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Temperament and the environment in the etiology of childhood anxiety

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Abstract

Anxiety disorders are prevalent throughout childhood and adolescence. As such, identifying the factors and mechanisms that precede, maintain, or exacerbate anxiety disorders is essential for the development of empirically-based prevention and intervention programs. The current review focuses on child temperament (i.e., behavioral inhibition) and the child's environment, including parenting, child care, and peer relationships, as these factors have been linked to internalizing problems and anxiety diagnoses. Research programs are needed that examine the associations between the environment and anxiety in temperamentally at-risk populations. In order to be successful, early intervention and prevention programs require a more detailed analysis of the interplay between various environmental contexts, both distal and proximal to the child, and the child's temperamental reactivity to novelty and threat. Furthermore, conducting these investigations across multiple levels of analysis in large-scale, longitudinal samples would be an important addition to the literature on the developmental psychopathology of anxiety.

Keywords

Anxiety; Development; Parenting; Peer Relationships; Temperament

Anxiety disorders are one of the most prevalent types of clinical diagnosis in childhood and adolescence. Prevalence rates range from 2 to 17%, with 2.5 to 5% meeting criteria at any given age (Grills-Taquechel & Ollendick, 2007; Rapee, Schniering, & Hudson, 2009; Zahn-Waxler, Klimes-Dougan, & Slattery, 2000). Average age of onset varies somewhat between studies, but once diagnosed, childhood anxiety has been reported to continue across development. This is particularly true for Generalized and Social anxiety disorders (Grills-Taquechel & Ollendick, 2007). In addition, studies have shown prevalence rates of anxiety and general internalizing problems to increase across childhood and adolescence (Beesdo et al., 2007; Bongers, Koot, van der, & Verhulst, 2003). Long-term consequences of this continuity in anxiety spread across academic, vocational, and social domains of functioning, reaching into adulthood (Rapee et al., 2009). Elucidating the factors and mechanisms that precede, maintain, or exacerbate these trajectories is essential for the development of empirically-based prevention and intervention programs.

Behavioral Inhibition (BI) is a temperament that has been described in early childhood and is associated with risk for anxiety disorders. Approximately 15% of typically developing children display this temperament (Fox, Henderson, Marshall, Nichols, & Ghera, 2005). These children are characterized as hypervigilant of their environments, particularly to novel or unfamiliar social situations. They withdraw from social interaction and maintain a reticent

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stance (not playing by themselves, not interacting with others but rather onlooking and unoccupied during play situations). Longitudinal and cross-sectional studies suggest that children displaying this temperament are at risk for internalizing problems and anxiety disorders (see Table 1, for a list of representative studies). However, not all children identified with temperamental BI develop an anxiety disorder. Relations between BI and anxiety vary by study, and even within studies that do find a significant association, a certain amount of discontinuity between these measures remains (see Degnan & Fox, 2007, for a more detailed review). Given the importance of early identification of those at risk for an anxiety disorder, identifying factors that contribute to the emergence of anxiety amongst BI children is an important goal. The current review focuses on factors that are exogenous to the child---those within the child's environment, including parenting, child care, and peer relationships. First a general description of anxiety disorders and BI are given, followed by a brief discussion of their overlapping characteristics. Second, literature on the role of the environment from the parenting, child care, and peer domains is reviewed and discussed. Few studies have actually examined temperament (i.e., BI), environmental factors, and anxiety within the same model (see Table 1, for exceptions). Therefore, in their absence, evidence for temperament-environment effects and environment-anxiety effects (see Table 2, for a list of representative works) are reviewed when available. Furthermore, while a majority of the literature has examined moderational effects of the environment on BI-anxiety associations (Table 1), mediational pathways are often shown between environmental factors and anxiety (Table 2). The role of the environment in the etiology of child anxiety likely involves both types of effects. Figure 1 displays a theoretical overview of the potential role of environment in the relations between early temperament (BI) and anxiety. Thus, both types of effects are reviewed below, when available, and distinctions between them are discussed as future directions.

Anxiety

The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV; American Psychiatric Association, 2000) lists 11 possible anxiety diagnoses including Generalized Anxiety Disorder (GAD), Panic Disorder (PD), Social Phobia (SP), Specific Phobias, Obsessive Compulsive Disorder (OCD), and Posttraumatic Stress Disorder (PTSD). The Classification of Mental and Behavioral Disorders (ICD-10; World Health Organization, 1993) lists four broad groups of anxiety including phobic anxiety disorders (e.g., SP), other anxiety disorders (e.g., GAD), obsessive-compulsive disorder, and reaction to severe stress and adjustment disorders (e.g., PTSD). In studies of these anxiety sub-types, age of onset is somewhat inconsistent, due to an inability for young children to report internalizing symptoms and the difficulty adults have in discerning when children are displaying these problem behaviors. However, some work has suggested that phobias are seen in early to middle childhood, SP in early to middle adolescence, OCD in middle to late adolescence, PD in adulthood, and GAD throughout (Rapee et al., 2009). There also is a high degree of overlap and comorbidity between the various anxiety subtypes (Pine, 2007; Spence, Rapee, Mcdonald, & Ingram, 2001). However, the clinical child literature typically separates OCD and PTSD from the remaining anxiety categories due to their specific nature (Klein, 2009). Specific phobias can also be isolated due to their tendency to show early onset, but decline across childhood and adolescence (Grills-Taquechel & Ollendick, 2007). While literature on BI and anxiety has typically focused on GAD and SP, the current review includes all forms of anxiety and internalizing symptoms in order to gain a broad understanding of the links between BI, environmental factors, and anxiety.

Overall, anxiety includes heightened distress and withdrawal from perceived threats (Pine, 2007). For instance, GAD is described as a pattern of nonspecific worry, while SP is defined by worry about performance or interpersonal situations (Klein, 2009). Across development,

an increase in fears, especially social evaluative fears is normative; however, fear can lead to disorder when there is greater distress, interference in typical functioning, and immediate anxiety responses that seem irrational (Ollendick & Hirshfeld-Becker, 2002). Behavioral manifestations of anxiety, especially social anxiety, include crying and wariness in early childhood, followed by stuttering, poor eye contact, mumbling, nail biting, and trembling voice in later childhood (Ollendick & Hirshfeld-Becker, 2002). In addition, children's social functioning is often disrupted as they try to avoid anxiety-provoking situations (e.g., school, birthday parties).

Role of behavioral inhibition

One of the primary predictors studied in relation to childhood anxiety is temperamental reactivity to novelty, known as BI, which includes negative emotionality and motor reactivity to novelty in infancy (Hane, Fox, Henderson, & Marshall, 2008; Kagan, Reznick, Clarke, Snidman, & Garcia-Coll, 1984), vigilant and withdrawn behavior in response to novel situations, persons, and objects in toddlerhood (Calkins, Fox, & Marshall, 1996), and extreme social withdrawal or reticence in preschool and later childhood (Fox, Henderson, Rubin, Calkins, & Schmidt, 2001; Rubin, Burgess, & Hastings, 2002). In a community sample, approximately 15–20% of children may display heightened behavioral inhibition (Fox et al., 2005) and about half of these children with BI will continue to display signs of wariness across childhood (Degnan & Fox, 2007). Children displaying consistent BI have been found to evidence greater autonomic reactivity, elevated morning cortisol levels, heightened startle responses, and more vigilant attention styles (Perez-Edgar & Fox, 2005; Schmidt, Fox, Schulkin, & Gold, 1999; Schmidt & Fox, 1998). Functional imaging studies have also found those with BI to display heightened amygdala activation to novel neutral or threatening faces (Schwartz, Wright, Shin, Kagan, & Rauch, 2003; Perez-Edgar et al., 2007). Thus, inhibited behaviors, such as avoidance of novelty/threat, represent overt coping mechanisms by which this amygdala activation and the resulting fear reactivity is decreased. While coping with fear through avoidance does decrease the fearful reaction, it also reinforces the associated physiological responses and behaviors, leading to continued BI and social wariness (Fox, Henderson, & Marshall, 2001). Therefore, as children develop, the manifestations of temperament in reaction to novel stimuli, especially social stimuli, become increasingly relevant for social behavior and psychopathology (Fox, Henderson, Rubin, et al., 2001; Kagan, Snidman, Zentner, & Peterson, 1999; Rubin et al., 2009). Evidence indicates that shy and withdrawn behavior in reaction to social interactions with peers also may manifest as internalizing problems in childhood (e.g., Bosquet & Egeland, 2006; Coplan, Wilson, Frohlick, & Zelenski, 2006; Fox, Henderson, Rubin et al., 2001; Henderson, Marshall, Fox & Rubin, 2004; Rubin, Hymel, & Mills, 1989; Rubin et al., 2002) and adolescence (e.g., Coplan, Arbeau, & Armer, 2008; Chronis-Tuscano et al., 2009; Rubin, Chen, McDougall, Bowker, & McKinnon, 1995).

