pertinent story was scary or not. Results indicated that children with higher levels of anxiety, as measured by the trait version of the *State-Trait Anxiety Inventory for Children* (STAIC; Spielberger, Edwards, & Lushene, 1973), needed to hear fewer sentences before deciding a story to be threatening compared to children with low levels of anxiety. The authors further showed that high trait anxious children more frequently perceived threat while listening to the stories, more often interpreted the stories as threatening, and displayed higher levels of negative feelings and cognitions in relation to these stories than children with lower levels of anxiety. Thus, as these and other authors suggest (e.g., Daleiden & Vasey, 1997), the tendency to be more acutely vigilant for signals of potential threat may leave trait anxious children to quickly move through the interpretation stage and conclude that the situation is dangerous even though a search for further information would show it is not. According to Daleiden and Vasey (1997), such a tendency to quickly jump to the conclusion that situations are dangerous and to cease searching for additional information before making a judgment may foster the tendency to interpret ambiguous situations as threatening.

Support for the existence of interpretation bias in non-clinically anxious children comes from a study by Hadwin, Frost, French, and Richards (1997), where children low or high on trait anxiety were confronted with ambiguous homophones that had either a

neutral of a threatening interpretations (e.g. dye versus die). High levels of trait anxiety were found to be positively related to threatening interpretations of homophones.

Research in adults with high trait anxiety also show a processing bias with respect to interpreting ambiguous stimuli, such that if ambiguous stimuli have both a threatening and neutral meaning, then trait-anxious adults tend to choose the threatening interpretations (Eysenck, Mogg, Ma, Richards, & Mathews, 1991). Importantly, these interpretive biases have been found to pertain specifically to interpersonal events in socially anxious individuals. For example, in a study of non-clinical socially anxious college students, Constans and colleagues (1999) found that individuals with high compared to low levels of socially anxiety gave more threatening and less positive interpretations of ambiguous interpersonal events, but not of non-interpersonal events.

The tendency to focus primarily on threatening information has also been suggested to impair the ability to utilize and to learn about available coping resources, and may interfere with the processing of contextual or other information that is important for dealing with the situation at hand (Daleiden & Vasey, 1997; Derryberry & Reed, 1996). Indeed, socially withdrawn/shy children are less able to understand perspectives of others in early childhood (LeMare & Rubin, 1987), and in middle childhood, are more likely to endorse avoidant coping strategies than controls in situations involving unfamiliar peers (Burgess, Wojslawowitz, Rubin, Rose-Krasnor, & Booth-LaForce, 2006). Further, Olah, Torestad and Magnusson (1989) found trait anxiety in adolescents was significantly positively associated with escape coping and negatively associated with constructive coping. In similar research with adults, trait anxiety has been related to a

preference for avoiding problem-solving activities, poor problem-solving confidence, and little perceived control (Davey, 1994).

Furthermore, the allocation of attentional resources to processing threat cues have been suggested to prevent the matching of responses to situational factors, thus leading anxious children to select responses based on their emotional states or the operation of threat schemas rather than on specific situational determinants (Daleiden & Vasey, 1997). In support of this idea, non-clinical anxious children have been found to be more likely to interpret nonhostile peer interaction situations as hostile compared with nonanxious children in a social cue interpretation task (Bell-Dolan, 1995). Likewise, a series of studies by Fox, Houston and colleagues found that trait anxious children responded to a math test with greater preoccupation with negative aspects of the task, more negative cognitions regarding their performance, and a less analytic attitude toward the situation (Fox, Houston, & Pittner, 1983; Houston, Fox, & Forbes, 1984). In addition, college students high on social anxiety overestimate the extent to which their vulnerabilities are apparent to others (Ashbaugh, Antony, McCabe, Schmidt, & Swinson, 2005).

In sum, available data indicate that the cognitive processing of trait anxious individuals is characterized by a variety of interpretation biases and restricted coping responses. The presence of such biases early on are congruent with the idea that initial reaction tendencies (temperament) may bring about biased information processing, and this biased information processing may facilitate encoding of social information as threatening. Biased perceptions of social situations may in turn influence how individuals engage in future social situations, thus contributing to further emotional and social development.

### *Social Information Processing Biases and Social Anxiety*

Social information processing biases have also been proposed to play a causal role in the maintenance of anxiety symptoms (Eysenck, 1992; Mathews & MacLeod, 2002). A good deal of research indicates interpretive biases in clinically anxious individuals as well. For instance, children with clinically significant levels of anxiety are more likely to adopt a threatening interpretation of ambiguous social scenarios, and express more avoidant plans, perceive themselves as less influential, or underestimate their own competencies (Barrett, Rapee, Dadds, & Ryan, 1996; Bogels & Zigterman, 2000; Chorpita, Albano, & Barlow, 1996). Individuals with social phobia are also more likely to rate their own performance as overly negative (Rapee & Lim, 1992). Anxiety disordered children have also been found to show more negative social expectations, lower social self-competence, and higher social anxiety than controls in anticipation of joining a group of unfamiliar peers (Chansky & Kendall, 1997). Altogether, these findings of biased interpretations of social or otherwise threatening events may have important implications for our understanding of the mechanisms underlying the later development of social anxiety symptoms. Therefore, one of the primary goals of the current study is to examine the association between behavioral inhibition in childhood, social information processing biases, and displays of socially anxious behaviors during an interaction with an unfamiliar peer in adolescence.

### *Memory Biases*

The consistent tendency for threat-related cues to selectively capture the

attentional resources in anxious and introverted individuals has led some researchers (e.g., Mathews, Mogg, May, & Eysenck, 1989; Reed & Derryberry, 1995) to hypothesize corresponding differences in the way that information concerning danger is represented in memory. Specifically, cognitive models imply that anxious individuals selectively recall negative anxiety-relevant self-relevant information as a result of negatively biased dispositions (Mueller & Courtois, 1980a). However, data on memory biases in anxious individuals has yielded mixed results across a variety of tasks (see Coles & Heimberg, 2002, for review). Some studies have found that anxious individuals recall more self-descriptive unlikable trait words (especially those with anxiety content) than nonanxious controls (e.g., Claeys, 1989; Greenberg & Beck, 1989; McNally, Foa, & Donnell, 1989; O'Banion & Arkowitz, 1977), whereas other studies found no recall biases (e.g., Foa, McNally, & Murdock, 1989; Greenberg, Vazquez, & Alloy, 1988; Sanz, 1996). These contradictory findings may be an artifact of variability in the nature of the encoding task, the retrieval task, and the stimuli (Coles & Heimberg, 2002). For example, word recall tasks in of themselves may not adequately tap into specific domains of concerns for individuals, and may instead encourage shallow processing during encoding. That is, single word retrieval tasks may fail to encourage elaborative interpretation of information. Also, memory for specific traits may depend on the specific meaning that these traits have for an individual.

In line with this idea is evidence of recall biases in socially anxious individuals under conditions of social evaluative threat (e.g., Breck & Smith, 1983; Mansell & Clark, 1999). For example, in a study examining memory biases in a sample of socially anxious individuals, Mansell and Clark (1999) found that socially anxious individuals recalled

fewer positive public self-referent words (i.e., information about how they think they are viewed by others) than neutral words (rather than more negative words), but only when anticipating evaluative situations (i.e., giving a speech). These findings suggest that memory recall bias in socially anxious individual may depend on the activation of relevant stressor, such as events congruent with the specific trait of anxiety. These and other findings highlight the importance of investigating more elaborative or self-relevant forms of memory storage, such as autobiographical memories. Unlike word recall tasks, autobiographical memory task promote self-referential encoding.

*Temperament, Personality and Autobiographical Memories.*

Autobiographical memories are recollections of one's personal experiences that can be placed in a specific time and location (Rubin, 1982). Three commonly studied aspects of autobiographical memory are the specificity and affective valence of the memory, and the latency to retrieve the memory. *Specificity* refers to the extent to which memories can be placed in a particular time and location. When seeking an autobiographical memory, individuals typically move from a general abstract level to more specific (Blagov & Singer, 2004). *Affective valence* describes the affective tone of the memory as positive, negative, or neutral. Finally, *retrieval latency* reflects the time required by individuals to generate an autobiographical memory.

