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LONGITUDINAL ASSOCIATIONS BETWEEN TEMPERAMENT, SOCIAL COMPETENCE, AND INTERNALIZING DISORDERS RISK IN MIDDLE CHILDHOOD

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LONGITUDINAL ASSOCIATIONS BETWEEN TEMPERAMENT, SOCIAL COMPETENCE, AND INTERNALIZING DISORDERS RISK IN MIDDLE CHILDHOOD

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Abstract

While psychopathologists posit that temperament plays a critical role in internalizing disorder (i.e., depression and anxiety) risk, the mediators of this risk are poorly understood. Additionally, no previous studies have examined whether temperament traits interact to predict risk mediators. The current study examined longitudinal associations between temperament and social competence in middle childhood, a likely mediator of temperamental risk for psychopathology, using a multi-method approach. A sample of 205 7-year-old children was assessed for temperament using laboratory and parent-report measures. At age 9, these children completed a stress task that entailed social evaluation, before and after which cortisol samples were collected. Children and their parents also completed self- and parent-report measures of social competence. Associations were found between an array of temperament measures and measures of social competence. Positive emotionality moderated the effects of negative emotionality and behavioural inhibition on several indices of social competence, appearing to both buffer and exacerbate the negative effects of other traits. We found partial support for the hypothesis that social competence mediates temperamental vulnerability to psychopathology. Results of this study highlight the importance of child temperament and social competence in internalizing disorder risk in middle childhood.

Keywords: temperament; social competence; internalizing disorders; middle childhood

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Temperament and Psychopathology Risk

Temperament is defined as early emerging, stable patterns of behavioral and emotional reactivity with neurobiological underpinnings (Degnan & Fox, 2007; Rothbart & Bates, 1998). While temperament has historically been used to refer to individual differences in childhood, there is evidence that several core traits emerge early and exhibit stability across the lifespan (Caspi, 2000; Caspi et al., 2003; Shiner, 2000; John, Caspi; Robins, Moffitt, & Stouthamer-Loeber, 1994; Rothbart & Bates, 1998; Tellegen, 1985). In particular, positive and negative emotionality (PE and NE, respectively) are broad traits evident in all major models of personality and temperament. PE refers to the tendency to experience positive moods, to be interested in, and engaged with, the environment, and to seek out social interactions (Clark & Watson, 1991). NE refers to proneness to negative emotions and cognitions and high levels of perceived stress (Watson, Clark & Mineka, 1994).

The emphasis on the affective bases of these traits has generated a great deal of interest in linking these traits to affective disorder risk; in particular, contemporary research has sought to understand if, and how, individual differences in NE and PE are linked to risk for depressive and other Axis I disorders. That research, which has focused primarily on adults and adolescents, has shown that NE appears to convey a general vulnerability to psychopathology, including both anxiety and depression (i.e., internalizing disorders; Clark et al., 1994), while low PE is both concurrently and prospectively linked to relatively specific risk for depression (Clark, 2005; Clark et al.,

1994; Krueger, Caspi, Moffitt, Silva, McGee, 1996; Kotov, Gamez, Schmidt & Watson, 2010; Trull & Sher, 1994; Watson, Clark, & Carey, 1998). Child temperament may affect internalizing disorder risk in many ways such as differences in temperament affecting positive and negative experiences that children have and their reactions to such events as well as their social relationships (Goldsmith, Lemery, & Essex, 2004; Klein, Durbin, & Shankman, 2009; Nigg, 2006). Cross-sectional observational studies of young children have linked both PE and NE in childhood to markers of mood disorders risk (Durbin et al., 2005; Olino et al., 2010), although the interactive relationships between these traits and risk appear complex there is emerging literature suggesting PE may act to buffer the effects of negative temperament traits (Olino et al., 2010).

As far as other traits are concerned, a distinct literature focused primarily on children has examined the role of temperamental behavioral inhibition (BI) in psychopathology vulnerability. BI, which refers to the tendency to respond to unfamiliar stimuli with reticence and wariness, also shows continuity from early childhood to adulthood (Degnan & Fox, 2007; Fox et al., 2005). BI has been implicated in the pathogenesis of anxiety disorders (Degnan & Fox, 2007; Fox et al., 2005), although it may also be linked to depression risk (Biederman et al., 2001; Gladstone, Parker, Mitchell, Wilhelm, Malhi, 2005). For example, children of parents with anxiety disorders have been found to have increased levels of BI (Biederman et al., 1988). In sample of children identified as high in BI through laboratory observations, Rosenbaum and colleagues (1991) found that these children's parents were at significantly higher risk for multiple anxiety disorders compared to uninhibited children. In addition to general links to anxiety disorders, BI has been specifically linked to social anxiety and social phobia,

and may therefore have particularly high relevance to the development of clinically significant anxiety related to social contexts (Biederman et al., 2001; Coplan, Wilson, Frohlick, Zelenski, 2006; Essex, Klein, Stattery, Goldsmith, & Kalin, 2010; Gladstone & Parker, 2005; van Brakel, Muris, Bogels, & Thomassen, 2006).

The aforementioned research, as well as a larger body of literature not reviewed in detail here, has clearly established meaningful links between temperament and psychopathology (e.g., De Pauw & Mervielde, 2010; Nigg, 2006; Watson, Kotov, & Gamez, 2006), at least in adolescence and adulthood. However, the mediators of this risk are poorly understood, due to the fact that few studies have tested theoretically plausible pathways using longitudinal methods that span important developmental periods (Caspi, Moffitt, Newman, & Silva, 1996; van Os et al., 1997). Additionally, the relationships between temperament and disorder are likely highly complex, as described in detail by Klein and colleagues (2009) and the various models are somewhat difficult to empirically contrast and test. More specifically, a number of pathways likely tie childhood temperament to disorder; for example, work examining how childhood emotional temperament influences information processing biases linked to depression has provided supportive results (Degnan & Fox, 2007; Hayden, Klein, Durbin, & Olino, 2006). The present research aims to examine whether social competence is an additional mediator of the vulnerability to internalizing disorders conferred by temperament.

Social Competence

Social competence generally refers to social interest/engagement, social skills and social success (Rubin et al., 2006; Sallquist et al., 2009), and has been shown to have important implications for children's psychological health and disorder (Booth-LaForce

& Oxford, 2008; Rubin et al., 2009; Sallquist et al., 2009). Booth-LaForce and Oxford (2008) identified distinct trajectories of children with low social competence based on teacher report measures and parent-reported measures of inhibited temperament. Specifically, children characterized as socially withdrawn were compared across grades 1 through grade 6. Children following a trajectory of increased social withdrawal (compared to children with decreasing levels of withdrawal, or those who were never withdrawn) reported increased levels of loneliness, depression, and victimization and exclusion by their peers. This study was limited in that measures of child depressive symptoms were based on teacher reports, which may have underestimated child depressive symptoms (Verhulst, Dekker, & van der Ende, 1997).

In related research, Oh and colleagues (2008) identified three trajectories reflecting groups of children characterized by stable, low levels of social withdrawal, decreasing social withdrawal, and increasing social withdrawal. Children whose social withdrawal increased were found to experience the greatest amount of peer exclusion and peer victimization, whereas those in the decreasing trajectory group experienced less victimization and exclusion. While this work has clear implications for children's psychopathology risk, measures of depressive and anxious symptoms were not included, so it is unclear how children in these trajectories differed in risk for internalizing disorders. Similarly, as measures of temperament were not collected, it is unknown whether child temperament was associated with social competence in this study.