A number of studies have used cross-sectional designs, concurrent or retrospective measures of early temperament, and/or questionnaire data assessing anxiety problems or personality traits (Biederman et al., 2001; Gladstone et al., 2005; Hayward, Killen, Kraemer, & Taylor, 1998; Kagan & Snidman, 1999; Caspi et al., 2003; Muris, Merckelbach, Wessel, & van de Ven, 1999). For instance, undergraduates and adults with social anxiety, panic disorder, and depression retrospectively reported greater childhood inhibition (Reznick, Hegeman, Kaufman, Woods, & Jacobs, 1992; Mick & Telch, 1998). Similarly, a sample followed throughout the high school years retrospectively reported greater social avoidance in elementary school when they had a current diagnosis of social phobia (Hayward et al., 1998). One group of studies has found children of parents with panic disorder or agoraphobia to display higher rates of BI than comparison children (Rosenbaum et al., 1988Rosenbaum et al., 2000). In addition, parents of BI children themselves report higher

rates of anxiety disorders (Rosenbaum et al., 1991). It is possible that BI is linked to a general family risk for internalizing disorders and not one specific type of disorder, however genetic studies of familial anxiety have shown specificity between parental and child anxiety disorders (Low, Cui, & Merikangas, 2008).

Additional work has found measures of BI taken in early childhood to be significantly related to later diagnosis and symptoms of anxiety (e.g., Biederman et al., 1990; Gladstone & Parker, 2005; van Brakel, Muris, Bogels, & Thomassen, 2006). Specifically, early BI is related to an increased risk for anxiety disorders themselves (e.g., Hirshfeld-Becker et al., 2007) and an increased likelihood that their parents have a history of anxiety disorders (Rosenbaum, Biederman, Bolduc, Hirshfeld, Faraone, & Kagan, 1992; Biederman et al., 1993). Follow ups of these children into late childhood and adolescence suggest that early BI is more specifically related to social anxiety (Biederman et al., 2001; Schwartz, Snidman, & Kagan, 1999). Furthermore, consistently high levels of BI from toddlerhood through middle childhood have been linked to increased risk for phobias in childhood (Hirshfeld et al., 1992) and social anxiety in early adolescence (Chronis-Tuscano et al., 2009).

Common and specific features of BI and anxiety

Given that many characteristics of BI, such as social withdrawal, negative affect, and vigilance to perceived threat also describe certain anxiety disorders (American Psychological Association, 2007), the connection between BI and anxiety might be expected. For example, the DSM-IV (2000) diagnostic criteria for social anxiety include a persistent fear of social situations, intense anxiety and distress in response to the feared situations, and avoidance of the feared situations. In addition, both BI and anxiety are terms used to describe similar types of data and there are multiple theories on how these two constructs are related (see Nigg, 2006 for a more detailed discussion). As one example, the spectrum model posits that BI and anxiety are on the same continuum, with BI representing a subclinical level of anxiety. Indeed, taxometric studies support this conclusion (Haslam, 2003) and behavioral genetic studies have shown that internalizing and externalizing problem behaviors share genetic covariation with temperamental constructs, such as withdrawal (Goldsmith & Lemery, 2000).

However, a vulnerability/resilience model suggests that temperamental traits predispose to or protect from certain types of psychopathology in certain contexts (Nigg, 2006). For instance, BI may be one possible risk factor which, with certain environmental characteristics, will lead to higher rates of anxiety. In this case, BI would be a related, but separate construct from anxiety. One indication of this is the presence of unique/non-overlapping characteristics of BI and anxiety (Rapee & Coplan, in press). BI includes wariness and avoidance of novel social and nonsocial stimuli, while anxiety includes heightened distress/fear and withdrawal from perceived threats that leads to immediate psychophysiological symptoms and interference in daily functioning. From these definitions it is clear that although BI may show conceptual similarities to multiple anxiety disorders, it does not overlap completely with one single disorder (i.e., social anxiety). While wariness and avoidance of social novelty are delineated in the description of social anxiety, wariness and avoidance of *nonsocial* novelty may be more closely linked to GAD or panic disorder. In addition, the physiological symptoms linked to an immediate anxiety response are not part of the basic definition of BI. Furthermore, studies have reported that only a subset of shy or high worrying adults meet diagnostic criteria for anxiety, with the ones that report greater social fears meeting criteria for social anxiety and those reporting chronic/distressing worry, less control over negative intrusive thoughts, and greater somatic hyperarousal meeting criteria for GAD (Heiser, Turner, Beidel, & Roberson-Nay, 2009; Ruscio, 2002;

Ruscio & Borkovec, 2004). Thus, the link between early BI and specific forms of anxiety may rely on other intervening factors.

In addition to these symptom or characteristic differences, a great deal of work suggests only modest associations between BI and anxiety (Degnan & Fox, 2007; Nigg, 2006). In the same studies that support a link between BI and anxiety, 28% of the BI sample neglected to show any diagnosable anxiety disorder and 39% to 83% were not diagnosed with social anxiety disorder (e.g., Biederman et al; 2001; Gladstone, Parker, Mitchell, Wilhelm, & Malhi, 2005; Schwartz et al., 1999). These modest effects also have been shown in studies using questionnaire measures of inhibited temperament and psychopathology (e.g., Coplan et al., 2006; 2008; Muris, Meesters, Blijlevens, 2007; Lemery, Essex, & Smider, 2002; Reznick et al., 1992). Studies examining links between shyness and social anxiety also report that these constructs are not synonymous, with almost half of high-shy individuals neglecting to meet diagnostic criteria and 15% to 18% of the non-shy group meeting criteria (Chavira, Stein, & Malcarne, 2002; Heiser, Turner, & Beidel, 2003). Furthermore, Caspi and colleagues(2003) reported that participants characterized by extreme low or high BI at age 3 were at increased risk for depression, at age 21, but not anxiety.

One possibility is that this discontinuity between BI and anxiety is the result of measurement error, where more infants and children are labeled as behaviorally inhibited than the ones that actually have this temperamental bias. This may particularly be found when examining parental report of temperament. However, measurement error/bias may also account for greater continuity when the same reporter rates levels of BI and symptoms of anxiety. Indeed, research is needed that clarifies the consistency of relations between BI and anxiety when using different combinations of measurement tools. Another possibility is that the development of adaptive attention and regulatory skills, supported by particular styles of parenting or caregiving contexts, contributes to discontinuity by influencing the display of inhibited and wary behavior across childhood and adolescence. These explanations are not necessarily mutually exclusive, but a review of measurement tools is beyond the scope of the current review. Thus, the current discussion focuses on how exogenous factors including parenting styles, caregiving contexts, and peer relationships contribute to the continuity and discontinuity between BI and anxiety across development (Figure 1). BI is suggested to represent the beginning of a vulnerability pathway, which begins with reactivity of the withdrawal system and leads to a variety of internalizing disorders (e.g., depression and anxiety), especially when combined with other risk factors or particular environmental contexts (Nigg, 2006). Indeed, our own work has shown that early BI is associated with later internalizing behavior or psychopathology, but only when combined with other risk factors, such as response monitoring, psychophysiological reactivity, or parenting behaviors (Degnan, Henderson, Fox, & Rubin, 2008;Hane, Cheah, Rubin, & Fox, 2008;McDermott, Perez-Edgar, Henderson, Chronis-Tuscano, Pine, & Fox, 2009;Reeb-Sutherland et al., 2009;Williams et al., 2009). These findings, as well as others from the literature, imply that there is more to the relations between BI and anxiety than methodological error (Rapee & Coplan, in press).

Role of environmental factors

Temperamental risk factors, such as BI, need to be studied along with moderating or mediating factors, rather than as a single risk factor for the development of psychopathology (Degnan & Fox, 2007). Integral to a vulnerability/resilience model of the links between temperament and psychopathology is the role of ecological and contextual factors (Nigg, 2006). Throughout the literature, there are documented associations between temperament and the environment and between the environment and child psychopathology (see reviews below). However, this work and similar theoretical discussions, suggest that direct effects of

the environment are modest and that interactions between biological (i.e., temperament) and environmental factors are more likely to affect the development of psychopathology (McLeod, Wood, & Weisz, 2007; Rubin, Coplan, & Bowker, 2009). In addition, some of this literature suggests that environmental risk factors show non-specificity in relation to child psychopathology (e.g., Shanahan, Copeland, Costello & Angold, 2008), while other work points to the existence of specific environmental risk for individual anxiety factors (Hallett, Ronald, Rijsdijk, & Eley, 2009). As suggested by the current review, research should be focused on how environmental factors might influence the psychopathological outcomes for specific subgroups of children, such as those with certain temperamental characteristics (i.e., BI). Similarly, specific psychopathological outcomes (i.e., anxiety) might develop from the interplay of certain personalities coming into contact with specific contextual characteristics. Indeed, the effects of child temperament may vary by environment and the effects of environmental factors may vary by child temperament (Propper & Moore, 2006; Wood, McLeod, Sigman, Hwang, & Chu, 2003). Much of this conceptualization is grounded in research on parent-child relationships and parenting behaviors; however, parallels can be made between the parent-child context and other environmental contexts (e.g., child care, peers). Given that relationships are bidirectional in nature (Bell, 1968; Cook & Kenny, 2005), it is difficult to disentangle the effects of the environmental context (e.g., parents, child care providers, peers) from the child's temperament. Therefore, both temperament and the environment may show transactional effects (Sameroff & Mackenzie, 2003) where they influence one another over time and extend joint effects on psychopathology throughout development.