Compared to memories for factual information and nonpersonal events, autobiographical memories tend to be more self-relevant or elaborated, emotionally salient, and often take place in the social-context (Fivush, 1998; Thorne, 1995). In this way, personality researchers have deemed autobiographical memories as central in linking temperament and personality, and suggest autobiographical memories reveal core

patterns that may serve as internalized working models that summarize goals and expectations for social interactions (Neisser, 1988; Singer & Salovey, 1993; Thorne, 1995). For example, research has linked aspects of personality, such as the desire to affiliate with others, to the content and themes of autobiographical memories, such that individuals show a tendency to recall autobiographical memories congruent with their self-reported personality features (Woike, 1995; Woike, Gershkovich, Piorkowski, & Polo, 1999). Similarly, Moffitt and Singer (1994) found that participants who endorsed more avoidant personality features generated autobiographical memories with greater relevance to their avoidant tendencies. Additionally, participants with higher percentages of avoidance tendencies also recalled less positive memories (Moffitt & Singer, 1994). Autobiographical memory content and affect have also been meaningfully related to aspects of personality, and overall personal adjustment. Blagov and Singer (2004) found that poorer social-emotional competence, as measured by Weinberg Adjustment Inventory index of high and low (but not moderate) levels of Self-restraint, predicted a pattern of less integrative autobiographical memories—a variable which reflects the ability for people to cope with or regulate negative emotions. Autobiographical memories of threatening content were also found to predict higher levels of emotional distress (Blagov & Singer, 2004). Such findings support the idea that motives and goals influence how personal experiences are remembered and stored in long-term memory (e.g., Singer & Salovey, 1993). These findings also speak to the idea that autobiographical memories are affectively charged reconstructions of past events that have the power to influence our rational understanding of past experiences, bias ongoing processing of information, and intensify the importance of events that bear similarities to

the situations recollected in these memories (Singer & Blagov, 2004).

Adolescence is a time period when autobiographical memories are considered to be particularly self-defining and hence significant for the development and formation of personality. This idea is based on the widely noted cognitive phenomenon in which individuals older than 35 years show a relative overrepresentation of memories for the time period from adolescence to early adulthood, as indicated by the *reminiscence bump* (Neisser & Winograd, 1988; Rubin, Wetzler, & Nebes, 1986). This phenomenon has been attributed to the significance of events occurring during adolescence in terms of social development and self-concept development, with important implications for personality (Conway, Rubin, Spinnler, & Wagenaar, 1992; Fitzgerald, 1988). Conway and Pleydell-Pearce (2000) also suggest that better recognition of adolescent memories is critically related to the individual's first consolidation of a sense of identity. The connection of particular memories from the reminiscence bump period to the origins of a more preserved sense of identity formation may give these memories a special prominence and enduring affective power, which may reveal repetitive affective patterns and themes that stamp adolescents' most important concerns and unresolved issues (Singer & Salovey, 1993; Singer & Blagov, 2004). Importantly, the essential elements of personality may be contained within the simple memories from childhood and adolescence.

*Autobiographical Memories in Social Anxiety.*

To date, only a few studies have investigated autobiographical memory distortions in socially anxious individuals using cued threatening words (e.g., words pertaining to social events). Wenzel, Jackson, and Holts (2002) found social phobic

adults retrieved more memories with negative affect for social threat (e.g., conversation, speech) but not neutral (e.g., combination, glass) words compared to non-anxious participants. However, there were no group differences in the degree of specificity of the content of either social or neutral cued memories (Wenzel et al., 2002). In another study, Rappe and colleagues (1994) failed to find evidence for biased autobiographical recall for social threat words in social phobic adults. More recently, Wenzel and colleagues (2004) failed to find differences between anxious and nonanxious college students in the specificity or affect of autobiographical memories to social or neutral cued words. However, nonanxious individuals retrieved a greater number of memories characterized by negative affect and specificity when cued by social threat words, whereas the affective valence and specificity of memories retrieved to social and neutral cue words did not differ for social phobic participants (Wenzel et al., 2004). Although this was in contrast to earlier findings, the authors suggested that individuals with social phobia may have avoided sharing past negative experiences in social situations due to the negative feelings related to these memories (e.g., embarrassment, discomfort, anxiety). According to the authors, such a response bias could have masked exaggerated verbal recall of negative social experiences that were otherwise particularly salient for them. Results have been equally mixed for latencies to retrieve autobiographical memories in anxious individuals, where anxious individuals have sometimes, but not always, been found to retrieve anxiety related memories faster than non-anxious individuals (Burke & Mathews, 1992; Levy & Mineka, 1998; Richards & Whittaker, 1990). Overall, the evidence for autobiographical and recall memory biases in socially anxious individuals allude to the possibility that different patterns of recall may exist, although the nature of these differences remains

unclear. The possibility that memory biases depend on the activation of self-relevant and specific trait anxiety-provoking stimulus requires further investigation.

### Summary

In summary, the goal of this study was to examine the relations among behavioral inhibition and shyness in childhood, biases in social information-processing and autobiographical memory, and social anxiety as assessed in adolescence. The behaviorally inhibited temperament type is of interest for two reasons: First, temperamentally inhibited children show at least some stability but also instability over development. Studying this group across development will therefore enable a closer examination of mechanisms underlying both continuity and change and help understand how temperament contributes to the development of more elaborate ways of thinking and personality in adolescents. Second, behavioral inhibition shares many patterns characteristic of certain anxiety, mood, and personality disorders. Not surprisingly, behavioral inhibition has been linked to increased risk to social anxiety and psychopathology in both childhood (Biederman et al., 1990; Hirshfeld et al., 1992) and adolescence (Biederman et al., 2001; Schwartz et al., 1999), and is predictive of social difficulties in later life. Behaviorally inhibited children are also at greater risk for multiple anxiety disorders (Biederman et al., 1990; Biederman et al., 1993). Studying individual differences in the long term consequences of this temperament group may therefore be critical for understanding the etiology of psychopathology among behaviorally inhibited children. We propose social information-processing and autobiographical memories may act as a social-cognitive mechanism by which

temperament characteristics may be linked with social and emotional outcomes and the development of personality later on.

### *Hypotheses*

- 1) Behavioral inhibition in early childhood will be associated with more threatening interpretations to ambiguous social stories. Specifically, when provided with ambiguous social scenarios, behavioral inhibition will be associated with an overestimation of danger/perceived threat, increased negative affect, and lower perceived control/estimations of their own competency to cope with danger.
- 2) Behavioral inhibition will be associated with an autobiographical memory pattern of increased specificity and negative affect, and decreased latencies to generate memories when confronted with words of social content, but not neutral words. In addition, we expect behavioral inhibition to be associated with enhanced recall of words of social content on a word recall task, as compared to neutral words.
- 3) Enhanced threatening interpretations (i.e., overestimation of danger, increased negative affect, and lower perceived control) to ambiguous social stories are expected to be associated with more anxious behavior during the self-presentation speech task in adolescence.
- 4) Biased autobiographical memories (of increased specificity and negative affect and decreased latencies) as well as enhanced free recall for social cued words will be associated with more anxious behavior during the self-presentation speech task in adolescence.

5) A final goal of this study is to explore the role of social-cognitive processing biases (toward interpreting ambiguous social stories as threatening and memory biases for social words) in mediating and/or moderating the association between behavioral inhibition and observed anxiety in adolescence. Two models will be tested:

- a. We hypothesize that social cognitive biases will partially mediate the relation between behavioral inhibition early on and observed anxiety in adolescents.
- b. We hypothesize that social cognitive biases will moderate the relation between behavioral inhibition early on and observed anxiety in adolescents. Specifically, it is hypothesized that behavioral inhibition early on, when combined with social-cognitive processing biases, will increase the risk for anxiety in adolescence.

## Chapter II: Methods

### Participants

Adolescents were drawn from a cohort participating in a longitudinal study of temperament and social development. Of the 153 adolescents followed longitudinally, 111 participants had complete data on the measures of interest in the current study. Adolescents were Caucasian (51 males, 60 females) from middle to upper middle class homes. The age range was 13 to 17 years, mean age was 14.7. These individuals were initially selected based on extreme patterns of motoric and affective reactivity to novel sensory stimuli at 4-months of age. Infants were classified as high on motor activity and negative affect (High Negative), high on motor activity and positive affect (High Positive), or low on motor activity and affect (Low Reactive). Further details of the 4-month screening procedure and subsequent behavioral assessments have been described elsewhere (Calkins et al., 1996; N. A. Fox et al., 2001).