Temperament and Social Competence

The work showing that social competence in childhood predicts internalizing symptoms and related outcomes is complemented by work on the role of temperament in

shaping children's social competence. Much of this work has focused on the role of BI in shaping social competence in later childhood. BI may be an important early predictor of the development of social competence, considering that inhibited children, who by definition tend to withdraw from novel experiences, will obtain fewer opportunities to practice and learn about social interactions, relative to uninhibited children (Bohlin, Hagekull, & Andersson, 2005). Numerous studies have found that BI is negatively related to successful peer interactions (Broberg, 1993; Kochanska, 1998; Kochanska & Radke-Yarrow, 1992; Reznick et al., 1986, Rubin et al., 1997).

Less is known about the role of other temperament traits in shaping children's social competence; in particular, PE may have relevance for children's social competence, considering that interest in social interaction is considered a core facet of this trait (Watson, Clark & Carey, 1988). Children higher in PE may find social interactions more intrinsically rewarding, which may lead such individuals to seek out the company of others, thus fostering the development of better interpersonal and social skills. A study of emotion and social competence in preschoolers found that higher levels of observed PE predicted greater teacher-rated social competence at a one-year follow up (Denham, Blair, DeMulder, Levitas, Sawyer, Auerbach-Major & Queenan, 2003), but little is known about associations between PE and social competence in middle and late childhood. Also, it is important to note that negative outcomes have also been associated with high PE. For example, high intensity PE has been associated with difficulties in emotion regulation (Kochanska et al., 2000) and socially inappropriate behaviors in school (Sallquist, Eisenberg, Spinrad, Reiser, Hofer et al., 2009). Additionally, parent-rated child exuberance and high intensity pleasure (i.e., pleasure expressed via high-

intensity behaviors, typically in exciting and intense contexts, cf. contentment or pleasure derived from quiet activities) have been related to externalizing problems in childhood (Oldehinkel et al., 2004; Rydell et al., 2003), suggesting that complex associations may exist between PE and the development of social competence and other important outcomes.

In addition to examining associations between PE and NE and how these traits individually are associated with social competence and internalizing disorder risk, interactive effects between these temperament traits are possible. The few studies that have examined interactions between these temperament traits in adolescent and adult samples have yielded equivocal findings (Gershuny & Sher, 1998; Joiner & Lonigan, 2000; Kendler et al., 2006; Wetter & Hankin, 2009). Olino and colleagues (2010) examined interactions between laboratory assessed temperament and parental depression history, a marker of children's own risk, in a preschool sample. Associations between BI and NE and rates of parental depression were moderated by interactions with PE, but in complex and unexpected ways. Whereas this study provides preliminary support for interactive effects of temperament predicting a marker of depression risk, it is unclear whether interactions between temperament traits influence putative mediators, such as children's emerging social competence. The very limited amount of research on this topic makes it clear that additional work examining prospective associations between multiple temperament traits and potential mediators of risk for disorder is needed.

Psychophysiological Reactivity to Social Challenges

With respect to mediators, it is important to note that there are many different ways of operationalizing social competence. However, psychophysiological reactivity to

standardized socially evaluative tasks is an especially promising approach, as it provides an objective measure of reactivity obtained under controlled circumstances. In their meta-analysis of laboratory-based stressors used in adult samples, Dickerson and Kemeny (2004) showed that tasks containing both uncontrollable and social-evaluative elements produced the largest cortisol changes and longest times to recovery. The importance of social evaluation in eliciting a cortisol response suggests that individual differences in psychophysiological responses to social stress paradigms may be an important marker of social competence/engagement.

Less is known about key methodological aspects of children's cortisol responses. Lopez-Duran and colleagues (2009b) found marked variability in the time to reach peak cortisol responses in seven-year-old children, ranging from 10 to 45minutes post-stress in a review of studies using fear and frustration paradigms. This variability may be partially due to paradigm characteristics. The Trier Social Stress Task (TSST; Buske-Kirschbaum et al., 1997), which includes a social-evaluative component, typically elicits a cortisol response 25 minutes post-stress, whereas paradigms using cognitive challenges elicit later peak responses (i.e., 45 minutes post-stressor, Lopez-Duran et al., 2009b). In addition to identifying individual variability in peak cortisol responses, Lopez-Duran and colleagues found a consistent and marked decline in cortisol levels following arrival at the laboratory, suggesting that arriving at a novel laboratory setting is associated with an increase in children's cortisol levels. Such levels were found to be lowest 30-40 minutes after arrival, suggesting that baseline samples acquired prior to stress tasks need to be obtained after an acclimatization period to allow children's cortisol to decline to "baseline" levels.

Although many studies have investigated links between temperament and physiological reactivity, particularly BI (Essex, Klein, Slattery, Goldsmith, & Kalin, 2010; Gunnar et al., 2009; Schmidt et al., 1997), few have examined associations between temperament and psychophysiological reactivity to stress entailing social evaluation (Stroud et al., 2009; Tykra et al., 2007). The literature on BI has linked this trait to hypothalamic-pituitary-adrenal (HPA) axis hyperactivity and high basal cortisol levels in both children and adults (Kagan, Reznick, & Snidman, 1988; Kertes, Donzella, Talge, Garvin, Van Ryzin, & Gunnar, 2009; Stansbury & Gunnar, 1994), but whether BI is linked to children's cortisol responses to socially-evaluative stress, such as that indexed via the TSST, in unclear. Recent cross-sectional studies using the TSST-C to examine stress reactivity during middle and late childhood have found differences in patterns of reactivity related to age and depressive symptoms (Hankin et al., 2009; Gunnar et al., 2009), however, measures of temperament have not been included in these studies.

Summary and Current Study

Although temperament traits, particularly PE and NE, have been identified as important risk markers for the development of internalizing disorders, potential mediators of this temperamental vulnerability are not well understood. Additionally, most of the research on temperament and disorder risk has focused on adolescence and adulthood, and many studies that do examine putative child temperamental risk are not longitudinal, and predict risk markers rather than children's internalizing symptoms. To address these gaps in the literature, we examined links between temperament and social competence in children who were seven-year-olds at the initial assessment, and nine-year-olds at follow-up when social competence/engagement was assessed. We chose to focus on this age

range because reduced social competence/engagement, especially socially reticent or solitary behaviors, may have particularly negative consequences for children this age (e.g., Rubin, Chen & Hymel, 1993).

We used a multi-method assessment approach, consisting of laboratory and parent report measures of child temperament at baseline, and self-, parent-, and laboratory-assessed measures of children's social competence/engagement at follow-up, including behavioral and hormonal (i.e., cortisol) responses to the TSST. Parent- and child self-reported symptoms of psychopathology were also collected at baseline and follow-up. Child- and parent-reported child symptoms are often only moderately correlated at best (De Los Reyes & Kazdin, 2005; Jensen, Rubio-Stipec, Canino, Bird, Dulcan, et al., 1999; Klein, 1991). The same is true of parent-reported and observed measures of child temperament (Durbin, Klein, Hayden, Buckley, & Moerk, 2005). Because the literature suggests poor agreement between parent and other reporters of child temperament and psychopathology, it is not anticipated that aggregation of study constructs across informants will be possible.

We predicted that social competence in middle childhood would be associated with prospective measures of temperament traits, such that PE, NE, and BI will be associated with social competence indexed by laboratory, self-, and parent-reported measures of social competence. Interactive effects between temperament traits on children's social competence will also be examined. High BI is expected to have relatively specific effects on psychophysiological reactions to social evaluation, such that children characterized by high BI will exhibit a higher peak cortisol response to the TSST compared to children low in BI. Social competence is expected to mediate links between

temperament and symptoms of anxiety and depression.