There are multiple ways to conceptualize the role of the environment in these pathways. One pathway, a mediational model, suggests that children's temperament influences their environment, which in turn influences whether psychopathology develops or not (Fairchild & MacKinnon, 2009; MacKinnon & Fairchild, 2009). Another pathway, a moderational model, suggests that environmental factors influence whether there are significant effects or what the nature of those effects is between temperament and children's outcomes (Baron & Kenny, 1986; Fairchild & MacKinnon, 2009). A majority of the literature has examined moderational effects of the environment, but mediational pathways are likely involved as well (See Figure 1 for a theoretical overview). Both types of effects are reviewed below, where available, and distinctions between them are discussed as future directions. Overall, few studies have examined temperament (i.e., BI), environmental factors, and anxiety within the same model (see Table 1, for exceptions). Therefore, evidence for temperament-environment effects and environment-anxiety effects (see Table 2, for a list of representative works) are reviewed when available. Furthermore, while a majority of the literature has examined moderational effects of the environment on BI-Anxiety associations, mediational pathways are often shown between environmental factors and Anxiety. We focus the review below on the parenting domain (effects of parental behaviors and attitudes about parenting, parental personality/psychopathology), non-parental child care, and the peer domain (peer victimization, rejection, and friendships). Overall, studies are needed that examine all environmental domains simultaneously and throughout development with specific reference to children's BI and psychopathology.

Parenting Domain

Maternal parenting behavior—One of the most common environmental factors examined in relation to child temperament and psychopathology is maternal parenting behavior. From birth, caregivers engage and disengage infants' attention in order to alter their arousal levels. Caregivers, who are sensitive to infants' needs to disengage attention, help reduce this arousal before it becomes overwhelming (Gottman, Katz, & Hooven, 1997). In contrast, adults who are not as attuned to infants' needs may exacerbate their distress by

preventing them from disengaging from the source of distress. This cyclical process of attention engagement and disengagement is one way infants learn how to regulate their emotions and behavior (Fox et al., 2005) and one way that maternal behavior can influence children's trajectories of inhibited behavior and anxiety.

There are observed parenting behaviors that are associated with the continuity of BI and may also be involved in the pathway to anxiety. In general, over-solicitous, intrusive, or controlling parenting is associated with greater toddler inhibition and preschool social reticence (Rubin, Burgess, & Hastings, 2002; Rubin, Cheah, & Fox, 2001; Rubin, Hastings, Stewart, Henderson, & Chen, 1997) and maternal acceptance, warmth, sensitivity, and responsiveness are associated with less inhibited, more socially adaptive behavior (Hane, Cheah et al., 2008; Park, Belsky, Putnam, & Crnic, 1997; Wood et al., 2003). In a recent meta-analysis, van der Bruggen and colleagues (van der Bruggen, Stams, & Bogels, 2008) reported that maternal control was highly associated with children's anxiety, independent of maternal anxiety. In addition, studies show that harsh discipline and over-intrusive behavior increase the likelihood of adolescent anxiety (Shanahan et al., 2008; van Brakel et al., 2006). Furthermore, when mothers were asked to interact with their child in a controlling manner, children appeared more anxious during a subsequent speech task, compared to children whose mothers were asked to interact in a sensitive manner (de Wilde & Rapee, 2008). Maternal negative control also was found to predict an increasing pattern of anxiety across childhood, as opposed to a pattern of stable, low anxiety (Feng, Shaw, & Silk, 2008).

Links between maternal negative control or intrusiveness and children's BI and anxiety are prevalent throughout the developmental and clinical literatures. The effects of maternal control or intrusiveness are shown specifically for children high on fearfulness or anxiety (van Leeuwen, Mervielde, Braet, & Bosmans, 2004). Mothers display greater intrusive and involved behavior with children with an anxiety disorder and even with siblings of that child, compared to non-anxiety disordered children (Hudson & Rapee, 2002). In addition, greater maternal intrusive behavior is observed when children with an anxiety disorder display negative affect compared to similar displays in non-affected controls (Hudson, Comer, & Rapee, 2008).

In contrast, findings also support the idea that sensitive/warm parenting may maintain inhibited behavior by catering to the child's fears and suggesting that extreme fearfulness is not something one can change (Kagan, Arcus, & Snidman, 1993; Park et al., 1997). Indeed, parents who are over-solicitous (i.e., warm and controlling) tend to have children who maintain their behaviorally inhibited tendencies across childhood (Degnan et al., 2008; Rubin, Burgess, & Hastings, 2002). In addition, other work suggests that low intrusiveness is related to greater BI (Park et al., 1997; Rubin et al., 1997). While oversolicitous parenting includes warm caregiving, some research has focused on its intrusive, over-controlling qualities. Indeed, much of the debate as to where maternal sensitivity ends and maternal intrusiveness begins is due to the different ways sensitive parenting is measured and defined. Overall, parents who use supportive strategies to guide their children to engage socially may protect their children from developing more extreme patterns of social anxiety (Wood et al., 2003) by decreasing their attention bias to threat and promoting exploration and social activity in their children (Fox et al., 2005). Supporting this claim, studies found that when mothers displayed low encouragement, engagement, or sensitivity with their infants, the infants display greater avoidant and anxious behaviors at follow up assessments (Crockenberg & Leerkes, 2006; Murray et al., 2008).

Perceived parenting styles—Another line of research on parenting has utilized parent or adolescent report of parenting styles to explain the relations between early BI and later anxiety problems. Perceived parenting style may be especially important since it is thought

to provide an emotional climate for the parent-child relationship (Baumrind, 1967). Although still measures of parental behavior, styles are distinct in that they are derived from an attitude that is expressed towards the child across a wide-range of situations (Darling & Steinberg, 1993). Baumrind's (1971) original conceptualization of parenting style included parents' attitudes and values about parenting, beliefs about development, and the parenting practices they utilize with their children. More recently, perceived parenting style has been measured in similar fashion to Baumrind's authoritative, authoritarian, and permissive parenting (Maccoby & Martin, 1983), or other types of parenting, such as rejection, overprotection, warmth, and support (e.g., Brown & Whiteside, 2008; Hastings, Sullivan, McShane, Coplan, Utendale, & Vyncke, 2008). Overall, while parenting practices may influence child behavior during specific situations, parenting styles are thought to influence the effectiveness of parents' socialization attempts by providing a context from which the children are parented and develop over time (Darling & Steinberg, 1993).

Studies using maternal report of parenting style show that authoritarian, permissive, low proactive, and low supportive parenting are associated with greater internalizing problems from childhood into adolescence (Hastings et al., 2008; Lansford, Malone, Stevens, Dodge, Bates, & Pettit, 2006). In addition, both maternal and paternal reports of overprotective parenting are associated with greater internalizing problems (Hastings et al., 2008). And, adolescent reports of low maternal acceptance, psychological intrusiveness, and harshness have also been linked to greater internalizing symptoms (Buehler, Benson, & Gerard, 2006). Adolescent reports of parental alienation and rejection, as well as overprotection, have been significant predictors of child anxiety disorders (Brown & Whiteside, 2008; Galambos et al., 2003; Hale, Engels, & Meeus, 2006; Lieb, Wittchen, Hofler, Fuetsch, Stein, & Merikangas, 2000). However, work examining interactions between these perceived parenting styles and temperament is rare. A study from Fox's laboratory found that internalizing problems at age 4 were greatest among behaviorally inhibited children who also were exposed to permissive parenting. As well, greater authoritative parenting was associated with less of an increase in internalizing behavior problems over time, when controlling for BI (Williams et al., 2009).