### *Temperament Assessment*

The behavioral inhibition measures in the current study included a composite of laboratory observations and maternal ratings of social fear from the Toddler Behavioral Assessment Questionnaire (TBAQ) (Goldsmith, 1996) collected at 24 months of age. At 24 months, the infant's reactions to unfamiliar stimuli in the laboratory were coded to provide an index of behavioral inhibition. The unfamiliar stimuli consisted of an unfamiliar room/environment, an adult stranger, a novel toy/object, and an adult stranger dressed in a clown costume, and the child's willingness to crawl through an inflatable tunnel. The index of behavior inhibition at 24 months was based on: (1) time spent in proximity to mother during free-play, (2) time spent in proximity to mother during the

robot episode, (3) time spent in proximity to mother during the truck episode, (4) time spent in proximity to mother during the tunnel episode, (5) latency to approach the stranger and/or touch the truck, (6) latency to approach and/or touch the robot, and (7) latency to pass through the tunnel.

#### Procedures at Adolescent Visit

As part of a larger follow up assessment in adolescence, two aspects of social cognition were assessed: (1) Memories for neutral versus social prompts, and (2) social cognitive biases in the interpretation and feelings of competence for coping with potentially anxiety provoking situations. In addition, social anxiety was assessed in by observing adolescents in a dyadic interaction with control participants.

#### Measures

##### *Autobiographical Memory Task*

Participants were presented with 30 words (15 neutral and 15 social threat), which were drawn from words used in past research (see Perez-Edgar & Fox, 2005; Wenzel et al., 2002). Words were presented individually on flash cards (12.5 x 7.5 cm.) in random order. Participants were told to recall the first personal, specific autobiographical memory for each word presented on the card. They were asked to describe the memory as soon as it came to mind. Memories were recorded on videotape. Recall latency was recorded from the time the stimulus card was presented until the first memory was generated. Memories were recorded regardless of whether a specific or general memory was retrieved, instead of requiring participants to generate a specific memory. If subjects were unable to retrieve a memory, a time of 60 seconds was recorded. Before presenting the target words, participants completed two practice trials for neutral words. After all 30

words were presented, participants were asked to rate on a 5-point scale how they had felt during the recalled event (happy, sad, angry, scared, and nothing at all) from 0 (none) to 4 (extremely). Participants were also asked to rate how intensely they felt that emotion 0 (slightly) to 3 (extremely). Approximately ten-minutes following completion of this task participants were asked to perform an incidental free recall task of the original cue words, listing as many of the 30 target words as possible.

### Coding

Memories were transcribed and coded by two independent raters. Memory content was categorized as either general or specific. Specific memories are defined as memories that refer to a discrete event that occurred during a period of time no longer than one day. A memory was categorized as general if it had one of the following attributes: An event that took place over more than one day (e.g., “Last summer we went on a trip to Europe”); a recurrent event (“Every year we go to the spring festival”); not enough information available to discern that the person was referring to a discrete event (e.g., “learning about the industrial revolution in history class”); a word association; a non memory (e.g., “the conversation we’re having right now”). In the event that multiple discrete memories are generated for a single word, the specific memory most pertinent to the word was coded.

In addition, memories were coded for affect by independent raters in one of five categories. Ratings of positive affect or negative affect were assigned when participants made specific reference to an emotion associated with these constructs. Ratings of positive tone and negative tone were given when participants made no specific reference to a descriptor of positive or negative affect, but they clearly described an experience that

most people would regard as positive or negative. Responses that have no discernable valence were given neutral ratings. Inter-rater reliability, based on 25% of the sample, was 92.5% for specificity and 85.8% for affect. Discrepancies on cases coded by two individuals were resolved by consensus.

Proportion scores were derived for (1) specificity, (2) each category of rated affect (positive affect, positive tone, neutral, negative tone, and negative affect), and (3) self-reported affect (happy, sad, angry, scared, and nothing at all) separately for social versus neutral cued words. Mean latency to generate memory and intensity of self-reported affect scores were computed for social versus neutral words. In addition, recall scores were computed on the proportion of words recalled correctly for social versus neutral cued words.

#### *Social Information Processing Task*

Adolescents listened to nine stories describing ambiguous situations across three separate domains: social situations (e.g., inviting peers to a birthday party), separations situations (e.g., losing sight of a parent in a department store), and generalized anxiety (e.g., failing to follow instructions to bake a cake) (see Bogels & Zigterman, 2000). The stories were presented in a fixed order with story themes alternating between social, separation, and generalized anxiety. Male and female versions were developed in order to maximize identification. Stories were read aloud by a research assistant, and the adolescents were instructed to imagine that the event described in the story happened to them. After each story, children were asked an open-ended question (“What would you do if you were in this situation?”). Open responses were videotaped and transcribed afterwards.

Next, adolescents were asked a series of closed-ended questions to assess their affective reactions (“How would you feel if you were in this situation?”), evaluations (“What do you think of this situation?”), and strategies for dealing with the situations (“How would you deal with the situation?”). Affective reactions were rated by choosing one of the following seven emotions they would expect to feel: fear, shyness, excited, calm, relaxed, loneliness, worry. Evaluations of the situation were rated by selecting from one of five responses: dangerous, frightening, unpleasant, harmless, interested. Adolescents were asked to choose from the following coping responses to assess strategies for dealing with the situation: helplessness, knowing what to do, being able to influence the situation.

#### Coding:

The open-responses were first rated according to valence (positive, negative, or neutral). Negative statements were further classified into one of eight categories describing cognitive biases previously associated with various symptoms of anxiety (e.g., Beck, Emery, & Greenber, 1985). These categories are (1) overestimation of danger of being left alone, (2) underestimation of independent functioning, (3) overestimation of criticism and rejection, (4) underestimation of own competence concerning social behavior, (5) overestimation of own responsibility and guilt, (6) overestimation of dangers concerning own health, physical integrity, (7) underestimation of own competence (with regard to nonsocial performance), and (8) other negative cognitions. Two raters were trained to rate the adolescents’ cognitions according to this system. Inter-rater reliability for valence and categories were both high: Raters agreed on 96.9% of the 616 cognitions rated for reliabilities. Of the 206 negative cognitions rated for

reliabilities, raters agreed in 83.9 % about the specific category. Disagreements between coders were resolved by consensus.

#### *Social Interaction with an Unfamiliar Peer*

Anxiety/shyness was assessed during a Self-Presentation Speech Task. Each target adolescent was asked to give a five-minute speech about themselves to a gender- and age-matched unfamiliar peer who had been recruited specifically for this task and screened with the CBCL (only children with T-scores in the normal range for internalizing, externalizing, and total problems were recruited). The adolescents were provided with sample topics (e.g., friends, family, hobbies, school) and given two-minutes to prepare. Speeches were videotaped for later coding.

#### Coding:

Behavioral markers of anxiety and shyness were derived on the basis of a review of behavioral assessment research and selected in combination with the constraints of the task (e.g., blushing could not be reliably coded from videotapes). The behaviors coded are similar to those reported by both Cheek and Buss (1981) and Asendorf (1989). Independent observers rated children on a Likert scale for loudness and clarity of voice, eye contact, friendliness (e.g., openness, enthusiasm, interest in the interaction, affect and facial expressions), speech content (e.g., breadth and depth of topic coverage relevant to the task demands), and nervousness/anxiety (e.g., fidgeting, tapping, or other extraneous movement; lip biting; hair twirling; nail biting; uncomfortable facial expressions; nervous laughter; comments about feeling awkward, weird or uncomfortable; reliance on RA) from 1 (not at all) to 4 (extremely). In addition, latencies were recorded to derive a score

for total duration of silence. Kappa coefficients ranged from .81 to .90. Disagreements between pairs of coders were resolved by consensus.

### Hypothesis Testing

#### *Hypothesis 1: Behavioral inhibition and social information processing*

Correlational analyses will be used to examine the association between behavioral inhibition and threat-related response to social stories.

#### *Hypothesis 2: Behavioral inhibition and memory recall*

Correlation analyses will be performed to examine the association between behavioral inhibition and memory specificity, affect, response latency, and word recall scores for both social and neutral words.

#### *Hypothesis 3: Social information processing biases and adolescent social anxiety*

The composite measures of observed social anxiety (derived from PCA) will be correlated with social story composite variables.

#### *Hypothesis 4: Memory biases and adolescent social anxiety*

Correlation analyses will be carried out to examine the association between observed social anxiety in adolescence and memory specificity, affect, response latency, and word recall scores for both social and neutral words.