METHOD

Participants

A community sample of 205 7-year-old children and their parents were recruited from London, Ontario and the surrounding areas. Participants were recruited through a psychology department database, and advertisements placed in local newspapers and online. Children with a diagnosis of any psychological or developmental disorder were not eligible to participate. Families were compensated monetarily for their participation.

Sample Characteristics

The sample consisted of approximately equal numbers of boys ($N = 96$; 46.83%) and girls. The mean age of children at study enrollment was 88.44 months ($SD = 3.58$; range: 84 to 96 months). The Peabody Picture Vocabulary Test, Fourth Edition (PPVT-IV; Dunn & Dunn, 2007) was administered as a general screener of the cognitive functioning of participants. Age- and grade-based standard scores for the PPVT have a mean of 100 and standard deviation of 15. Children in the current study performed within the normal range ($M = 111.92$; $SD = 12.15$).

Parents identified their child's race as Caucasian ($N = 180$; 87.8%), Asian ($N = 4$; 1.9%) or other ($N = 16$; 7.8%). The vast majority of the children ($N = 187$; 91.2%) came from two-parent homes. Approximately half of the families participating ($N = 103$; 50.2%) reported a family income ranging from $40,000-$100,000; 26.8% ($N = 55$) of families reported a family income greater than $100,000, and 15.1% ($N = 31$) of families reported a family income of less than $40,000. Almost half of the mothers ($N = 100$; 48.7%) and fathers ($N = 107$; 52.2%) reported that they either graduated from high school

(or received a GED), attended some college, or received a 2-year degree as their highest level of educational attainment. Just under half of the mothers ($N = 93$; 45.3%) and approximately one-third of the fathers ($N = 78$; 30.1%) received a 4-year college/university degree or beyond. A small proportion of mothers ($N = 6$; 2.9%) and fathers ($N = 10$; 4.8%) did not finish high school. These sample characteristics are comparable to data pertaining to race, income and educational attainment reported in the 2006 census for London, Ontario (Statistics Canada, 2008). The mean age of parents was 37.48 years ($SD = 8.96$) for mothers and 40.43 years ($SD = 11.50$) for fathers. Only data from mothers are included in the present study.

Measures

Baseline Laboratory Assessment of Temperament

Child temperament was assessed using an hour-long battery of laboratory tasks based on the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith et al., 1995) adapted to be appropriate for older children. Tasks were designed to elicit individual differences in emotionality (PE, BI, and aspects of NE including sadness, fear, and anger/frustration). Furthermore, tasks simulated naturalistic events likely to be experienced by children in their everyday lives (e.g., being allowed to play with a novel toy, interacting briefly with a stranger, or attempting to complete a frustrating puzzle), and were ordered to minimize carry-over effects in that no episodes presumed to evoke a similar affective response occurred consecutively. Children were also provided with a short break between tasks in order to return to a baseline state. Tasks were video-recorded for coding and are described below in the order that they were administered along with the traits they were designed to elicit.

Exploring New Objects (BI, Fearfulness, PE)

The child was left alone to play freely in room containing several ambiguous or mildly "scary" objects: a cloth tunnel and tent, a remote-controlled spider, a plastic skull covered with a red cloth, a Halloween mask, and a box containing a plastic beating heart and fake spider webs. After four minutes, the experimenter returned and asked the child to approach and touch each object.

Racing Cars (Anger, Sadness, PE)

The child was given photographs of an exciting/desirable toy (a remote-controlled race car) and of a relatively boring toy (a small plastic doll with unmoving parts) and was told to choose which s/he wanted to play with. Next, the child was told that the requested toy was lost and was given the non-preferred toy to play with. Following a short delay, the desirable toy was given to the child.

Stranger Approach (BI, Fearfulness)

The child was left alone in the main experimental area to play with a toy golf set. Following a short delay, a friendly male research assistant entered the room. The stranger attempted to engage the child following a scripted set of prompts and gradually approached the child. The experimenter then returned and introduced the stranger as her friend.

Frustrating Puzzle (Anger, Sadness)

The child was left alone to complete a puzzle that the experimenter said was easy but actually contained pieces that would not fit together. After 3 minutes, the experimenter returned and explained that she had made a mistake and had given the child the wrong pieces. The child was then given the correct pieces and allowed to complete

the puzzle.

Practical Joke (PE)

The experimenter showed the child how to use a remote-controlled whoopee cushion, and the child was invited to surprise his/her parent with the toy when they sat in a chair in the experimental room.

Object Fear (BI, Fearfulness)

The child was shown a pet carrier and told that it contained "something scary." The child was instructed to look inside and subsequently left alone in the room. If the child did not look inside the carrier after 1 minute, the experimenter returned and showed him/her that the carrier actually contained a stuffed toy animal.

Toy Parade (PE)

The child was given a bell and told that each time they rang it, a research assistant would bring them a new toy, but that they would have to trade in the toy they had for the new toy. Toys were intended to be fun and included Mr. Potato Head, a Fun Hop, a Gearation Toy, a floor piano and guitar, and legos.

Coding procedures.

Undergraduate, post-baccalaureate, and graduate student raters blind to other study data coded all videos (N = 8 total coders). As part of the training process, raters coded videos with a trained "master" coder. Trainees then coded sets of 10-15 videos independently until they were able to code 5 videos with a minimum ICC = .80. Ongoing reliability checks were done to maintain minimum interrater reliability (minimum ICC =.80) for all episodes. Each undergraduate and post-baccalaureate coder rated sets of 20 videos, and half of all coders' affect coding was also coded by the master coder, and if

the ICC was below .80, raters met with the master coder to discuss the video and make a final rating. Videos rated by more than one coder were averaged and the average rating was used for all analyses.

Each display of facial, bodily, and vocal positive affect, fear, sadness, and anger in each episode was rated on a 3-point scale as low, moderate, or high. The number of instances of moderate and high behaviors were weighted to account for their greater intensity (e.g., N of moderate intensity smiles*2; N of high intensity vocal sadness*3). After weighting, the total number of low, moderate, and high intensity behaviors were summed separately within each channel (facial, bodily, vocal) across the seven episodes and summed across the three channels to derive total scores for positive affect (referred to as PE henceforth), fear, sadness, and anger. NE was the sum of the standardized total sadness, fear, and anger variables (). Temperament scale internal consistencies, indexed by Cronbach's α, were all moderate: PE (54 items; $\alpha = .75$) NE (162 items; $\alpha = .52$), anger (54 items; $\alpha = .52$), fear (54 items; $\alpha = .57$) and sadness (54 items; $\alpha = .59$).

In addition to the affective coding, behavioral coding was applied to two tasks designed to assess BI (Exploring New Objects and Object Fear). This coding system was designed to assess traditional behavioral components of BI, such as approach, withdrawal, and fear responses. More specifically, latencies to approach, touch, and look at lab stimuli were coded, as well as withdrawal attempts (attempts to leave the room or withdraw from lab stimuli), and tentativeness in interacting with novel stimuli was rated. Reverse coding of variables was used as needed and ratings were summed across tasks to derive a total BI score (Cronbach's $\alpha = .73$). As with the affect coding, post-baccalaureate, and graduate student raters blind to other study data coded all videos, and

ongoing reliability checks were done to maintain minimum interrater reliability (minimum ICC =.80) for all episodes.

Child Assessment: Home Visit and Parent-Report Questionnaires

Following the laboratory assessment, a home visit took place with each family an average of 40.02 days (SD = 29.65) later. During the home visit, children completed questionnaires assessing symptoms of anxiety and depression. For each questionnaire, an experimenter read items aloud to the child and recorded children's responses. Child self-report questionnaires included the Revised Children's Manifest Anxiety Scale (Reynolds & Richmond, 1978) and Depression Self Rating Scale (Birleson, 1981). Parents completed measures of child temperament (Temperament in Middle Childhood Questionnaire, Simonds & Rothbart, 2004) and child psychopathology (Child Behavior Checklist/4-18, Achenbach, 1991).