Closely related to perceptions of parenting style are parenting beliefs, such as beliefs about parenting or about the specific needs of certain children (Rubin et al., 2009). The link between maternal behavior and BI or anxiety may be developed through the mother's beliefs about particular child behaviors (Rubin, Nelson, Hastings, & Asendorpf, 1999). For instance, when mothers interpret children's wariness as highly distressing, they may feel overly concerned and attempt to control the situation to decrease their children's discomfort. Therefore, children with BI may elicit protection from others and, ironically, this protective parenting behavior may maintain inhibited child behavior and lead to an anxiety disorder (Mills & Rubin, 1993; Rubin & Mills, 1990). Although this concern and involvement may seem adaptive, such beliefs and behaviors may prevent an inhibited child from independently experiencing positive achievements and developing coping skills in novel situations. Conversely, research has shown that BI is negatively related to maternal endorsement of empathy, appropriate developmental expectations, and use of positive discipline strategies (Partridge, 2003), suggesting that some parents may not adopt such a concerned attitude towards their inhibited child. These diverse differences in parental beliefs may exert important influences on their subsequent parenting behavior and the developmental outcomes of their BI children. In addition, it is important to note which individual is reporting on parents' behavior or style, as individual biases may influence their responses. For instance, children with heightened anxiety may perceive their parents as more rejecting or negative, due to their own vigilance to the surrounding environment. Similarly, parents with their own psychopathology may have low efficacy in their parenting skills, and as a result report more negative, controlling styles. More work is needed with multiple

informants of parenting behaviors, psychopathology, and the overall parent-child relationship in order to tease apart these intervening factors from child BI and anxiety.

Mother-child attachment and family relationships—Parents' repeated interactions with their inhibited children influence the broader parent-child relationship and family climate. When parents react to their inhibited children by protecting and guarding them from their fears, and parenting in an overprotective or intrusive manner, the child's fears are reinforced and even heightened. While it is plausible that maternal efforts to minimize their children's fears may appear sensitive in nature and might lead to a secure attachment, parents' constant effort to guard children from fearful situations might actually put a great deal of strain on the relationship, leading to an insecure attachment. In fact, research has shown that insecure attachment is linked to higher levels of anxiety disorders (e.g., Manassis, Bradley, Goldberg, Hood, & Swinson, 1995), especially for those children who were behaviorally inhibited (Shamir-Essakow, Ungerer, & Rapee, 2005). In addition, a recent study found that insensitive parenting mediated the relations between insecure attachment in toddlerhood and an increase in social withdrawal across middle childhood (Booth-LaForce & Oxford, 2008). And, van Brakel and colleagues (2006) found that the effect of maternal control on adolescent anxiety levels depended on the combination of retrospectively reported BI and attachment security. Additional work is needed to study other aspects of the parent-child attachment relationship. Rutter and colleagues suggest that studies need to include levels of disorganization, as well as inhibited/disinhibited attachment disorders, when exploring the effects of parent-child attachment on child outcomes (Rutter, Kreppner, & Sonuga-Barke, 2009). Specifically, including these attachment measures may help clarify the specific aspects of attachment that influence the etiology of anxiety in children with behavioral inhibition.

Conceptually related to parent-child attachment is the family climate or context, which has also been linked to children's risk for anxiety. This may be especially true if they have a behaviorally inhibited temperament. In fact, research has shown that high levels of family dysfunction are associated with child anxiety (Drake & Kearney, 2008). One study found that high, stable trajectories of family dysfunction were related to similarly high, stable trajectories of anxiety across the same developmental timeframe (Pagani, Japel, Vaillancourt, Cote, & Tremblay, 2008). In addition, a study examining maternal report of inter-parental hostility found that hostility was significantly related to greater adolescent internalizing problems (Buehler et al., 2006). Furthermore, this effect was mediated by the adolescents' report of maternal harshness, psychological intrusiveness, and acceptance. These examples support the idea that family context exerts an influence on children's anxiety across development. However, it is somewhat limited in that it has not investigated the role of family climate specifically for children with BI.

Maternal personality/psychopathology—Parents' interactions and relationships with their children also depend on parent personality and parent psychopathology (e.g., Knappe, Beesdo, Fehm, Lieb, & Wittchen, 2009). These factors may influence the relations between children's BI and later anxiety. For instance, recent work suggests that maternal neuroticism is related to greater stability in children's behavioral inhibition (Degnan et al., 2008), while maternal extraversion is related to fewer child internalizing problems (Rosenbaum et al., 1988). These differences in personality traits may translate into different styles of responsiveness to children's emotions. For example, mothers who are more extraverted, agreeable, or positive tend to display more adaptive parenting behavior, such as warmth and support (Belsky, Crnic, & Woodworth, 1995; Mangelsdorf, Gunnar, Kestenbaum, Lang, & Andreas, 1990).

Parental psychopathology also has been related to children's BI and anxiety. Rosenbaum, Biederman and colleagues (Biederman, Rosenbaum, Bolduc, Faraone, & Hirshfeld, 1991; Rosenbaum et al., 1988; 2000) showed that children were more likely to display BI when their parents were diagnosed with panic and/or depression disorders. Similarly, parents of behaviorally inhibited children evidence greater rates of anxiety disorders from childhood through adulthood (Rosenbaum et al., 1991). Moreover, a recent study examining one latent factor of psychopathology, including measures of parental anxiety and depression, predicted child anxiety, but this effect was mediated by the level of conflict and control in the family environment (Buehler et al., 2006). Additional work has shown measures of maternal depression to predict greater internalizing problems (Leve, Kim, & Pears, 2005) and an elevated, increasing trajectory of anxiety across childhood (Feng et al., 2008). Maternal anxiety has also been shown to effect child anxiety, either in terms of behavior or treatment outcomes. Murray and colleagues (2008) found that infants with BI who had mothers with social phobia (SP) were more likely to increase their avoidant behavior to a stranger. In addition, this effect was mediated by maternal encouragement such that mothers with SP encouraged their BI children the least and mothers without SP encouraged their BI children the most to approach the stranger. This work suggests that treating maternal anxiety may help children with BI develop positive coping skills instead of anxiety. However, a recent study showed that while maternal anxiety was negatively related to children's anxiety treatment outcomes, treating maternal anxiety did not increase children's outcomes any more favorably than when it was not treated (Creswell, Willetts, Murray, Singhal, & Cooper, 2008).

It is conceivable that treating maternal anxiety disorder may have only decreased the functional impairment of the disorder and not the underlying emotional and cognitive aspects of the condition. This may explain why the children's anxiety was not influenced by the mothers' treatment in the study by Creswell and colleagues (2008). Indeed, maternal expressions of fear were positively related to reported measures of child anxiety post-treatment. Additional work has shown that when mothers express their fears more often, or provide negative information about potentially threatening stimuli, children's fear of those stimuli is increased (Field & Lawson, 2003; Field, Lawson, & Banerjee, 2008; Fizak & Grills-Taquechel, 2007; Muris, Steerneman, Merckelbach, & Meesters, 1996). In turn, when mothers do not express their fears, children report minimal fears, even if mothers report having a high level of fear, themselves (Muris et al., 1996). Studies examining parental modeling in an experimental setting have also shown this effect. Parents were instructed to either react positively or negatively to different classes of stimuli (i.e., fear-relevant vs. fear-irrelevant) and infants and toddlers showed increased fear and avoidance of stimuli mothers reacted negatively towards and showed increased positive affect and approach to stimuli mothers reacted positively towards (Dubi, Rapee, Emerton, & Schniering, 2008; Egliston & Rapee, 2007; Gerull & Rapee, 2002).

Anxious mothers may influence children's anxiety through multiple processes. Indeed, their expressions and behavior may be driven by their own fear biases or in response to their children's fearful behavior. One study found anxious mothers reported greater negative interpretation bias to personally relevant situations and child-relevant situations than non-anxious mothers (Lester, Field, Oliver, & Cartwright-Hatton, 2009), suggesting that these cognitive biases extend beyond mothers' own environments. In addition, some genetic studies suggest a strong genetic component to child anxiety, linking parental diagnoses to the same disorder developing in the child (Low et al., 2008), while others suggest that genetic influences are dynamic and change throughout childhood (Kendler, Gardner, & Lichtenstein, 2008). In sum, parents with anxiety disorders themselves may inadvertently model anxious behaviors or poor coping strategies for children, either because of their own biases or in response to their children's fearful behavior. These biases and behaviors, in

addition to genetic influences, contribute to a cyclical process, which results in the development and maintenance of child anxiety disorders.