#### *Hypothesis 5: Moderation*

In order to examine the moderating role of social cognitive biases in the prediction of social anxiety in adolescents from earlier behavioral inhibition, two separate hierarchical regression analyses will be conducted with variables entered in the following order: (1) behavioral inhibition, (2) information-processing biases or memory biases, and

(3) interaction between behavioral inhibition and information-processing biases, as well as behavioral inhibition and memory biases. With this approach, it will be possible to determine whether the association between BI and SA is conditional on presence of certain social cognitive biases. The predictor variables will be centered prior to conducting regression analyses.

*Hypothesis 5: Mediation*

A series of linear regressions will be used to test whether social cognitive biases mediate the relationship between behavioral inhibition in early childhood and social anxiety in adolescence. First, social cognitive biases will be regressed on behavioral inhibition, to test whether behavioral inhibition predicts social cognitive biases. Second, social anxiety will be regressed on behavioral inhibition. Third, social anxiety will be regressed on both behavioral inhibition and social cognitive biases. Separate coefficients for each equation will be estimated and tested to determine whether the social cognitive biases affect social anxiety, and whether the effect of behavioral inhibition on social anxiety is reduced when the mediator is controlled.

## Chapter III: Results

### Data Reduction and Preliminary Analysis

#### *Behavioral Inhibition*

Laboratory assessments and maternal reports of social fear at 24 months were correlated ( $r(98) = .44, p < .001$ ). Therefore, a composite measure of behavioral inhibition at 24 months was derived by averaging standardized scores of 24-month observed inhibition and maternal reports of Social Fear on the Toddler Behavioral Assessment Questionnaire (TBAQ). Standardized scores on this aggregate measure ranged from -1.84 to 2.26 ( $M = .06, SD = .87$ ), with higher scores indicating more behavioral inhibition.

#### *Autobiographical Memories*

Means and standard deviations of all memory variables are presented in Table 1 as a function of cue-type. Social words elicited significantly more specific memories ( $t(102) = -10.55, p < .001$ ) and more emotionally intense memories ( $t(102) = -3.22, p < .01$ ) compared to neutral-cued words, suggesting that social information is processed more deeply and elaborately compared to neutral information in adolescents. In addition, significant differences in affective valence (both coded and self-reported) all favored greater affect, both negative and positive, for social- than neutral-cued words, indicating that social words are tapping into more emotionally salient information than neutral words. Overall differences in cue-type suggest that social words captured a deeper level of processing than neutral words.

Correlation analyses were performed to reduce the number of affect memory variables used for hypothesis testing. Three composite variables for affective content

were computed for each word type: (1) *positive memory affect*, (2) *negative memory affect*, and (3) *total affective valence*. The value for the *positive memory affect* composite was computed by adding standardized scores of self-reported Happy, Positive Affect ratings, and Positive Tone ratings. The *positive memory affect* composite scores ranged from -1.40 to 1.90 ( $M = .07$ ,  $SD = .70$ ) for social words and from -1.20 to 2.22 ( $M = .06$ ,  $SD = .76$ ) for neutral words. The *negative memory affect* composite was computed by adding standardized scores of self-reported negative emotions (Sad, Angry, and Scared), Negative Affect ratings, and Negative Tone ratings. The *negative memory affect* composite scores ranged from -.93 to 1.86 ( $M = .00$ ,  $SD = .60$ ) for social words and from -.88 to 2.16 ( $M = .03$ ,  $SD = .69$ ) for neutral words. Finally, a *total affective* composite was compiled by taking the difference score between the sum of the *positive memory affect* composite and *negative affect memory* composite and the sum of standardized scores of Neutral Affect ratings and self-reported Nothing (i.e.,  $(positive\ affect + negative\ affect) - neutral\ affect$ ). This composite was derived to reflect the tendency to generate emotionally laden memories, in light of a significant positive correlations between positive and negative memory affect for both Social- and Neutral cued words, ( $r(110) = .27$ ,  $p = .004$ ;  $r(110) = .43$ ,  $p < .001$ ), and their inverse correlation with neutral memory affect (positive memory affect:  $r(111) = -.70$ ,  $p < .001$  and  $r(111) = -.70$ ,  $p < .001$ ; negative memory affect:  $r(111) = -.56$ ,  $p < .001$  and  $r(111) = -.65$ ,  $p < .001$ ). The *total affective* composite scores ranged from -2.09 to 2.60 ( $M = .02$ ,  $SD = .99$ ) for social words and from -1.65 to 2.81 ( $M = .01$ ,  $SD = 1.00$ ) for neutral words. Higher scores on this composite indicate more affective memories.

### *Social Stories*

Three stories were excluded due restricted range of response categories. For the six remaining stories (2 social, 2 separation, 2 general anxiety), responses to closed questions were reduced in the following way. A *negative affective reaction* score was derived by summing the number of negative affective reactions (fear, loneliness, shyness, worry) across the six stories. The *negative affective reaction* composite ranged from 0 to 6 ( $M = 3.95$ ,  $SD = 1.48$ ). A *perceived danger* score was derived by summing the number of negative evaluations (dangerous, frightening, unpleasant) across the six stories. The *perceived danger* composite ranged from 0 to 6 ( $M = 3.12$ ,  $SD = 1.43$ ). Finally, a *perceived helplessness* composite was derived by summing the number of Helpless responses across the six stories. The *perceived helplessness* composite ranged from 0 to 4 ( $M = 0.90$ ,  $SD = 0.88$ ).

For open-responses, positive coded responses were summed across the stories to create a *positive valence* composite ( $M = 0.47$ ,  $SD = 0.76$ ; range = 0 to 4). Negative coded responses were summed across the stories to create a *negative valence* composite ( $M = 2.47$ ,  $SD = 1.78$ ; range = 0 to 6). Neutral coded responses were summed across the stories to create a *neutral valence* composite ( $M = 4.03$ ,  $SD = 2.06$ ; range = 0 to 6). The means and standard deviations for the story variables are presented in Table 2.

### *Data Reduction: Self-Presentation Speech Task*

The 6 coded behaviors were intercorrelated with Pearson's correlations ranging from 0.19 to 0.72. Inverse scores were taken for four of the coded speech variables (loudness and clarity of voice, eye contact, friendliness, and content), so that higher scores corresponded to more socially anxious behaviors. All correlations were

significantly positively correlated at  $p < .001$ , with the exception of one variable (loudness and clarity), which fell short of significance and was not included in further analyses.

In order to reduce the number of dependent variables, principal components analyses was computed for the 5 coded speech behaviors. We followed standard factor-analytic procedures, first entering the variables into a principal components analysis, specifying eigenvalues  $\geq 1$  (Kaiser's criteria), and using the scree plot and percent variance accounted for to determine the number of factors. The results justified a single factor solution of *self-presentation anxiety* which accounted for 65.84% of the variance (eigenvalue = 3.29). Scores on this factor ranged from -1.64 to 2.24 ( $M = 0$ ,  $SD = 1.00$ ). All five items loaded strongly on this one factor (eye-contact = .79, nervousness = .79, friendliness = .78, content = .79, duration of silence = .86).

### Hypothesis Testing

#### *Behavioral inhibition and self-presentation anxiety*

The association between behavioral inhibition in early childhood and self-presentation anxiety in adolescence was first examined. There was a significant correlation between behavioral inhibition in childhood and self-presentation anxiety in adolescence ( $r(109) = .20$ ,  $p < .05$ ). Higher levels of behavioral inhibition at age two were associated with higher levels of self-presentation anxiety in the dyadic interaction in adolescence.

*Behavioral inhibition and social information processing*

Correlation analyses were performed to examine the associations between behavioral inhibition at age two and responses to ambiguous stories, including negative affective reactions, perceived danger, perceived helplessness, and negative, positive, or neutral coded valences on open responses (Table 3). No significant associations were found.

*Behavioral inhibition and autobiographical memories*

Correlation analyses were performed to examine the associations between behavioral inhibition at age 2 and autobiographical memories in adolescence, including memory affect composites, specificity, response latency, and word recall scores for both social and neutral words (Table 4). Behavioral inhibition was inversely correlated with *positive memory affect* ( $r(102) = -.20, p < .05$ ) and *total memory affect* ( $r(102) = -.20, p < .05$ ), for social but not neutral words ( $r(102) = -.08, ns$ ;  $r(102) = -.13, ns$ ), indicating that participants higher in behavioral inhibition as toddlers recalled fewer positive memories and fewer overall affective memories for social words as adolescents. No other correlations reached significance.