Revised Children's Manifest Anxiety Scale (RCMAS)

The RCMAS (Reynolds & Richmond, 1978) is a 37-item self-report measure designed to assess the level and nature of anxiety in children between the ages of 6 and 19 years. Children answer yes or no to each item on the RCMAS. For example, "I get nervous when things do not go the right way for me". This measure, which has demonstrated reliability and validity (e.g., Muris et al., 1998; Muris et al., 2002), yields a total anxiety score as well as three subscales; the total score was used in the present study. The RCMAS total score demonstrated good internal consistency (Cronbach's α= 0.84). Consistent with other community samples (e.g., Turgeon & Chartrand, 2003), the overall average was low (M = 15.49, SD = 6.38).

Depression Self Rating Scale (DSRS)

The DSRS (Birleson, 1981) is a 24-item self-report measure of depression in children and youth, with items tapping affective, cognitive, behavioral, and somatic symptomatology (Asarnow & Carlson, 1985; Kazdin & Petti, 1982). Children answer "most of the time", "sometimes", or "never" to each item on the DSRS. For example, "All I can see ahead of me is unpleasantness rather than pleasantness". DSRS scores demonstrated good internal consistency (Cronbach's $\alpha = 0.73$). The average score in the current sample was 12.44 ($SD = 5.32$), which is comparable to that observed in other nonclinical samples (e.g., Asarnow & Carlson, 1985; Hayden et al., 2006).

Temperament in Middle Childhood Questionnaire (TMCQ)

The TMCQ (Simonds & Rothbart, 2004) is a 5-point scale, 157-item parent-report measure of temperament for children between the ages of 7 and 10, and is an upward adaptation of the Children's Behavior Questionnaire (Rothbart, Ahadi, Hershey, & Fisher, 2001). The surgency factor, based on Rothbart and colleagues' (2001) factor analysis, was used as an indicator of child PE. This factor consists of 35 items and is the aggregate of the activity, assertion/dominance, high intensity pleasure, impulsivity and shyness (reverse scored) scales. An example item from the assertion/dominance scale on the surgency factor is "is first to speak up in a group". The Anger/Frustration (e.g., "gets angry when called in from play before s/he is ready to quit"), Sadness (e.g., "tends to become sad if plans don't work out"), and Fear (e.g., "is afraid of heights") scales were used as measures of facets of NE, and an aggregate NE factor was made based on Rothbart et al.'s factor analysis consisting of 44 items (including the anger, discomfort, fear, sadness and soothability (reverse scored) scales). The TMCQ does not measure BI per se. The shyness scale, however, may tap related behaviors in a social context, and

was therefore included as a parent-reported indicator of BI-related behavior. The shyness scale was composed of 5-items such as, "becomes self-conscious when around people". The internal consistencies for all TMCQ scales that comprised the PE and NE factors were moderate to good, ranging from .54 to.88.

Child Behavior Checklist (CBCL/4-18)

The CBCL (Achenbach, 1991) is a widely used measure designed to identify social, emotional, and behavioral problems in children, and was used as a measure of parent-reported child psychopathology. Parent ratings were made on a 3-point scale: "not true", "sometimes/somewhat true", or "often/always true". Traditional scoring of the CBCL yields standard scores for 8 empirically derived problem areas as well as three composite scores assessing overall Internalizing, Externalizing, and Total Problems (Achenbach, 1991). Although such scales differentiate between clinical and nonclinical samples (e.g., Achenbach, 1991; Drotar, Stein, & Perrin, 1995; Rishel, Greeno, Marcus, Shear, & Anderson, 1995), the lack of correspondence between items in these scales and diagnostic criteria for various disorders makes them less useful for differentiating among specific disorders (see Lengua, Sadowski, Friedrich, & Fisher, 2001). Given that the presence and severity of symptoms of anxiety and depression were of primary interest, alternative scale scores derived to be consistent with DSM-IV diagnostic criteria for anxiety and depressive disorders were used (Lengua et al., 2001). The depression scale consisted of 12 items, for example "complains of loneliness". The anxiety scale consisted of 7 items, for example "too fearful or anxious". The internal consistencies of maternal reports of anxiety (Cronbach's $\alpha = 0.64$) and depression (Cronbach's $\alpha = 0.64$) were moderate. Average scores for anxiety ($M = 1.49$, $SD = 1.87$) and depression ($M = 1.38$,

SD = 1.87) were low and consistent with published means reported for a community sample (Lengua et al. 2001). As baseline symptom scores were primarily of interest as control variables in analyses predicting symptoms at follow-up, their associations with other study variables will not be presented in detail.

Follow-up Assessment

At age 9, children (*N* = 168) and their primary caregivers were recruited for follow-up data collection comprised in part of questionnaire measures of child symptoms and child social competence. Most of these children (*N* = 155) also participated in a follow-up laboratory visit approximately 2 years after the initial assessment (mean time between visits = 2.1 years, SD = .35). There were no significant differences in PPVT scores, sex, psychopathology symptoms, or temperament comparing participants who participated in the follow-up to those who did not (all *ps* > .11). During the laboratory visit, children completed a laboratory task designed to assess emotional, behavioral and physiological reactions to a social stressor. All lab visits began between 12:00pm and 3:30pm in the afternoon to control for diurnal variation in cortisol levels (Gunnar & Talge, 2005; Meewisse, Reitsma, de Vries, Gersons, & Olff, 2007). The laboratory visit took approximately 2 hours to complete. Procedures are described below in the order they occurred. A list of all study measures is provided in Table 10 (in Appendix A).

Trier Social Stress Test for Children (TSST-C)

Children participated in a modified version of the TSST-C (Buske-Kirschbaum et al., 1997). Upon arrival at the laboratory, children played with a quiet activity or watched a family-friendly movie for 30 minutes, to allow any potential increase in salivary

cortisol due to the arrival at the laboratory to return to baseline levels before sampling began (Tottenham, Parker, & Lui, 2001). During this time, children were encouraged to stay seated and engage in minimal activity, to avoid a cortisol increase related to physical activity (Jansen, Gispen-de Wied, Jansen, van der Gaag, Matthys, & van Engeland, 1999). After 30 minutes, a baseline salivary cortisol sample was collected, followed by the completion of the TSST-C.

After collecting the baseline sample, the child was brought to the testing room where they were told that they were being asked to complete a story for two "story judges," actually two student research assistants. The main experimenter provided the beginning of the story to children, and children were told that they would have 3 minutes to prepare a middle section and ending for the story (see Appendix B and C for more detailed study procedures). To increase the extent to which the task elicited anxiety, children were told that their story should be as exciting as possible, and better than the stories of other children. During the three-minute preparation period, the main experimenter remained in the room and was silent, except to answer any questions the child had regarding preparing the story. After the preparation period, the two research assistants entered the room. To increase the anxiety-provoking nature of the task, children were given a microphone to speak into and a video camera was held by one of the research assistants.

A research assistant directed the child through the TSST-C, prompting them to begin their story and to continue as necessary for a total duration of 5 minutes (see Appendix B for script). After this 5 minute period, the research assistant instructed the child to complete a subtraction task by counting backwards from the number 758 by the

number 7, and told the child that they should do this as fast and as accurately as possible. The research assistant stopped the child and asked him/her to start again following all mistakes. The subtraction task also lasted 5 minutes. Following this, children were asked to tell the research assistants about themselves and their personality in response to a series of prompts from the RA. Children were prompted to continue for 5 minutes or until all of the prompts had been repeated twice. Immediately following completion of the TSST-C, the children were praised and thanked for participating by the research assistants. Children were also given a prize by the main experimenter following the task and told again that they had done an excellent job at the task.