Mothers' personality or psychopathology also may influence children's outcomes through the specific parenting behaviors these mothers display (Brook, Tseng, Whiteman, & Cohen, 1998; Cummings & Davies, 1994; Kochanska, Clark, & Goldman, 1997). For instance, mothers who are extraverted and positive may attempt to use their children's negative experiences to teach them adaptive regulatory skills. Research on anxious mothers has shown that they are more likely to display negative affect and overcontrol and less likely to display positive affect or grant autonomy during parent-child interaction (Ginsburg, Grover, & Ialongo, 2004; Moore, Whaley, & Sigman, 2004). Hudson and colleagues (2008) observed parent-child discussions of emotionally relevant situations for the child and found that anxious mothers were more intrusive in their interactions when discussing situations in which the child felt anxious. Furthermore, in a study of anxious mothers, the level of autonomy granting to their 1st grade children was significantly associated with their children's levels of anxiety (Ginsburg et al., 2004). Given these findings, parents who are more extraverted, display positive affect, and support children's autonomy may decrease children's risk of developing anxiety disorders by providing them with the tools necessary to develop positive social relationships.

Summary—Throughout the developmental and clinical literatures, there are documented associations between temperament and parenting and between parenting and child anxiety (see Table 2). Specifically, aspects of parenting behavior, style, psychopathology, personality, and the parent-child relationship have been linked with heightened BI or child anxiety. However, limited work has examined aspects of parenting along with BI and anxiety. Studies that have included all three factors show maternal behavior, personality, parenting style, psychopathology, and attachment as moderators of the relations between BI and the development of anxiety across childhood and adolescence (see Table 1, for citations). In addition, research has found maternal behavior and family environment to mediate relations between other familial factors and internalizing behavior or anxiety (see Table 2, for citations). Furthermore, mothers' beliefs, personality, and psychopathology are implicated in the relationship with their children as well as the specific parenting behaviors they use. Thus, many of these parental factors seem to be important to the etiology of anxiety, as well as the link between BI and anxiety. However, studies are needed that examine the role of both BI and parenting on children's risk for anxiety. More work needs to examine how these relations differentiate children with and without BI, as well as how those differences influence the development of anxiety disorders. Some findings have suggested that maternal characteristics are related to child anxiety through their modeling or expressions of fear. However, it is still unclear whether these associations are stemming from genetics, the parent's own biases, or a reaction to children's fears. Future research needs to examine these effects in temperamentally at-risk samples, in order to examine the transactional effects between maternal anxiety and behavior and child anxiety and behavior across development.

Child care domain

Another environmental context in which children are exposed to different caretaking behaviors, personalities, and relationships is during non-parental child care. For children who are cared for by people other than their parents, the environment in which the child is developing is more variable. This change in environment has been associated with changes in BI across early childhood (Fox, Henderson, Rubin et al., 2001). Specifically, infants who showed high negative emotionality at 4 months of age were less likely to become inhibited when they were placed in non-parental child care environments with one or more non-

sibling children for 10 hours or more per week. In addition, Arcus and colleagues have shown that children who attended non-parental child care or experienced instability in their child care status were less likely to display stability in inhibition across toddlerhood (Arcus & McCartney, 1989). More recently, Morrissey (2009) found an association between non-parental child care experience and internalizing disorders. Specifically, preschoolers who experienced a larger number of child care arrangements (e.g., care by grandparents, in-home care, center care) were rated by caregivers as experiencing more internalizing problems, including withdrawn behavior. Therefore, the effects of child care on children with BI may be differentiated by how stressful the arrangements are. While non-parental care may be generally a positive influence, having too many child care transitions or providers may exacerbate their inhibition and present a greater risk for anxiety.

The relation between child care status and BI or anxiety may occur through multiple mechanisms. For one, the child is potentially exposed to a different type of caregiver. If this caregiver interacts with the child with a different style of behavior or personality, the child's behaviors could change in response to this. However, the effect of non-parental childcare may also be affected by the personality of parents who choose non-parental child care versus parental child care (Clarke-Stewart & Allhusen, 2002; Fox, Henderson, Rubin et al., 2001). For instance, a mother who herself exhibits social wariness may be less likely to place a behaviorally inhibited child in child care (NICHD, 1997). In turn, this decision might limit the child's range of experiences and lead to greater continuity of inhibited behavior (Fox, Henderson, Rubin et al., 2001; Rubin & Burgess, 2002; Rubin, Burgess, & Coplan, 2002). On the other hand, mothers who are socially adept may be more likely to place behaviorally inhibited children in non-parental child care, thus exposing them to additional environmental stimuli, teaching them to adapt. Of course, this positive effect of child care may only exist in positive, supportive child care environments (Clarke-Stewart & Allhusen, 2002; Gazelle, 2006). While it is not feasible to experimentally manipulate parents' selection of child care (as done with treatment studies), researchers need to take the parents' own biases into account when examining the effects of child care on BI and anxiety disorders.

Another potential mechanism by which BI and anxiety are altered during childcare is through additional peer contact. Within the child care context, children may gain experience interacting with peers in a variety of situations and then apply those skills to situations outside of child care. This experience with peers may be particularly important for behaviorally inhibited children, as they might not have access to these types of interactive situations otherwise. Indeed, socially withdrawn preschoolers given the opportunity to interact with other children seem to decrease their inhibited behavior (Furman, Rahe, & Hartup, 1979). However, as children get older, interactions with peers do not seem to have the same positive effect (see Peer Domain section below). Therefore, inhibited children who are exposed to peer interactions early on in the context of day care may develop stronger social approach strategies and become less inhibited over time.

Summary—Overall, there are few studies that have examined the effects of child care on children with BI and almost none to date that have examined child care effects on anxiety. However, moderational studies find mixed results as to whether non-parental child care is a positive or negative influence for these temperamentally at-risk children (e.g., Arcus & McCartney, 1989; Fox, Henderson, Rubin et al., 2001). Furthermore, research has not explored the effects of child care on the development of child anxiety disorders. Clearly more work is needed in this area. Longitudinal, observational studies should be designed in order to clarify which features of non-parental child care (e.g., caregiving quality, quantity, or peer experiences) are most influential at which points across development for children with BI and their potential risk for anxiety disorders. Studies should also include parental

effects on the selection of child care when examining these relations between BI and anxiety in childhood.

Peer domain

The influence of peer interactions is an important aspect of socialization to consider when examining the trajectories of BI across childhood and adolescence. Researchers have sought to differentiate both the characteristics of BI children's interactions with the larger peer group and their friendships, as well as the consequences of each of these on their inhibition or social anxiety over time. The most recent research has examined these components together, in considering the moderating role that various social experiences have on BI and anxiety across development. An overview of this work is provided below.

Peer interactions and victimization—When interacting with their peers, inhibited, or socially withdrawn children, are less socially competent than their more outgoing age-mates (Rubin & Krasnor, 1986). As a consequence, they are often disliked by their peers and excluded from play interactions (Gazelle & Ladd, 2003; Newcombe, Bukowski, & Pattee, 1993; Oh, Rubin, Bowker, Booth-LaForce, Rose-Krasnor, & Laursen, 2008; Rubin, Chen, & Hymel, 1993). Indeed, Rubin and colleagues (1993) found that withdrawn fifth graders were rated as less popular by their classmates when compared to non-withdrawn children. Rubin and colleagues (Rubin, Wojslawowicz, Rose-Krasnor, Booth-LaForce, & Burgess, 2006) have argued that exclusion occurs because children's inhibited behavior is contrary to normative behavior during childhood with respect to peer interactions and relationships. Children who are withdrawn and rejected are, in turn, at risk for developing internalizing problems, including high levels of anxiety (Gazelle & Ladd, 2003; Hymel, Rubin, Rowden, & LeMare, 1990; Ladd, 2006; Troop-Gordan & Ladd, 2005). Klima and Repetti (2008), for example, found that fourth-graders who were less accepted by their peers had higher teacher-rated internalizing problems in sixth grade.

Repeated rejection by peers and exclusion from play are two characteristics of relational aggression or bullying (Crick, 1995). The characteristics of socially withdrawn children (e.g., shyness) may make them easy targets for this type of behavior because they seem unlikely to retaliate or fight back. Their inhibited characteristics then increase their chances of being victimized, which can thereby result in further withdrawal from the social landscape (Rubin et al., 2009). Indeed research has shown that the experience of being victimized by peers is related to higher levels of anxiety concurrently (La Greca & Harrison, 2005) and over time (Vernberg, Abwender, Ewell, & Beery, 1992). Similarly, Oh and colleagues (2008) found that victimization significantly predicted increasing social withdrawal across the transition to middle school (Grades 6 through 8). Inhibited or withdrawn behavior, then, puts children at risk for negative interactions within the larger peer group which can, in turn, lead to social anxiety and continued withdrawal from peer relationships.

One aspect of peer interactions that appears to act as a buffer against social anxiety or withdrawal during adolescence is affiliation with a particular peer group or "crowd" (La Greca & Harrison, 2005). La Greca and Harrison found that tenth grade adolescents who reported that they identified themselves with either a high status (e.g., jocks) or low status (e.g., alternatives) crowd also reported lower rates of social anxiety. The authors reasoned that belonging to high status crowd may bring positive regard from peers as well as provide opportunities for greater social interaction, while adolescents with low status crowd affiliation may still reap the rewards of companionship and support, regardless of social status, making them less socially anxious than their peers who do not have a crowd

affiliation. Although limited, this work highlights one way that general peer interactions positively affect adolescents' anxiety.