*Concurrent associations between social information processing biases and self-presentation anxiety*

Correlation analyses were performed to examine the concurrent associations between self-presentation anxiety and story responses, including negative emotions, perceived danger, and perceived control on closed-responses and rated valence (positive, negative, or neutral) on open-ended response (see Table 3). Self-presentation anxiety was positively correlated with neutral valenced responses to open-ended questions,  $r(101) = -$

.21,  $p < .05$ , such that adolescents higher on self-presentation anxiety provided more responses to open-ended questions that contained no affective valence. No other significant associations were found.

*Concurrent associations between autobiographical memory biases and self-presentation anxiety*

Correlation analyses revealed significant associations between self-presentation anxiety and several aspects of autobiographical memories (Table 4). Higher self-presentation anxiety was linked to decreased *positive memory affect* for social cued words ( $r(102) = -.30, p < .01$ ) and neutral cued words ( $r(102) = -.29, p < .01$ ), as well as to decreased *total memory affect* for social cues ( $r(102) = -.30, p < .01$ ) and neutral cues ( $r(102) = -.29, p < .01$ ). *Negative memory affect* was inversely associated with self-presentation anxiety for neutral cues ( $r(102) = -.20, p < .05$ ) but not social cues ( $r(102) = -.09, ns$ ). Word recall scores were inversely correlated with self-presentation anxiety scores for both social and neutral cue-types ( $r(97) = -.26, p < .05$ ;  $r(97) = -.28, p < .01$ ), indicating that individuals who displayed higher levels of self-presentation anxiety recalled fewer words overall. Longer response latency correlated with higher self-presentation anxiety scores for neutral words only,  $r(101) = .22, p < .05$ . Finally, memory intensity was inversely related to self-presentation anxiety scores for both social and neutral cue-types ( $r(102) = -.28, p < .01$ ;  $r(102) = -.31, p < .01$ ), suggesting that individuals who were more socially anxious recalled less emotionally intense memories.

*Mediation Hypothesis*

A series of multiple regressions were conducted to examine total affect or “emotionality” of autobiographical memory biases as a mediator of the relationship

between toddler behavioral inhibition and self-presentation anxiety in adolescence (see Table 5). Initial regressions established that behavioral inhibition predicted self-presentation anxiety,  $F(1,107) = 4.61, p = .034$ , behavioral inhibition predicted *total memory affect*,  $F(1,100) = 6.03, p = .016$ , and *total memory affect* predicted self-presentation anxiety  $F(1,100) = 10.05, p = .002$ . To establish mediation, the initially significant relationship between the predictor and outcome variable becomes insignificant when the mediator is introduced in the regression (Barron & Kenny, 1986). When behavioral inhibition and *total memory affect* were both entered as predictors of self-presentation anxiety,  $F(2,99) = 5.85, p = .004$ , the relationship between behavioral inhibition and self-presentation anxiety was reduced to nonsignificance ( $\beta$  reduced from .24 to .15), suggesting partial mediation (Barron & Kenny, 1986). Collectively, this pattern of findings suggests behavioral inhibition at age two predicted self-presentation anxiety in adolescence through affective memory quality.

Because the mediator and outcome measure were assessed concurrently, a post-hoc analysis was conducted to test an alternative causal sequence, with self-presentation anxiety as the mediator and *total memory affect* as the dependent variable. This model first specified the direct effects of behavioral inhibition on *total memory affect*, followed by the inclusion of both behavioral inhibition and self-presentation anxiety to determine the extent that direct effects diminished in the presence of the mediator. The influence of behavioral inhibition on *total memory affect* was reduced to marginally significant ( $t(99) = -1.96, p = .052, \beta$  reduced from -.29 to -.26) by the inclusion of self-presentation anxiety into the model, although to a lesser extent than the hypothesized model. Together, the greater reduction in weighted beta in the hypothesized model, in comparison to the

reversed causal model, provides support for a memory-mediated mechanism. The data show that self-presentation anxiety has less of an influence on the relation between behavioral inhibition and memory affect than the influence that memory affect had on the relation between behavioral inhibition and self-presentation anxiety. It appears that behavioral inhibition influences *total memory affect* by way of a direct effect that does not depend on concurrent levels of self-presentation anxiety. These analyses provide some support of the direction of the effects hypothesized (see Figure 1).

#### *Moderation Hypothesis*

To explore the role of memory biases further, a series of hierarchical regression analyses were conducted in order to examine whether *total memory affect* moderated the relations between early temperament and self-presentation anxiety in adolescence. Behavioral inhibition was entered first, followed by *total memory affect*. In the third step, the two-way interaction between temperament and affective memory valence were entered. No significant interactions were found.

## Chapter IV: Discussion

The first goal of the present study was to examine the associations between early behavioral inhibition and social-emotional functioning approximately twelve years later in adolescence, as indicated by laboratory observations of anxious behaviors during a peer interaction task (*self-presentation anxiety*). The results showed that behavioral inhibition as assessed using maternal report and laboratory observations in the second year of life predicted higher levels of self-presentation anxiety in adolescence. This finding adds to the burgeoning literature suggesting the importance of early temperament for later personality and social functioning (Caspi et al., 1996; Caspi, 2000; J. Kagan, Snidman, Kahn, & Towsley, 2007), and dovetails with recent longitudinal research linking early behavioral inhibition to clinically significant social anxiety in adolescence (Prior et al., 2000; Schwartz et al., 1999).

The second purpose of the current study was to examine autobiographical memory biases and social information-processing biases as potential mediators of the association between early temperament and later social-emotional functioning. Researchers have suggested the importance of temperament in the development of representations of the social world (Derryberry & Reed, 1994b; Rothbart, 1991; Rothbart & Derryberry, 1997). Specifically, temperament biases direct and focus attention and facilitate the storage of significant information in memory. The information stored in long-term memory serves as a template from which individuals perceive, interpret, and regulate information for both ongoing events as well as influence anticipated future states of self and world. Further, cognitive theories presume preferential processing of threat—such as in attention, memory, and interpretations—are core dysfunctions that contribute

to the development and maintenance of anxiety-related schemas, and ultimately anxiety disorders (Beck, Emery, & Greenberg, 1986). In line with cognitive theories, we expected that the dispositional tendency to experience social novelty as aversive would facilitate memory and interpretative biases toward processing social information as threatening, which in turn, may leave these individuals more vulnerable to experiencing social anxiety in adolescence. That is, it was hypothesized that a negative processing style—characterized by a greater tendency to retrieve memories to social-cued words more specifically, more negatively, and more quickly; enhanced recall for social-cued words; and a greater tendency to interpret ambiguous vignettes in a threatening rather than a nonthreatening fashion—would mediate the relationship between early behavioral inhibition and self-presentation anxiety in adolescence.

Contrary to expectations, high levels of behavioral inhibition in early childhood were not associated with memory biases for enhanced threat. However, adolescents who had been higher in behavioral inhibition at age two provided fewer emotionally laden, and particularly positively valenced, autobiographical memories for social-cued words, indicating a pattern of emotional blunting. Although unexpected, this finding is not surprising when one considers the dispositional tendency in behaviorally inhibited individuals to avoid unfamiliarity (Kagan et al., 1988). The inhibition of emotional components of memories in response to social cued-words may therefore be an example of this avoidant coping. Aside from the finding of emotionally blunted responses to social-cued memories, behavioral inhibition was not associated with other measures on either memory or story tasks.

Concurrent associations between autobiographical memory patterns and laboratory observations of social anxiety in adolescence also failed to support predictions of preferential processing for threat in more anxious adolescents. Instead, the pattern in affective memory content was similar to that observed with behavioral inhibition, in that adolescents who were higher in observed self-presentation anxiety reported fewer overall affective memories. However, this pattern of blunted memory affect was evident for both social and neutral cue-types. The lack of specificity in the processing of content-relevant cue-types was also documented in a recent study by Wenzel and colleagues (2004). In this study, participants with social phobia retrieved memories characterized by equal amounts of negative affect, regardless of cue-type. In contrast, nonanxious individuals retrieved more memories characterized by negative affect when cued with social-threat words than when cued with positive words (Wenzel et al., 2004). Although puzzling, especially in light of our findings of content-specificity in behavioral inhibition, the lack of content-specific processing in self-presentation anxious individuals may reflect a general state of anxiety with subsequent effects on processing (Eysenck, 1992). This view is consistent with findings suggesting anxiety may impair processing of a broad range of stimuli, rather than those directly related to an individual's worries (Mogg et al., 1993). It may also be that in vulnerable or behaviorally inhibited individuals, a response pattern initially specific to socially-relevant information may overtime lead to a more diffuse bias, with the consequent development of social anxiety.