Cortisol Sampling Procedure

In addition to the baseline sample previously described, cortisol samples were obtained at ten-minute intervals following completion of the task (i.e., at 0, 10, 20, and 30 minutes following the end of TSST-C) for a total of four samples post-stressor to permit us to more accurately capture individual differences in time to peak cortisol response (Lopez-Duran et al., 2009). Cortisol can be readily indexed noninvasively through salivary assays, and such methods have been found to yield cortisol levels comparable to serum cortisol levels collected from blood samples (Dorn, Lucke, Loucks, & Berga, 2007); hence, this approach is more feasible and appropriate in research aimed at characterizing stress responsivity in childhood (Kryski, Smith, Sheikh, Singh, & Hayden, *in press*). To collect saliva, the children were asked to chew on an absorbent cotton dental roll until it was wet with saliva; saliva was subsequently expunged from the rolls for analysis. All samples were frozen immediately following the laboratory visit.

Samples were later taken to a laboratory at the University of Western Ontario to

be assayed in duplicate using an expanded range, high sensitivity, salivary cortisol enzyme immunoassay kit (Salimetrics, PA). It is often the case that cortisol distributions are positively skewed (Gunnar & Talge, 2005) and this was true for the data obtained in this study. To address this, as is standard in this literature, a log10 transformation of the raw cortisol values produced unskewed cortisol values which were used in all analyses. To capture individual variation in the timing of peak cortisol responses to the TSST, each child's sample with the highest concentration of cortisol post-stress was identified from the four possible samples and was used for analyses (controlling for their baseline cortisol levels).

Measures

With the help of a research assistant, children completed questionnaires assessing symptoms of anxiety and depression. The questionnaires were the same as those used during their initial lab visit, and included the RCMAS (Cronbach's α = .89) and the DSRS (Cronbach's α = .86). Average RCMAS and DSRS scores were again low and consistent with those reported in other community samples of children this age (e.g., Turgeon & Chartrand, 2003).

The child's mother completed the same measure of child psychopathology (CBCL/4-18, Achenbach, 1991), again yielding measures of depression (Cronbach's α = .73) and anxiety (Cronbach's α = .66) following procedures developed by Lengua et al. (2001), as described for the baseline assessment. Average scores for anxiety and depression were low and consistent with published means for a community sample (Lengua et al., 2001).

Social Skills Improvement System (SSIS)

As measures of social competence at follow-up, the mother and child completed the SSIS (Gresham & Elliott, 2008), which is designed to assess children's social skills and problem behaviors. Although the SSIS has multiple scales reflecting social competence, the engagement subscale was used in analyses as it has the greatest conceptual overlap with the social behaviors of interest in the present study. The SSIS social engagement scale consists of 7 items, for example "I make friends easily" rated on a 4-point scale.

The internal consistency of child (Cronbach's $\alpha = 0.73$) and mother (Cronbach's $\alpha = 0.79$) ratings of SSIS engagement were adequate, and the average scores for both child self- and parent-rated social skills were consistent with published means (Gresham & Elliott, 2008) reported for a community sample.

TSST-C Coding Procedure

To collect observational measures of behaviors relevant to social competence/engagement, ratings were made of children during each section of the TSST-C (i.e., the story, subtraction, and self-description sections; see Appendix D) by coders blind to all other measures. Several different coding systems derived from past research were used (Durbin et al., 2005). More specifically, social interest was rated on an 11-point scale, with higher scores reflecting more behaviors indicative of interest in interacting with others during the lab visit (e.g., initiating interactions, social referencing). The presence and degree of socially anxious (e.g., nervous smiling, sad responses to criticism) and avoidant behaviors (e.g., lack of eye contact, little social reciprocity) were rated on a 5-point scale, and overall sociability was rated on 3-point scale (low, moderate, and high). Ratings of social interest, social anxiety, social

avoidance, and overall sociability were averaged across the three sections of the TSST. Sociability and social interest rating scales were highly correlated (r = .83) and were therefore standardized and combined into a total laboratory social engagement/competence scale. A composite scale reflecting social fear and avoidance behaviors was also created, as these were also highly correlated (r = .60). Undergraduate and graduate student raters coded all videos, and were supervised by a trained graduate student "master" coder. For training purposes, raters coded approximately 5 videos together with the master coder. Trainees then coded sets of 5-10 videos independently until they were able to code at least 5 videos with no ICC lower than .80. Ongoing reliability checks were done to maintain minimum interrater reliability (minimum ICC =.80) for all codes.

Results

Correlational Analyses

Associations between temperament and social competence/engagement, social competence/engagement and symptoms, and temperament and symptoms are presented in Tables 1-5. A preliminary examination of cross-method/informant correlations across related constructs revealed, as expected, low to moderate associations between the two measures of temperament (mean r = .13, range = .01 - .31), measures of symptoms (mean r = .15, range= .12 - .18), and parent- and child-reported social engagement (r = .12). Hence, the various measures of similar constructs were not combined for analyses.

Bivariate associations between laboratory measures of temperament traits and social competence are presented in Table 1. As expected, laboratory anger at age 7 was significantly negatively correlated with child self-report social competence (r = -.16) and

TSST fear/avoidance (r = -.16). Also consistent with predictions, PE at age 7 was positively correlated with TSST social engagement/competence (r = .24) and showed trend-level negative associations with TSST fear/avoidance (r = -.15). Trend-level negative correlations were found for laboratory NE at age 7 and parent-reported social competence (r = -.13), as well as laboratory sadness (r = -.12) and anger (r = -.11) and TSST social engagement/competence. Laboratory fear was negatively correlated with parent-reported social competence (r = -.14) at trend level and unexpectedly, negatively correlated with TSST social fear/avoidance (r = -.12) at trend level. Laboratory fear was also positively correlated with peak cortisol reactivity (r = .15) at a trend level. Laboratory-assessed BI was negatively correlated with parent-reported social engagement/competence (r = -.13) at trend level and positively correlated with TSST peak cortisol reactivity (r = .25).

Associations between parent-reported temperament and social competence are presented in Table 2. Associations between negative emotionality and social competence were found, as predicted: parent-reported NE (r = -.43), anger (r = -.35), fear (r = -.25), sadness (r = -.32), and shyness (r = -.41) were negatively correlated with parent-reported social competence at age 9, while only parent-reported anger at age 7 was associated with child-reported social competence (r = -.19) at age 9. Parent-reported shyness at age 7 was negatively correlated with TSST social engagement/competence (r = -.24), positively correlated with TSST fear/avoidance (r = .25), and positively correlated with peak cortisol reactivity to the TSST (r = .21). Parent-reported surgency was positively correlated with parent-reported social engagement/competence at age 9.

Table 1

Correlations Between Age Seven Laboratory-assessed Temperament and Age Nine Social Competence.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
1. Laboratory Negative Emotionality	--										
2. Laboratory Anger	.61**	--									
3. Laboratory Fear	.58**	.00	--								
4. Laboratory Sadness	.67**	.15*	.08	--							
5. Laboratory Positive Emotionality	.08	.15*	.03	-.01	--						
6. Laboratory Behavior Inhibition	.19**	-.18**	.52**	-.01	-.17*	--					
7. Self-reported Social Engagement/Competence	-.05	-.16*	.06	-.02	-.12	.08	--				
8. Parent-reported Social Engagement/Competence	-.13†	-.01	-.14†	-.08	.00	-.13†	.16*	--			
9. TSST Social Engagement/Competence	.04	.13†	.10	-.12†	.24**	.04	.09	.15†	--		
10. TSST Social Fear/Avoidance	-.11	-.16*	-.12†	.06	-.15†	.00	-.11	-.15*	-.69**	--	
11. TSST Peak Cortisol[₮]	.03	-.09	.15†	.00	-.10	.25**	.05	-.10	-.11	.11	--
Mean	.00	.00	.00	.00	.00	17.57	15.45	14.92	.00	.00	-.89
Standard Deviation	.45	.71	.73	.74	.81	13.96	3.44	3.07	.94	.88	.27

† $p < .10$; * $p < .05$; ** $p < .01$.