Friendships—Even though anxious or socially withdrawn children report having fewer friends (Pedersen, Vitaro, Barker, & Borge, 2007), they are just as likely as their non-inhibited peers to have a close or best friendship (Rubin et al., 2006). These friendships, in turn, may buffer inhibited children from the negative effects of rejection by the larger peer group. In support of this, Laursen and colleagues (Laursen, Bukowski, Aunola, & Nurmi, 2007) found that having a close friend mediated the relations between social isolation in first grade and internalizing problems one year later.

Friendships may also provide behaviorally inhibited children with some support and companionship in the face of peer rejection, but there appear to be negative consequences to these friendships as well. The best friends of inhibited children have been found to be more socially withdrawn than are the best friends of non-inhibited kids (Rubin et al, 2006). Inhibited children, then, may not have the opportunity to learn more successful social strategies from their friends and, instead, members of the friendship dyad may model each other's social incompetence, leading to further rejection and withdrawal from the larger peer group.

Inhibited children's friendships appear to be of lower quality than their non-inhibited peers' friendships. In one study, Schneider (1999) found less observed communication within inhibited friendship dyads as compared to non-inhibited ones. As well, Rubin and colleagues (2006) found that socially withdrawn adolescents reported their friends to be less helpful, to provide less guidance, and their friendships to involve less intimate disclosure. However, Klima and Repetti (2008) did not find a significant relation between children's teacher-reported internalizing symptoms (including anxiety) in fourth grade and the level of close friendship support children reported in sixth grade. One reason for this lack of significant relation could be that teachers are not accurate reporters of children's internalizing symptoms (Hinshaw, Han, Erhardt, & Huber, 1992).

Friendship quality, in turn, seems to influence children's social anxiety (La Greca & Harrison, 2005). Research has shown that friendship difficulties are associated with generalized anxiety disorder as well as a combined anxiety category (which included the presence of any of a variety of anxiety disorders, e.g., social phobia, SAD, panic disorder) in preadolescent males and adolescent females (Shanahan et al., 2008). LaGreca and Harrison found that adolescents who reported their friendships to be high in quality also reported less social anxiety; alternatively, when quality was low reports of social anxiety were higher. However, because these data were collected concurrently, the direction of effects is unclear. It is possible that socially anxious adolescents are less capable of engaging in high quality friendships.

A small number of studies have examined the moderating role of experiences with peers on the trajectories of behavioral inhibition over time in order to determine those factors that act to ameliorate or exacerbate the characteristics of this temperamental style. Gazelle and Ladd (2003) followed children's levels of anxious solitude from kindergarten to grade 4. They found that anxious solitude stayed high in children who were excluded by their peers, but decreased in children who did not experience peer exclusion. Following from this work, Ladd (2006) examined the additive affects of both child (temperament) and environment (experiences with peers) factors on internalizing problems across childhood. Results showed that both factors independently contribute to maladjustment, and that the probability or severity of anxiety symptoms increases when both factors were present.

In a more recent study, Booth-LaForce and Oxford (2008) identified three trajectories of social withdrawal from grades 1 to 6: low-stable, increasing and decreasing. They found that children in the increasing group, who were socially withdrawn in first grade and showed increases in social withdrawal across time, were more likely to be rejected by their peers in grades 2 and 3 than children in the low-stable or decreasing trajectories. The authors reasoned that children in the increasing group were likely socially incompetent early on, which led to exclusion by the peer group during early childhood and continued withdrawal as they got older. Children in the decreasing group, who had high levels of social withdrawal early on and showed decreases in social withdrawal across time, were less excluded in grade 6. Being more accepted by the peer group during late childhood likely helped these children to become less inhibited or withdrawn while in the company of peers, thereby allowing them to engage in more frequent peer interaction and build their confidence as they acquired more successful strategies for interacting with peers.

Oh and colleagues identified the same three trajectories as Booth-LaForce and Oxford (2008) in a group of children in grades 5 to 8 as they transitioned to middle school (Oh et al., 2008). Results showed that, for the increasing trajectory, having an unstable friendship in grade 5 and the absence of a best friend in grade 6 were related to increases in children's social withdrawal across time. As well, when target children had a stable friendship, the higher the friend's own social withdrawal level, the greater the increase in the target's withdrawal over time. For the decreasing trajectory, if children experienced less exclusion and victimization after the transition to middle school, their levels of social withdrawal decreased over time. These children may have had the opportunity for a "fresh start" at a new middle school where they could interact with a new group of peers who, by not rejecting them, allowed adolescents' to increase their approach behavior, thus breaking the withdrawal-rejection cycle. Future research is needed to examine the specific mechanisms that are operating for these adolescents.

Summary—Overall, research on moderating effects highlights the influence that experiences with peers can have on the trajectories of behaviorally inhibited children over time. Peer rejection, exclusion and victimization appear to exacerbate inhibited and withdrawn behavior, which has been shown to result in higher risk for social anxiety. Although having a close friend may provide some comfort to withdrawn children, this too may exacerbate their social problems, helping to maintain their socially unskilled behavior. Similarly, poor quality friendships may leave children feeling dissatisfied with their peer relations, resulting in further withdrawal from the peer group. Taken together, research in the peer domain sheds important light on the course of behavioral inhibition and social withdrawal across development. However, additional work is necessary to understand the specific influences of peers and friendships on the association between BI and anxiety throughout childhood and adolescence.

Future Directions

Child and adolescent anxiety is associated with poor outcomes within academic, vocational, and social domains of functioning (Rapee et al., 2009). Elucidating the factors and mechanisms that influence these trajectories is important for the development of empirically-based prevention and intervention programs. Two broad factors that have been implicated in developmental pathways to anxiety disorders are temperament (most notably, BI) and the environment (Rapee & Coplan, in press; Wood et al., 2003). As mentioned in a recent review by Nigg (2006), BI may represent the beginning of a vulnerability pathway, which begins with reactivity of the withdrawal system and leads to a variety of internalizing disorders (e.g., depression and anxiety), especially when combined with other risk factors. The current review focused on the role of environmental factors; however, other risk factors

related to psychophysiology, cognitive processing, and self-regulation are also implicated in these pathways (for a review of these processes see White, Helfinstein, Reeb-Sutherland, Degnan, & Fox, 2009) and should be examined in conjunction with temperament and the surrounding environment.

BI and Anxiety

Overall, a number of studies have examined the associations between BI and anxiety disorders or internalizing symptoms (See Table 1). However, results from these studies are mixed, with some showing high rates of association and some showing modest links between them (Degnan & Fox, 2007, for a more in-depth discussion of discontinuity). In addition, there is much debate in the literature regarding whether BI and anxiety are truly independent or whether they stem from the same underlying factors. Unfortunately the existing literature cannot answer this debate one way or another. While many studies find a relation between the two constructs, the associations are far from perfect. And, it is almost impossible to compare the studies for replication, given that they use different types of assessments (i.e., questionnaire vs. observational), across different age ranges, in both selected and unselected samples. Future work needs to delineate which features of BI and anxiety are overlapping or independent of one another (Rapee & Coplan, in press). Repeating this work, in samples selected using similar and comparable methods would help clarify when BI is a risk factor for an anxiety disorder and when it is not. It is possible that there are multiple outcomes for children with heightened BI and being able to predict which pathway a child is on is essential for designing early intervention programs for these populations.

BI, Parenting, and Anxiety

Integral to a vulnerability/resilience model of the links between temperament and psychopathology is the role of ecological and contextual factors (Nigg, 2006). While direct effects of parenting have been found, interactions between biological (i.e., temperament) and environmental factors are suggested to be more strongly linked to the development of psychopathology (McLeod et al., 2007). As reviewed above, multiple research programs are devoted to understanding the role of parental factors in either BI or the development of anxiety problems. However, most studies do not examine how BI and parenting influence children's risk for anxiety. Thus, the existing evidence cannot determine whether the parenting factors themselves, or the parenting factors in combination with a particular style of temperament, predict anxiety in childhood and adolescence. Moreover, parental beliefs and parental psychopathology may influence parenting behaviors and the parent-child relationship (e.g., Buehler et al., 2006; Drake & Kearney, 2008). However, a limited number of studies have included multiple parenting factors (e.g., behavior, personality, and psychopathology) in the same investigation. Even fewer studies have examined multiple aspects of parenting, child temperament, and anxiety disorders (for noted exceptions, see Table 1). Ideally, all aspects of parenting, along with BI and anxiety, would be measured repeatedly over time and analyzed for the effects between factors within and across time. These types of analyses would allow researchers to compare and contrast various theoretical models (i.e., moderation vs. mediation) about the role of the environment in the temperament – anxiety link.