The apparent difficulty in reporting emotional experiences in both adolescents rated higher on behavioral inhibition in early childhood as well as adolescents rated higher on self-presentation anxiety is consistent with research documenting the perverse

consequences of emotional avoidance. Research on individuals characterized by a *repressive coping style*, who report low levels of subjective distress but high levels of defensiveness on measures such as the Marlowe-Crowne Social Desirability Scale (Crowne & Marlowe, 1964), tend to avoid emotional content. Individuals characterized by this affect-regulatory style have been found to respond less to negative emotional content (Newman & Hedberg, 1999); generate fewer autobiographical memories associated with both negative and positive affective states (Davis & Schwartz, 1987); and report lower intensities of emotions (Weinberger, Schwartz, & Davidson, 1979). Furthermore, despite reporting experiencing low levels of subjective distress, these individuals spike on physiological indices of stress reactivity, such as heart rate, skin conductance, blood pressure, muscle tension, and sweat gland activity (Shedler, Mayma, & Manis, 1993; Singer, 1990; Weinberger et al., 1979; Weinberger & Davidson, 1994). Similarly, individuals classified by the adult attachment interview with avoidant attachment style (Main, Kaplan, & Cassidy, 1985) display a minimizing style of emotional expression on the adult attachment interview; recall fewer emotional events from early childhood (Mikulincer & Orbach, 1995); deny anxiety yet write projective stories revealing inner conflict (Magai, Hunziker, Mesias, & Culver, 2000); and show a deactivating strategy—where they report being unperturbed, despite elevations in skin conductance (Dozier & Kobak, 1992). In contrast, securely attached individuals elaborate both on more positive as well as negative recall of attachment experiences (Farrar & Fasig, 1997; Main et al., 1985). Importantly, these entirely separate lines of research demonstrate not only the negative interpersonal, psychological, and health consequences associated with this affect-regulatory style, but also that such processes may occur

outside awareness (Asendorpf & Scherer, 1983; Larson & Chastain, 1990; Schwartz, 1990; Shedler et al., 1993; Weinberger, 1990).

Hypothesized biases for preferential recall of social-cued words in more self-presentation anxious adolescents were also not supported. Instead, adolescents higher on self-presentation anxiety recalled fewer total words, regardless of cue-type. Although research on memory biases in anxiety have been mixed, a number of studies have similarly documented poorer recall in more anxious states (Foa et al., 1989; Mueller & Courtois, 1980a; Mueller & Courtois, 1980b). Such findings of impaired recall may be related to less elaborative or more shallow processing during encoding ( Craik & Lockhart, 1972; Craik & Tulving, 1975), which is also consistent with the pattern of affective blunting observed in the current study. This explanation is in accordance with recent research in anxiety suggesting a pattern of attentional disengagement at later stages to manage negative affect, despite an automatic vigilance toward threat (MacLeod & Rutherford, 1992). Such defensive shifts away from threat may therefore lead to reduced depth of processing and subsequent impaired efficacy of recalling information. The finding that adolescents higher in self-presentation anxiety reported less emotionally intense memories is also relevant here, for it further indicates an affective blunting or defensive maneuver to avoid emotional content (Holmes, 1970).

An alternative but not necessarily exclusive explanation may be attributed to the general impairing effects of anxious states on performance. According to this interpretation, anxiety may impair performance by limiting the capacity for attentional resources necessary for processing (Eysenck, 1985). For example, the impairing effects of high arousal or excessive concern about self-presentation arising from characteristics

of state anxiety (Rapee & Heimberg, 1997) may lead to increased effort that prevents processing effectiveness by consuming resources. This interpretation may explain the failure in the present study to find content-specific processing biases for social-cued words in relation to self-presentation anxiety, as well as the conflicting findings in previous studies regarding content-specific biases in relation to state anxiety. Together, these and other findings call into question cognitive models assuming content-specificity in the development of anxiety and mood disorders. Instead, the present findings seem to support postulations that anxious states may be more strongly related to a general distractibility rather than content-dependent biases (Kaspi & McNally, 1995; Mathews, May, Mogg, & Eysenck, 1990).

Furthermore, adolescents higher on self-presentation anxiety were found to show slower response times to generate memories for both cue-types, although the effects were only significant for neutral-cued words. The slower responses observed in more self-presentation anxious adolescents is in line with research implicating anxious states in a general slowing (Bower, 1981; Mathews et al., 1990), and further alludes to the perverse effects of anxiety on information-processing, perhaps either because of enhanced distractibility or strategic influences. Although highly speculative, the lack of significant latency effects for social-cued words may reflect the possibility of competing influences of automatic versus more deliberate processing, whereby, for example, defensive maneuvers could diminish or even reverse response latencies. In fact, these effects should be more prominent in response to social- relative to neutral- cued stimuli, given the increased complexity of processing and conflicting feelings and intentions that tends to be elicited in the social domain.

Responses on the story task also failed to support expectations of enhanced threat-related processing in adolescents higher in self-presentation anxiety. The lack of findings here is in contrast to Bogel's (Bogels & Zigterman, 2000) study, which found biased patterns of threat-related responses in clinically anxious children on both closed- and open-ended questions. A possible explanation for our lack of significant findings on closed-responses may be due to the forced-choice nature of the response format. Specifically, the current study employed a forced-choice response format which required participants to choose only one response to each closed-ended question about their affective reactions, evaluations, and strategies for dealing with situations, whereas participants rated each response item from 0 (not at all) to 4 (very much) in Bogel's study. Related to this, it was found in a study by Chorpita and colleagues that single-response formats tended to elicit nonanxious and socially appropriate responses from all participants, and therefore failed to discriminate between anxious and nonanxious individuals (Chorpita et al., 1996). However, the lack of findings cannot be fully explained by the response format, as threatening responses were also not found on the open-responses. Instead, adolescents higher in self-presentation anxiety tended to provide more neutrally valenced responses. This unexpected finding is consistent with the pattern of blunted emotional responses observed on the memory task. Similar tendencies to provide more neutral responses to ambiguous sentences have been reported in repressors (Haney, 1973). The avoidance of emotionally laden themes observed on the story task further points to a potential link between the repressive coping style and anxiety-related dispositions.

Overall, hypotheses related to enhanced threat-relevant processing biases were not supported in relation to either early behavioral inhibition or adolescent self-presentation anxiety. In fact, adolescents higher on self-presentation anxiety actually provided *fewer* negative memories. The failure to find evidence for a negative processing bias provides limited support to conventional cognitive theories, which implicitly assume that negative affect is related to maladjustment (Beck et al., 1985; Clark & Wells, 1995). The present study instead found that higher levels of both early behavioral inhibition as well as concurrent laboratory observations of self-presentation anxiety were associated with more difficulty in providing emotionally valenced autobiographical memories for socially-cued words. In personality, the tendency to avoid or deny emotional content in describing intra and interpersonal experiences has been recognized as an important individual difference variable (Singer & Salovey, 1993). Conceptually, both behavioral inhibition temperament and anxiety are linked to an avoidant coping style, which is thought to maintain or exacerbate fear. Although not initially hypothesized, the similarity in the blunted response tendency found in relation to both early behavioral inhibition and adolescent self-presentation anxiety may suggest a theoretically important link between early behavioral inhibition and later social-emotional functioning.

In fact, the data revealed that the tendency to provide emotional memories appears to mediate the influence of early behavioral inhibition on adolescent self-presentation anxiety. Although open to interpretation, these findings seem to suggest that behaviorally inhibited children who regulate their feelings of arousal by avoidance (behaviorally or internally) are vulnerable to chronic shyness and social anxiety. This interpretation may be viewed in accordance with theoretical models positing interactions

between reactivity and self-regulation in temperament (Derryberry & Rothbart, 1997), or similarly, between ego-control and ego-resiliency in personality (Block & Block, 1980). For example, Derryberry and Rothbart (1997) describe how children who are prone to fearfulness and distress may foster an overregulated coping style aimed at avoidance. Research in personality similarly describes an overcontrolled coping style which is associated with the tendency to tightly regulate emotional reactions or withhold emotional expression (Asendorpf & Scherer, 1983; Asendorpf & van Aken, 1999; Block & Block, 1980). Both lines of research suggest that although a certain degree of control or regulation is beneficial, excessive control may be destructive by limiting experience, flexible thinking, and alternative ways of coping.