Note: Raw cortisol values were log 10 transformed to produced unskewed cortisol variables and these transformed variables were used in all analyses. Cortisol levels are measured in microgram per deciliter (μg/dl).TSST = Trier Social Stress Test.

[₮] All correlations between TSST peak cortisol and other study variables are partial correlations, controlling for baseline cortisol levels.

$N = 155$

Associations between social competence and children's depressive and anxious symptoms at age 9 are presented in Table 3. Child-reported social engagement/competence was negatively correlated with child-reported depressive (r = -.31) and anxious symptoms (r = -.23) at age 9. Parent-reported social competence also showed significant, negative correlations with parent (r = -.16) and child reported (r = -.16) depressive symptoms at age 9. Laboratory social engagement/competence and peak cortisol reactivity (adjusting for baseline cortisol levels) at age 9 were unrelated to child and parent-reported symptoms.

Correlations between laboratory assessed temperament at age 7 and child- and parent-reported depressive and anxious symptoms at age 9 are presented in Table 4. Unexpectedly, laboratory positive emotionality at age 7 was positively correlated with child-reported anxiety at age 9 (r = .16). No other associations between laboratory measures of temperament and symptoms were found. Parent-reported negative emotionality was significantly, positively correlated with parent- (r = .26) and child-reported (r = .16) depression at age 9 and child reported anxiety (r = .15) at age 9 (Table 5). Parent-reported anger showed similar positive correlations with parent-reported depression (r = .24), child-reported anxiety (r = .20), and child-reported depression (r = .25) though stronger correlations were found between parent-reported anger and child symptoms than for parent-reported NE and symptoms. Parent-reported fear was positively

Table 2

Correlations Between Age Seven Parent-reported Temperament and Age Nine Child Social Competence.

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. Parent-reported Negative Emotionality	--									
2. Parent-reported Anger	.66**	--								
3. Parent-reported Fear	.71**	.25**	--							
4. Parent-reported Sadness	.83**	.53**	.45**	--						
5. Parent-reported Shyness	.54**	.22**	.32**	.35**	--					
6. Parent-reported Surgency	-.15*	.26**	-.25**	-.14*	-.21**	--				
7. Self-reported Social Engagement/Competence	-.06	-.19*	.14†	-.07	-.02	-.03	--			
8. Parent-reported Social Engagement/Competence	-.43**	-.35**	-.25**	-.32**	-.41**	.20**	-	--		
9. TSST Social Engagement/Competence	-.07	-.08	.04	-.06	-.24**	.02	-	-	--	
10. TSST Social Fear/Avoidance	.03	.06	-.09	.01	.25**	-.03	-	-	-	--
11. TSST Peak Cortisol ₸	.01	-.12	.00	.00	.21**	-.11	-	-	-	-
Mean	81.27	20.69	23.47	26.42	13.20	104.27	-	-	-	-
Standard Deviation	21.90	4.92	5.64	5.19	4.16	12.20	-	-	-	-

† $p < .10$; * $p < .05$; ** $p < .01$.

Note: Raw cortisol values were log 10 transformed to produced unskewed cortisol variables and these transformed variables were used in all analyses. Cortisol levels are measured in microgram per deciliter (μg/dl).TSST = Trier Social Stress Test

₸ All correlations between TSST peak cortisol and other study variables are partial correlations, controlling for baseline cortisol levels.

$N = 155$

Table 3

Correlations Between Age Nine Child Social Competence and Age Nine Child- and Parent-reported Anxious and Depressive symptoms.

	Child-reported Social Engagement/ Competence	*Parent-reported Social Engagement/ Competence*	*TSST Social Engagement/ Competence*	*TSST Social Fear/Avoidance*	*TSST Peak Cortisol*	*Mean*	*SD*
Age 9 Parent-reported Anxiety	.01	-.06	-.01	.04	.06	1.63	1.78
Age 9 Parent-reported Depression	-.10	-.16*	.05	.03	-.08	1.72	2.45
Age 9 child self-reported Anxiety	-.23**	.03	.10	.05	-.10	10.48	6.79
Age 9 child self-reported Depression	-.31**	-.16*	.02	.07	-.09	14.10	7.22

† $p < .10$; * $p < .05$; ** $p < .01$.
Note: $N = 155$

Table 4

Correlations Between Age Seven Laboratory-assessed Temperament and Age Nine Child Anxious and Depressive Symptoms.

	Laboratory Negative Emotionality	*Laboratory Anger*	*Laboratory Fear*	*Laboratory Sadness*	*Laboratory Positive Emotionality*	*Laboratory Behavior Inhibition*
Age 9 Parent-reported Anxiety	-.06	-.09	.00	-.04	.04	.18
Age 9 Parent-reported Depression	-.11	-.11	-.05	-.05	.04	.02
Age 9 child self-reported Anxiety	.06	.03	.01	.06	.16*	-.07
Age 9 child self-reported Depression	.08	.08	.02	.04	.06	-.12

† $p < .10$; * $p < .05$; ** $p < .01$.
Note: $N = 168$

Table 5

Correlations Between Parent-reported Temperament and Child Anxious and Depressive Symptoms.

	Parent-reported Negative Emotionality	*Parent-reported Anger*	*Parent-reported Fear*	*Parent-reported Sadness*	*Parent-reported Shyness*	*Parent-reported Surgency*
Age 9 Parent-reported Anxiety	.11	.02	.17*	.11	.14†	-.05
Age 9 Parent-reported Depression	.26**	.24**	.11	.30**	.06	.08
Age 9 child self-reported Anxiety	.15*	.20**	.06	.16*	.02	.02
Age 9 child self-reported Depression	.16*	.25**	.01	.13†	.03	-.01

† $p < .10$; * $p < .05$; ** $p < .01$.
Note: $N = 168$

correlated with parent-reported anxiety (r = .17). Parent-reported sadness was correlated with parent-reported depression (r = .30) and child-reported anxiety (r = .16) at age 9 and showed trend level associations with child-reported depression (r = .13) at age 9. Parent-reported shyness was positively correlated with parent-reported anxiety (r = .14) at a trend level. No associations were observed between parent-reported surgency and any measure of age 9 child symptoms.

Regression Analyses of Temperament Predicting Social Competence/Engagement

To examine whether laboratory-assessed and parent-reported NE, laboratory-assessed PE/parent-reported surgency, and laboratory-assessed BI interacted to predict children's social competence, hierarchical regressions were conducted on the following measures of social engagement/competence, using laboratory and parent-report measures of temperament as predictors: child self-reported social engagement/competence, parent-reported social engagement/competence, TSST social engagement/competence, TSST social fear/avoidance and TSST peak cortisol. Each predictor variable was centered as necessary and interaction terms were formed as the product of the two centered predictors (Aiken & West, 1991). Models in which no significant main effects or interactions were obtained are not presented in full to conserve space.