Finally, studies need to examine the specific mechanisms that drive the associations among BI, parenting, and anxiety. There is now some work to suggest that maternal characteristics and beliefs are related to children's anxiety through parental modeling or expressions of fearful behavior (e.g., Dubi et al., 2008; Fizak & Grills-Taquechel, 2007). Thus, there are multiple ways in which parents might influence children to develop a heightened attention bias to threat that fosters greater anxiety. Fox and colleagues (Fox, Hane, & Pine, 2007)

have described a model whereby children with BI (and a certain genetic profile) both influence and are influenced by their caregiving environment, in which threat is likely to be highlighted. This higher attention to threat exacerbates the child's already fearful temperament by altering critical affective neurocircuitry that enhances and maintains anxious behavior. An additional model by Degnan and Fox (2007) described both moderating and mediating influences of the environment on the continuity of BI and associations between BI and anxiety. Overall, work is needed that includes parent and child measures across genetic, physiological, behavioral, and cognitive domains in order to examine these models in detail and clarify which combinations of environment and child characteristics and which transactional processes between parents, peers, and children contribute to the development of anxiety. This information would especially assist parent-education and parent treatment programs by providing a window into which therapeutic techniques would be most effective for specific families.

Indeed, clinicians are including parents in the treatment of their children's anxiety (Dadds and Roth, 2008; Rapee, Kennedy, Ingram, Edwards, & Sweeney, 2005; Hirshfeld-Becker et al., 2008). Programs that include the family seem to increase the rate of anxiety remittance in children, lower fearfulness, and lower general internalizing problems, in comparison to individual child treatment programs (Barrett, Dadds, & Rapee, 1996). Furthermore, the developmental literature suggests that when mothers assist children in discussing stressful experiences by providing emotional details and causal explanations, children show more adaptive, positive outcomes (Sales & Fivush, 2005). Overall, these parent treatment sessions provide knowledge about anxiety and coping skills for the parents (Dadds & Roth, 2008; Hirshfeld-Becker et al., 2008; Rapee et al., 2005). In addition, Hirshfeld-Becker and colleagues (2008) included a component where the parent and child work together on coping skills. Evaluations of these programs showed that post-treatment, children were rated significantly lower on measures of internalizing problems (Hirshfeld-Becker et al., 2008), as well as lower behavioral inhibition (Dadds & Roth, 2008; Kennedy, Rapee, & Edwards, 2009).

While it is promising that child anxiety intervention programs are integrating parents into treatment, the exact mechanisms by which these programs are working and the magnitude of their effects are not clear. Hirshfeld-Becker and colleagues (Hirshfeld-Becker et al., 2008) reported that different parents seemed to respond positively to different aspects of the "Being Brave" program; however, they did not actually assess changes in parental behavior, personality, or psychopathology across the intervention period. It is possible that characteristics of the parents who seek treatment programs for their children may influence the treatment outcomes. However, an experimental study where a group of parents was randomly selected for the intervention and another group was put on the waitlist, therefore experimentally eliminating any effect of parents perceptions or beliefs, showed significant effects of the treatment on children's anxiety and behavioral inhibition 6 months later (Kennedy et al., 2009). In addition, other intervention programs have shown little effect on parent's own psychopathology or that changes in parental psychopathology have little effect on children's treatment outcomes (Creswell et al., 2008; Dadds & Roth, 2008; Kennedy et al., 2009). Future work should use experimental procedures to test the specific processes that are affected by these different treatment programs. This work would provide clinicians with information to more finely tune their prevention and intervention programs.

BI, Child Care, and Anxiety

With more and more children spending increasing amounts of time in non-parental child care, the effects of these environments need to be better understood. The existing literature is quite sparse and work examining child care effects on the development of anxiety is needed. In addition, studies should explore what specific features of the non-parental context

are influential for children with BI and anxiety. For instance, is it a difference in caregivers or is it the additional peer exposure that inhibits or exacerbates children's fearful temperament. If a BI child has similar caregiving from both contexts that fosters their inhibition and withdrawal (i.e., intrusive and overprotective), the additional context would only exacerbate their proneness for anxiety. On the other hand, a different form of caregiving behavior may assist in their positive social development. Furthermore, exposure to social interactions with peers may allow a child with BI the opportunity to learn positive social skills and practice them. Overall, additional work is necessary to clarify how quantity/quality of care and other features of the non-parental care context differentially predict anxiety for children with BI.

BI, Peers, and Anxiety

Recently, researchers have examined models of child behavior that incorporate both experiences in the larger peer group as well as close friendships (e.g., Laursen et al., 2007). Others have gone one step further to examine the influence of these experiences in specific populations, including those who are behaviorally inhibited or anxious (e.g., Laursen, et al., 2007). This work provides a good foundation from which future work can build upon to elucidate the impact of peer relationships on the relations between BI and anxiety over time. Specifically, researchers need to incorporate a variety of child characteristics and experiences into their models, as well as compare various models to one another (Ladd, 2006) in order to determine if the processes operating are additive, bidirectional, or transactional in nature. It is also important for researchers to extend their models into the adolescent period, as the majority of research thus far has focused childhood and the transition to adolescence (e.g., Booth-LaForce & Oxford, 2008; Gazelle & Ladd, 2003; Ladd, 2006; Oh et al., 2008).

Conclusions

Throughout the developmental and clinical child literatures, both temperament and the environment have been implicated in the pathway to anxiety. However, limited work has examined these links in temperamentally at-risk populations (for exceptions, see Table 1). Even fewer studies have explored the specific mechanisms that explain *how* these constructs influence each other over time (Figure 1). Early intervention and prevention programs for child and adolescent anxiety disorders require a more detailed analysis of the interplay between various environmental contexts, both distal and proximal to the child, and the child's temperamental reactivity to novelty and threat (i.e., BI). Furthermore, these types of investigations need to include assessments across multiple levels of analysis, including genetic, physiological, behavioral, and cognitive measures. This type of large-scale, longitudinal study would greatly inform not only the developmental literature on temperamental trajectories, but the clinical literature on the developmental psychopathology of anxiety.

Key points

- There is much debate in the literature regarding whether behavioral inhibition and anxiety are truly independent or whether they stem from the same underlying factors and the existing literature is inconclusive.
- Specific parenting factors have been linked with child anxiety, but more work needs to examine how these associations differentiate children with and without behavioral inhibition, as well as how those differences influence the development of anxiety disorders.

- Children may develop a heightened attention bias to threat from their environment through inheriting a specific pattern of genes, learning anxious behavior through modeling, and explicitly being taught how to be afraid.
- Experiences with peers can have a large impact on the trajectories of behaviorally inhibited children over time. Peer rejection, exclusion, and victimization appear to exacerbate inhibited and withdrawn behaviors in children, which may result in a higher incidence of social anxiety.

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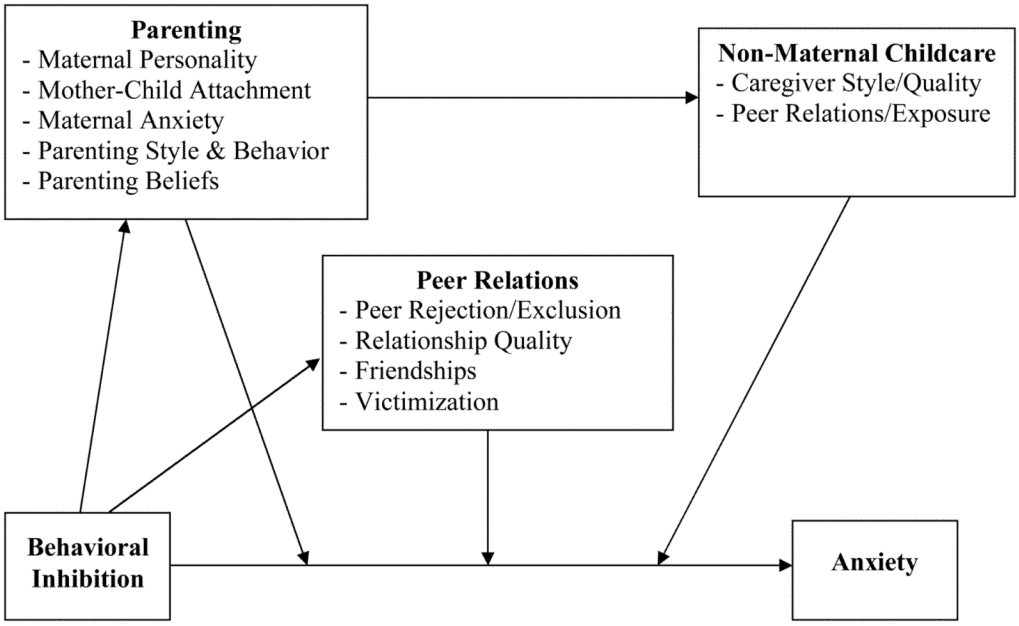