Given the exploratory nature of the findings, the precise mechanism underlying the blunted affective response style cannot be unambiguously determined at present, but several possible explanations present themselves. For instance this bias may reflect a deliberate strategy at the time of recall either to prevent discomfort with disclosing information to the experimenter or to avoid the potentially anxiety-provoking effects of elaborating on emotionally-laden content. Conversely, this blunting response may reflect emotional encoding at the time of the experience, and specifically, the defensive shutting off of emotional experiences. Yet another explanation for the blunted affective pattern may be due to differences in actual experiences that inhibited individuals acquire. For example, the dispositional tendency for heightened reactivity to novelty may lead individuals to avoid social situations where threat is anticipated. Such regulatory strategies involving active avoidance may result in the acquisition of fewer positive affective memories, which may inhibit engagement in future interactions. The failure to

develop skills from social interactions early in development may have particularly deleterious impacts on the developing self-concept and interpersonal relationships in adolescence. Perhaps more importantly, the involvement of “third variables” such as parent-child interactions are also likely to impact children’s emotional regulatory capacities and must be examined in combination with temperament in future research.

### *Theoretical Implications*

The failure to find biases toward processing of threat in this non-clinical sample adds to the inconsistencies in research on memory biases in anxiety (Amir, McNanny, Reimann, & Clements, 1996; Rapee et al., 1994; Wenzel & Holt, 2002; Wenzel, Haugen, & Schmutzer, 2003). The repeated failure to document memory biases in relation to anxiety are in sheer contrast to the more consistent findings of unconscious (or “preattentive”) attentional biases *toward* threatening stimuli in both state and trait anxious individuals (Bradley, Mogg, Falla, & Hamilton, 1998; Broadbent & Broadbent, 1988; Derryberry & Reed, 1994a; Fox, Russo, Bowles, & Dutton, 2001; Mathews & MacLeod, 1985). Many inconsistencies may be due to methodological and conceptual failures to distinguish automatic versus intentional processes. Mogg (1987) proposed a “vigilant-avoidance” pattern of processing in anxious individuals, characterized by an initial attention toward threat followed by strategic cognitive avoidance (Mogg, Mathews, & Weinman, 1987). According to this model, although anxious individuals may more readily identify threatening information, they engage in less elaborative processing as a result of cognitive avoidance. Mogg and others have suggested that the failure to adequately process such information may serve to maintain anxiety by preventing

habituation, and allowing threat cues to maintain anxiety provoking properties (Mogg, Bradley, Bono, & Painter, 1997).

A corollary implication of the automatic-intentional distinction concerns the nature of the task used to elicit these processing biases. In the current study, memory and interpretation biases were assessed solely by means of explicit measures—that is, by examining self-report of conscious representations. In contrast to explicit tasks, which require effortful or deliberate processing, implicit tasks elicit more automatic or unconscious processes that are implicated in more affectively laden representations. The implicit-explicit distinction, taken with the increasingly abundant evidence suggesting that anxiety-related processing occurs at a preconscious level (LeDoux, 1990a; LeDoux, 1990b; Mathews, Mogg, May, & Eysenck, 1989; Ohman & Soares, 1993), highlight the need for future studies to incorporate procedures that bypass conscious modes. One way to address this issue may be by employing dot-probe tasks with different exposure durations to delineate automatic or preconscious versus more intentional or conscious processes.

### *Clinical Implications*

The results in the present point to the perverse effects of avoidance coping strategies, which may prevent more adaptive styles of coping. Shy children who cope with their fear by avoidance (either behaviorally or internally) will likely be vulnerable to continued shyness. Research suggests that peer exposure and early out-of-home care may ameliorate early inhibition (Fox, Schmidt, Calkins, & Rubin, 1996), perhaps by facilitating opportunities for more adaptive ways of coping. Maternal elaborative reminiscing style may also allow an inhibited child to gain clarity of emotional

experiences (Fivush, 2007). These findings may also have important treatment implications if replicated in clinically anxious samples. Namely, the presence of an affect-regulatory strategy aimed at avoidance may suggest a limitation in cognitive therapy which deals primarily with distortions by targeting explicit or controlled verbal processes. The effectiveness of cognitive therapies may be especially limited if the processing biases occur outside awareness, as mounting research suggests, since simply working at conscious representations may have little effects in ameliorating automatically elicited fear, and ways of regulating feelings of fear. As Freud put it, a person cannot alter behavior of which he is not aware, and he is unlikely even then to change it unless he understands the function it serves is unnecessary or that a more efficient mechanism may be used in its place.

#### *Study Limitations and Future Directions*

The study has several limitations that need to be addressed in future research. First, as noted earlier, the present findings do not allow inferences about the precise mechanism underlying the blunted affective response. The nature of the memory task used in the current study provided no requirements to disclose affective content, and allowed individuals to report whatever events they desired within the 1-minute time limitation. In such conditions with limited restrictions, adolescents could report whatever they chose and dismiss embarrassing or uncomfortable memories. It is therefore possible that more anxious adolescents do experience more negative thoughts and feelings, but may have deliberately avoided reporting them. Implicit memory tasks, in which participants are not aware of the words, are thought to bypass conscious introspection and may therefore be less susceptible to defensive reporting. Implicit tasks may also index

spontaneous, automatic evaluations of self that are not accessible through conscious introspection, yet nevertheless play an important role in representations and behaviors. Indices of verbal defensiveness such as topic shifts, idiosyncratic word use, coherence, complexity, avoidance of content, misinterpretation of word, failure to complete thought, taking back a response, as well as nonverbal behaviors (e.g., facial expressions, body movements, sighing, etc) may also prove useful in identifying defensive processing (Shedler et al., 1993). Physiological indices of emotional processing should also supplement self-reports.

The coding of memory specificity in the current study may have masked an overgeneral effect. Specifically, because our interest was in memories containing the most detail, memories were coded as specific if they contained both general and specific portions, rather than the first memories that came to mind. Furthermore, this study allowed individuals to recall any memories within the one-minute time constraints. In retrospect, a more stringent coding system for specific memories may have been more useful in detecting an overgeneral response, since even individuals with difficulty retrieving specific memories may produce specific responses with longer response durations or when not coded for first response.

Another limitation is that certain stimuli, particularly stories, tended to be responded to in a similar manner for all participants. For example, in a story about going to a friend's house over the weekend, less than 1.5% of the entire sample endorsed any negative emotions, negative evaluations, or feelings of helplessness. Another story about a natural disaster elicited negative responses in over 90% of the sample. These dominant response patterns not only fail to elicit individual differences in responding, but also cast

doubt on the core assumption of the task—that is, to assess responses to ambiguous situations. Because many of the stories seemed to arouse a particular emotional reaction, it is therefore unclear whether information-processing biases would have been revealed if the story content tapped into domains which were more ambiguous.

A further shortcoming involves the highly constricted response format used to assess memory and interpretation biases, which classified a reaction solely according to one valence or response choice. This procedure rests on the assumption that significant events or memories elicit only one feeling or thought; however, both research and clinical experience suggests that representations of interpersonal schemas often include an amalgam of thoughts and feelings (e.g., Davis, 1999; Westen, 1991). Future research should therefore assess a range of different emotions for each response in order to elucidate important information, particularly in elements with contrasting affective valences.

It should be noted that the concurrent assessment of autobiographical memories and self-presentation anxiety leaves open the possibility of the reverse causal sequence. That is, rather than autobiographical memories influencing self-presentation anxiety, it is plausible that self-presentation anxiety may influence performance on the memory task. This model would be consistent with mood state-dependency theory, which predicts that people are more likely to recall experiences that are affectively congruent with mood during recall (Bower, 1981). Although we attempted to address this issue of directionality by analyzing the reverse causal sequence, only longitudinal data examining temporal sequence can provide definitive conclusions about the nature of the relations.

Another potential objection is that the significant findings in relation to behavioral inhibition may have been due to chance, alone, because of the larger sample size and number of tests run. Although some caution is clearly warranted due to the low magnitude of the correlations, we believe these findings to be meaningful for two reasons: First, the pattern of findings obtained in relation to behavioral inhibition does not seem random, but rather, is consistent with the overall pattern of findings obtained in the current study, which convey an affective blunting response style. That behavioral inhibition was also related to this response style in the same way as adolescents higher on self-presentation anxiety renders it unlikely that the correlations were simply due to chance. As well, the tendency for behaviorally inhibited individuals to show higher levels of self-presentation anxiety is in line expectations. Second, the weak correlations may be accounted for by the fact that the outcome variables were assessed eleven to fifteen years later, during which several other factors are also likely to come into play. Future studies are therefore needed to examine the manner in which temperament and contextual factors interact to affect later development.