Because of our limited sample size and the number of independent variables we proposed to test (Tabachnik & Fidell, 2007), we elected to build separate models in which laboratory and parent-reported measures of temperament were used as predictors of children's social competence/engagement. Additionally, because parent-reported shyness was fully subsumed within the parent-reported surgency factor, it was excluded from analyses. For analyses predicting children's peak cortisol responses to the TSST,

baseline cortisol was entered as a covariate. To minimize the number of analyses conducted, broad measures of laboratory and parent-reported NE were used, rather than each facet of NE (e.g., anger, sadness). To understand the nature of any significant interactions, Hayes and Matthes' guidelines (Hayes & Matthes, 2009) were used for testing regions of significance in two-way interactions in multiple linear regression according to the Johnson-Neyman technique (Johnson & Fay, 1950). This procedure uses the asymptotic variances, covariances, and other regression parameters to derive the values of the moderator at which the conditional effect of the focal predictor variable transitions from significant ($p < .05$) to nonsignificant, in terms of the outcome of interest.

Laboratory measures of temperament.

With respect to child self-reported social engagement/competence[1], child PPVT scores were included as a covariate for all analyses, because age 7 PPVT scores were negatively correlated with child self-reported social engagement/competence. Laboratory-assessed temperament traits and their interactions predicting child social engagement/competence are presented in Table 6. A significant interaction between PE and NE emerged, indicating that the relationship between NE and child self-reported social engagement differed depending on children's PE. To better understand the nature of the interaction, analyses of regions of significance according to the Johnson-Neyman technique (Johnson & Fay, 1950) were used, and results are presented in Figure 1. This

[1] Parallel analyses predicting parent-reported social engagement/competence and TSST social fear/avoidance from laboratory measures of temperament yielded nonsignificant main effects and interactions (all *ps* > .09)

Table 6

Laboratory Measures of BI, NE, PE, and their Interactions as Predictors of Child Self-reported Social engagement/competence.

	Overall Model				Change Statistics			
	df	R^2	*F*	*Cohen's* f^2	*df*	ΔR^2	ΔF	*B*
Step 1	1,158	.031	5.131*	.032				
PPVT								-.006*
Step2	4,155	.056	2.287†	.026	3,155	.031	1.329	
PPVT								
Laboratory BI								.003
Laboratory NE								-.040
Laboratory PE								-.047
Step 3	7,152	.107	2.592*	.057	3,152	.051	2.886*	
PPVT								-.006
Laboratory BI								.004
Laboratory NE								-.021
Laboratory PE								-.069
Laboratory BI x NE								-.002
Laboratory BI x PE								.005
Laboratory NE x Laboratory PE								-.318**

$^{**}p < .01$, $^{*}p < .05$, $^{\dagger}p < .10$.

Note: PPVT = Peabody Picture Vocabulary Test used as a covariate.

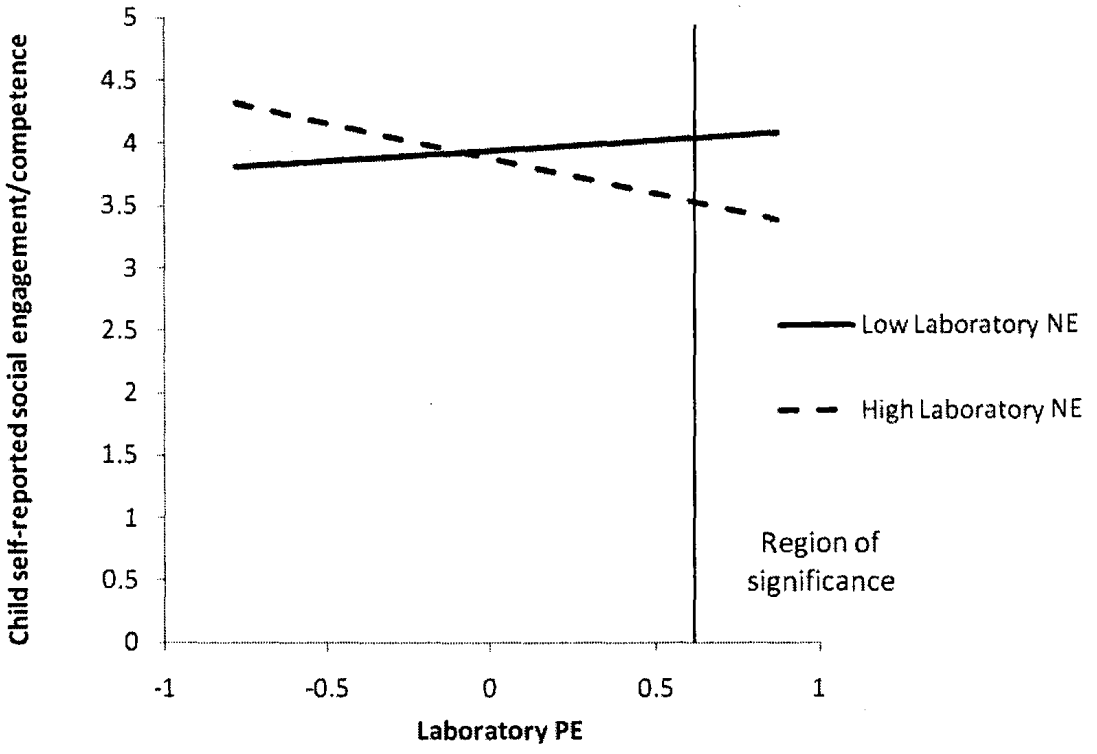

Figure 1. Relationship between laboratory negative emotionality and child self-report social engagement/competence by laboratory positive emotionality.
Note: NE = negative emotionality, PE = positive emotionality. The line on the X axis at .62, derived from the Johnson-Neyman technique (Johnson & Fay, 1950), indicates the value of laboratory positive emotionality above which the effect of NE on child self-reported social competence is significant ($p < .05$) controlling for child PPVT.

figure indicates that the effect of NE on social competence emerges only when PE is relatively high, and further suggests that the combination of high NE and high PE is associated with the lowest child self-reported social competence.

A full model testing predictors of TSST social engagement/competence is presented in Table 7. For this model, a main effect of PE was found, indicating that baseline measures of PE were associated with greater social engagement at follow-up. No other main effects or interactions were significant.

Finally, laboratory measures of temperament were examined as predictors of peak cortisol reactivity (adjusted for baseline cortisol levels). Results shown in table 8 indicated a significant main effect of BI; however, this main effect was qualified by a significant interaction between BI and PE, indicating that the effect of BI on children's peak cortisol reactivity differed depending on children's PE. Once again, analyses of regions of significance according to the Johnson-Neyman technique (Johnson & Fay, 1950) were used to interpret the PE-BI interaction, and results are presented in Figure 2. This figure indicates that the effect of BI on children's peak cortisol is only significant at moderate to lower levels of PE; at higher levels of PE, BI was unrelated to peak cortisol. The figure further suggests that the combination of lower PE and higher BI is associated with the greatest degree of peak cortisol reactivity to stress.

Parent-reported measures of temperament.

Parent-reported traits and their interactions predicting parent-reported social engagement/competence are presented in Table 9. For this model, a main effect of NE was found, indicating that baseline NE is associated with lower social

engagement/competence at follow-up[2]. The interaction with surgency was not significant.

Mediation Analyses

Mediation analyses were used to examine whether associations between temperament and depressive and anxious symptoms at follow up were mediated by social competence, controlling for the analogous symptom measure collected at baseline. To test mediation models, the bootstrap sampling procedure and companion macro developed by Preacher and Hayes (2004, 2008) was used. This procedure yields estimates of mean direct and indirect effects and confidence intervals (CIs) derived from multiple samples. When estimated CIs yielded by the bootstrapping procedure contain the value "zero" within them, the estimated effect is not statistically significant at $p < 0.05$. This strategy is comparable and conceptually similar to multiple regression, but with numerous advantages over more traditional approaches to testing mediation (e.g., robustness with respect to smaller sample sizes and violations of normality, see Preacher and Hayes (2008a, 2008b) for an extensive discussion and validation of this method).