Figure 1.
Theoretical pathways from behavioral inhibition to anxiety: The potential role of environmental factors

Table 1

Studies examining behavioral inhibition and internalizing behavior problems/anxiety disorders

Citations	Ages of Assessment, in years			Environmental factors
	BI	Internalizing	Anxiety Dx	
Biederman et al. (1990)	4–7 (o)		4–7 (ca)	
Biederman et al. (1993)	2–8 (o)		5–12 (ca)	
Biederman et al. (2001)*	2–6 (o)		5–6 (ca)	Parental psychopathology (mo)
Bosquet & Egeland (2006)	7–10 days (ca)	5–6, 11, 16 (ar)	17 (ca)	
Chavira et al. (2002)	≥ 18 (sr)		≥ 18 (ca)	
Crockenberg & Leerkes (2006)*	6 months (pr)	2 (pr)		Maternal behavior (mo)
Chronis-Tuscano et al. (2009)	1–7 (ar)	14–16 (ar, sr)	14–16 (ca)	
Coplan et al. (2006)	6–14 (sr)	6–14 (sr)		
Coplan et al. (2008)*	5–6 (o, ar)	5–6 (ar)		Maternal parenting style, personality (mo)
Degnan et al. (2008)*	4 months, 4 (o)	7 (o, ar)		Maternal behavior (mo), personality (mo)
Fox et al. (2001)	1–4 (o)	4 (ar)		
Gladstone et al. (2005)	≥ 18 (sr)		≥ 18 (ca)	
Gladstone & Parker (2005)	≥ 18 (sr)		≥ 18 (sr)	
Hayward et al. (1998)	14–18 (sr)	14–18 (sr)	14–18 (ca)	
Heiser et al. (2003)	≥ 18 (sr)		≥ 18 (ca)	
Henderson et al. (2004)	1–2 (o, ar)	4 (ar)		
Hirshfeld et al. (1992)	2–7 (o)		7–8 (ca)	
Hirshfeld-Becker et al. (2007)	2–6 (o)		6–15 (ca)	
Kagan et al. (1984)	2 (o)	4 (ar)		
Kagan et al. (1999)	4 months (o)	7 (ar)		
Lemery et al. (2002)	3–4 (ar)	5 (ar)		
McDermott et al. (2009)	1–7 (o)		14–16 (ca)	
Mick & Telch (1998)	≥ 18 (sr)		≥ 18 (sr)	
Muris et al. (2007)	9–13 (sr)	9–13 (sr)		
Rankin Williams et al. (2009)*	1–2 (o)	4, 7, 14–16 (ar)		Maternal parenting style (mo)
Reeb-Sutherland et al. (2009)	1–7 (o)		14–16 (ca)	
Reznick et al. (1992)	≥ 18 (sr, ar)		≥ 18 (sr, ca)	
Rubin et al (1989)	5–6, 7 (o, peer)	9–10 (sr)		
Rubin et al. (1995)	7 (o, sr)	14 (sr)		
Rubin et al., (2002)*	2 (o)	4 (ar)		Maternal behavior (mo)
Schwartz et al. (1999)	1–2 (o)		13 (ca, o)	
Shamir-Essakow et al. (2005)*	3–4 (o, ar)		3–4 (ca)	Attachment (mo)
Stifter et al. (2008)	2 (o)	4 (ar)		
van Brakel et al. (2006)*	11–15 (sr)		11–15 (sr)	Attachment (mo), Maternal behavior (mo)

Note: Type of assessment: (o) = observational, (ar) = adult report, (sr) = self-report, (ca) = clinical assessment; Model effect: (me) = mediational, (mo) = moderational;

* denotes studies that examined an indirect effect of environment on the relations between BI and Internalizing/Anxiety

Table 2

Studies examining environmental factors in relation to internalizing behavior problems/anxiety disorders

Citations	Ages/Types of Assessment, in years		
	Environmental factors	Effect	Internalizing/Anxiety Dx
Biederman et al. (1991)*	4–7, Parental psychopathology (ca)		4–7 (ca)
Booth-LaForce & Oxford (2006)	6, 54 months, Maternal behavior (o); 24 months, Attachment (o)	me	5–11 (tr)
Brown & Whiteside (2008)	7–18, Parental behavior (cr); 7–18, Attachment (cr)		7–18 (cr)
Buehler et al. (2006)	11, parental behavior (cr); 11, Inter-parental hostility (pr, o)	me	11 (cr, pr, tr)
Crockenberg & Leerkes (2006)	6 months, Maternal behavior (o)	mo	2 (pr)
Creswell et al. (2008)*	6–12, Maternal Anxiety (ca); 6–12, Maternal behavior (o)		6–12 (ca)
de Wilde & Rapee (2008)	7–13, Maternal behavior (o)		7–13 (o)
Drake & Kearney (2008)	7–18, Family environment (pr); 7–18, Parent Psychopathology (pr); 7–18, Parent Anxiety Sensitivity (pr)	me	7–18 (cr)
Feng et al. (2008)*	1, Attachment (o); 3, Maternal depression (ca); 2, 3, Maternal behavior (o)		2–10 (pr) 10–11 (ca)
Gazelle & Ladd (2003)	5–9, Peer exclusion (tr) 5–9, Peer rejection (peer)		5–9 (tr)
Galambos et al. (2003)	11, Parenting behavior (cr); 11–14, Peer deviant behavior (cr)		11–13 (cr)
Ginsburg et al. (2004)*	6, Maternal anxiety; 6, Maternal behavior	mo	12 (cr, ca)
Hale et al. (2006)	12–19, Parental behavior (cr)		12–19 (cr)
Hastings et al (2008)	2–5, Parental behavior (pr, o)		2–5 (pr)
Hudson & Rapee (2002)	7–16, Maternal behavior (o); 7–16, Maternal anxiety (pr)		7–16 (cr)
Hudson et al. (2008)*	7–13, Maternal behavior (o)		7–13 (ca)
Hymel et al. (1990)	7, Social acceptance (peer); 7, Social isolation (o, peer)		7, 10 (tr)
Klima & Repetti (2008)	9, 11, Friendship (cr); 9, 11, Peer acceptance (tr)		9, 11 (tr)
Knappe et al. (2009)*	14–17, Parental psychopathology (ca, cr); 16–19, Parenting style (cr)		14–28 (ca)
Ladd (2006)	5–12, Peer rejection (peers, tr)		5–12 (tr)
LaGreca & Harrison (2005)	14–19, peer crowd affiliation (cr); 14–19, Peer vicitimization (cr); 14–19, Friendships (cr)		14–19 (cr)
Lansford et al. (2006)	5–13, Maternal behavior (pr)		5–13 (tr)
Laursen et al. (2007)	7–9, Social isolation/participation (peer); 7–9, Friendships (peer)	me	7–9 (cr)
Leve et al. (2005)	5, Maternal depression (pr)		5–17 (pr)
Lieb et al. (2000)*	14–17, Maternal psychopathology (pr); 14–17, Parenting style (cr)		14–17 (ca, cr)

Citations	Ages/Types of Assessment, in years		
	Environmental factors	Effect	Internalizing/Anxiety Dx
Manassis et al. (1995)	18–59, Attachment (o)		18–59 (pr)
Morrissey (2009)	2–3, Non-parental child care (pr)		2–3 (tr)
Pagani et al. (2008)	2–11, Family environment (pr), 2–11, Maternal depression (pr)		2–11 (pr)
Rosenbaum et al. (1992)*	4–7, Parental psychopathology (ca)		4–7 (ca)
Sales et al. (2008)	8–12, Maternal coping (pr)		8–12 (cr)
Shanahan et al. (2008)*	9–16, Parental characteristics (cr, pr); 9–16, Family dysfunction (cr, pr); 9–16, Peer problems (cr, pr)		9–13 (ca)
Troop-Gordan & Ladd (2005)	9–12, Peer victimization (peer)		9–12 (cr, pr, tr)
Van Leeuwen et al. (2004)	7–15, Parental behavior (pr, cr)		7–15 (pr)
Vernberg et al. (1992)	12–14, Friendship (cr); 12–14 Peer rejection (cr)		12–14 (cr)

Note: Type of assessment: (o) = observational, (pr) = parent report, (cr) = child-report, (tr) = teacher report, (ca) = clinical assessment; Indirect effect: me = mediational, mo = moderational;

* denotes studies that assessed internalizing/anxiety disorders using a clinical interview