### *Conclusions*

In conclusion, the findings from this longitudinal study show a relation between temperament in the second year of life and social-emotional functioning in adolescents, as assessed by anxious behaviors coded during a peer interaction task (self-presentation anxiety) in adolescence. This relationship was mediated by a content-specific pattern in the affective quality of autobiographical memories—characterized by emotional blunted responses to socially-relevant information. Thus, behaviorally inhibited children who learn to regulate their feelings of arousal by avoidance may be at risk for chronic shyness

and socially anxiety. This finding suggests that temperament may influence characteristic ways of experiencing and regulating affect, which, in turn, may influence children's future social interactions and feelings of ease in social contexts.

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Tables

*Table 1: Means and standard deviations for memory variables as a function of cue-type, and t-values for significant differences between cue-types*

<b>Memory Variable</b>	<b>M(SD)</b>	<b>Range</b>	<b>t</b>	<b>p-value</b>
No. of recalled words ( <i>n</i> = 98)			-0.03	ns
Social	9.76(3.09)	1.00-15.00		
Neutral	9.76(2.98)	1.00-15.00		
Latency (seconds) ( <i>n</i> = 102)			1.20	ns
Social	7.31(4.74)	2.08-28.48		
Neutral	7.43(4.65)	1.92-23.19		
Prop. of specific memories ( <i>n</i> = 102)			-10.55	.001
Social	0.58(0.22)	0.00-1.00		
Neutral	0.42(0.22)	0.00-1.00		
Intensity ( <i>n</i> = 102)			-3.23	.002
Social	2.85(0.58)	0.60-3.73		
Neutral	2.67(0.60)	0.17-4.87		
<i>Coded Affect (prop.)</i>				
Positive affect ( <i>n</i> = 102)			-1.96	ns
Social	0.11(0.12)	0.00-0.50		
Neutral	0.09(0.12)	0.00-0.60		
Positive tone ( <i>n</i> = 102)			-3.56	.001

Social	0.17(0.13)	0.00-0.53		
Neutral	0.12(0.11)	0.00-0.47		
Neutral affect ( <i>n</i> = 102)			-5.06	.001
Social	0.59(0.24)	0.00-1.00		
Neutral	0.70(0.24)	0.07-1.00		
Negative tone ( <i>n</i> = 102)			-1.67	ns
Social	0.08(0.08)	0.00-0.33		
Neutral	0.06(0.07)	0.00-0.33		
Negative affect ( <i>n</i> = 102)			-1.17	ns
Social	0.05(0.08)	0.00-0.33		
Neutral	0.04(0.07)	0.00-0.27		
<i>Coded Affect (prop.)</i>				
Happy ( <i>n</i> = 102)			-1.54	ns
Social	0.57(0.16)	0.13-1.00		
Neutral	0.55(0.18)	0.13-1.00		
Sad ( <i>n</i> = 102)			2.02	ns
Social	0.06(0.07)	0.00-0.33		
Neutral	0.07(0.08)	0.00-0.33		
Angry ( <i>n</i> = 102)			.52	ns
Social	0.07(0.08)	0.00-0.40		
Neutral	0.07(0.08)	0.00-0.40		
Scared ( <i>n</i> = 102)			3.67	.001

Social	0.10(0.09)	0.00-0.40		
Neutral	0.04(0.06)	0.00-0.36		
Nothing ( $n = 102$ )			1.20	ns
Social	0.26(0.18)	0.00-0.73		
Neutral	0.20(0.15)	0.00-0.87		

*P*-values indicated significant difference between word-type.

Table 2: Means and standard deviations for story responses ( $N = 101$ )

Story Variable ( $N = 101$ )	M(SD)	Range
<i>Closed Responses</i>		
Neg. Affective reaction	3.95	0.00-6.00
Perceived Danger	3.12	0.00-6.00
Perceived Helplessness	0.90	0.00-4.00
<i>Open Responses</i>		
Positive Interpretation	0.42	0.00-6.00
Neutral Interpretation	4.03	0.00-3.00
Negative Interpretation	2.47	0.00-6.00

*Table 3: Correlations of story variables with behavioral inhibition and self-presentation anxiety*

<b>Story Variable</b>	<b>Behavioral inhibition</b>	<b>Self-presentation anxiety</b>
<i>Closed Responses</i>		
Neg. Affective reaction	-.07	-.03
Perceived Danger	.01	-.04
Perceived Helplessness	-.11	-.03
<i>Open Responses</i>		
Positive Interpretation	.07	-.05
Neutral Interpretation	.01	.17*
Negative Interpretation	-.02	-.15

Note: \* $p \leq .05$ , \*\* $p \leq .01$ , \*\*\* $p \leq .001$  (two-tailed). All variables are composite variables, to maximize reliability.

*Table 4: Correlations of memory variables with behavioral inhibition and self-presentation anxiety*

<b>Memory Variable</b>	<b>Behavioral inhibition</b>	<b>Self-presentation anxiety</b>
<b>Word Recall</b>		
Social	.03	-.28**
Neutral	-.05	-.31**
<b>Latency</b>		
Social	-.03	.08
Neutral	.03	.22*
<b>Specific</b>		
Social	.04	-.03
Neutral	.12	-.05
<b>Intensity</b>		
Social	-.11	-.28**
Neutral	-.07	-.31**
<b>Positive Memory Affect</b>		
Social	-.20*	-.30**
Neutral	-.08	-.29**
<b>Negative Memory Affect</b>		
Social	.04	-.09
Neutral	.06	-.20*

Total Memory Affect		
Social	-.20*	-.30**
Neutral	-.13	-.29**

Note: \* $p \leq .05$ , \*\* $p \leq .01$ , \*\*\* $p \leq .001$  (two-tailed). All variables are composite variables, to maximize reliability.

*Table 5: Results of regression analysis to explore effects of behavioral inhibition and memory affect on self-presentation anxiety*

<b>Testing steps in mediation model</b>	<b><i>B</i></b>	<b><i>SE B</i></b>	<b><i>p</i>-value</b>	<b><math>\beta</math></b>	<b><i>R</i><sup>2</sup></b>
Testing Step 1 (Path c)					
Outcome: self-presentation anxiety					
Predictor: behavioral inhibition	.24	.11	.03	.20	.04
Testing Step 2 (Path a)					
Outcome: total memory affect					
Predictor: behavioral inhibition	-.28	.12	.02	-.24	.06
Testing Step 3 (Paths b and c')					
Outcome: self-presentation anxiety					
Mediator: total memory affect	-.27	.10	.006	-.27	.11
Predictor: behavioral inhibition	.15	.09	.21	.12	

## Figures

Figure 1: Mediation model depicting the role of memory affect in mediating the effects of behavioral inhibition on self-presentation anxiety

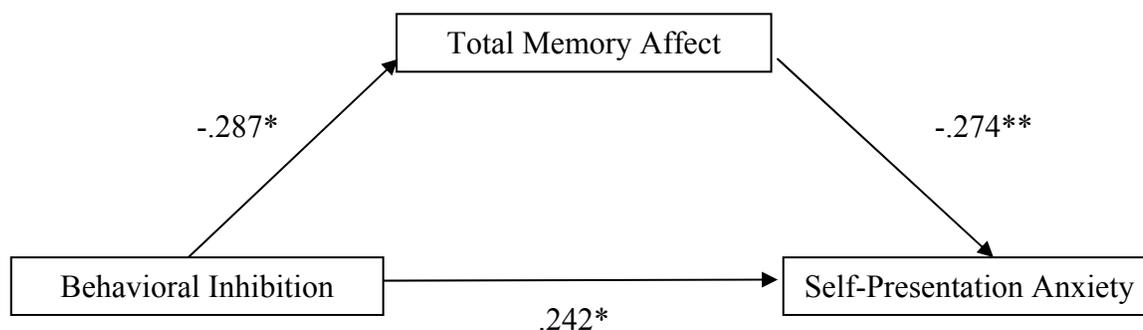


Figure 2: Mediation model depicting the role of self-presentation anxiety in mediating the effects of behavioral inhibition on memory affect