As a precondition for testing mediation, nonzero associations must be present between the predictor and the outcome variable, the predictor and the hypothesized mediator, and the hypothesized mediator and the outcome variable after controlling for the effects of the predictor (Baron & Kenny, 1986). Therefore, mediation analyses were done only in cases where associations were found between a) a specific temperament trait (i.e., the predictor) and a measure of depression or anxiety (i.e., the outcome), b) a specific temperament trait and a measure of social competence (i.e., the mediator), and c)

[2] Parallel analyses predicting child-reported social engagement/competence, TSST social engagement/competence, TSST social fear/avoidance, and TSST peak cortisol reactivity from parent-reported measures of temperament yielded nonsignificant main effects and interactions (all *ps* > .15)

Table 7

Laboratory Measures of BI, NE, PE, and their Interactions as Predictors of TSST Social engagement/competence.

	Overall Model				Change Statistics			
	Df	R^2	*F*	*Cohen's* f^2	*Df*	ΔR^2	ΔF	*B*
Step 1	3,158	.059	3.324*	.063				
Laboratory BI								.000
Laboratory NE								.078
Laboratory PE								.271**
Step 2	6,155	.037	2.031†	.023	3,155	.014	.753	
Laboratory BI								.00
Laboratory NE								.089
Laboratory PE								.267**
Laboratory BI x NE								-.006
Laboratory BI x PE								.008
Laboratory NE x Laboratory PE								-.007

$^{**}p < .01$, $^{*}p < .05$, $^{\dagger}p < .10$.

Note: TSST = Trier Social Stress Task.

Table 8

Laboratory BI, NE, PE, and their Interaction as Predictors of Child Peak Cortisol Reactivity.

	Overall Model				Change Statistics			
	Df	R^2	*F*	*Cohen's* f^2	*Df*	ΔR^2	ΔF	*B*
Step 1	1,151	.158	28.379	.188				
Baseline cortisol								.362**
Step2	4,148	.215	10.135*	.073	3,148	.057	3.571	
Baseline cortisol								.360
Laboratory BI								.005**
Laboratory NE								-.007
Laboratory PE								-.028
Step 3	7,145	.260	7.262*	.061	3,145	.045	2.909	
Baseline cortisol								.353
Laboratory BI								.006
Laboratory NE								-.004
Laboratory PE								-.028
Laboratory BI x NE								-.004
Laboratory BI x PE								-.005**
Laboratory NE x Laboratory PE								-.039

$^{**}p < .01$, $^{*}p < .05$, $^{\dagger}p < .10$.

Note: Cortisol levels are measured in microgram per deciliter (μg/dl).

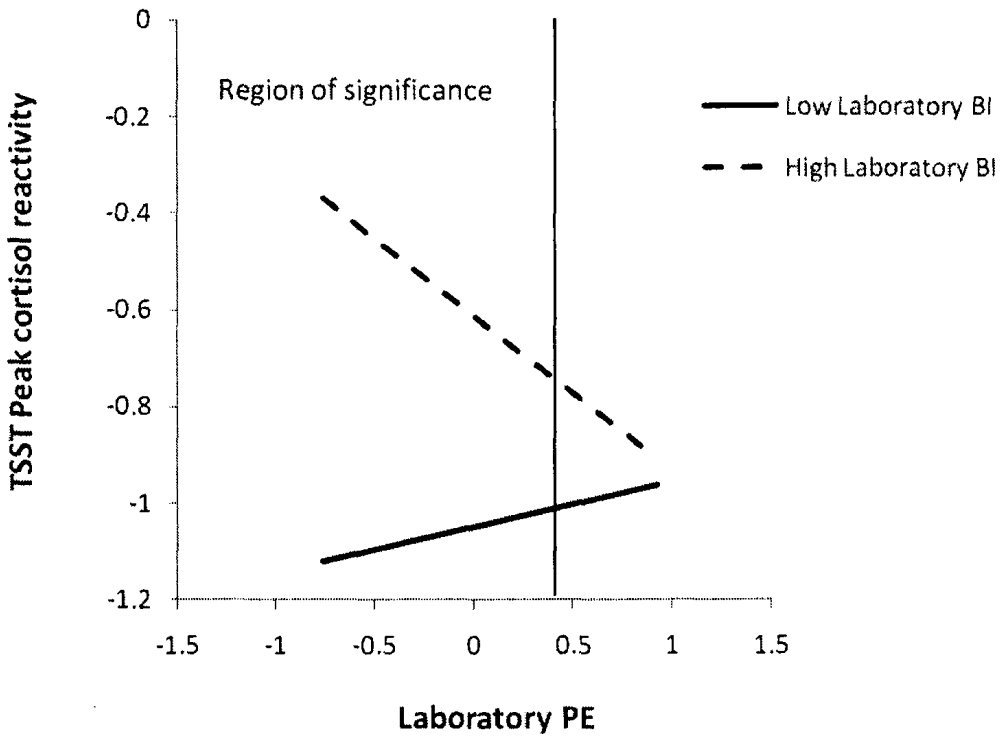

Figure 2. Relationship between peak cortisol reactivity and behavioral inhibition by laboratory positive emotionality.
Note: BI = behavioral inhibition, PE = positive emotionality. The line on the X axis at .40, derived from the Johnson-Neyman technique (Johnson & Fay, 1950), indicates the value of laboratory positive emotionality below which the effect of BI on peak cortisol reactivity is significant ($p < .05$).

Table 9. Parent-report Measures of NE and Surgency and their Interaction as Predictors of Parent-reported social engagement/competence.

	Overall Model				Change Statistics			
	Df	R^2	*F*	*Cohen's f²*	*Df*	ΔR^2	ΔF	*B*
Step 1	2,165	.199	20.463	.248				
Parent-reported NE								-.007**
Parent-reported Surgency								.004
Step 2	3,164	.203	13.885	.005	1,164	.004	.784	
Parent-reported NE								-.008
Parent-reported Surgency								.004
Parent-reported NE x Parent-reported Surgency								.000

**$p < .01$, * $p < .05$, $^{\dagger} p < .10$.

a measure of social competence and a measure of depression or anxiety, controlling for the temperament trait predictor. In several instances, both NE and a specific facet of NE (i.e., anger, sadness, fear) predicted both children's social competence and a symptom scale. In such cases, to limit the number of mediation models presented, either the broad NE scale or the lower order NE scale was used in analyses, chosen based on which index of NE showed the strongest bivariate associations with competence and symptoms.

Given our preconditions above, the following three models met preliminary requirements for possible mediation and were therefore tested:

1. parent-reported anger predicting child self-reported depression with child self-reported social engagement/competence as a mediator.

2. laboratory PE predicting child self-reported anxiety with child self-reported social engagement/competence as a mediator.

3. parent-reported anger predicting child self-reported anxiety with child self-reported social engagement/competence as a mediator.

Evidence for mediation exists when the direct path between the predictor and the outcome is reduced when the hypothesized mediator is included in models (Baron & Kenny, 1986). In the present study, only a single model yielded evidence in support of mediation[3]: child self-reported social engagement/competence mediating the association between maternal reports of child anger and child self-reported depressive symptoms at age 9 (controlling for age 7 depressive symptoms). Results are presented in Figure 3. The bootstrapping procedure indicated a significant indirect effect of parent-reported

[3] These models are not presented in full to conserve space. However, the path between the predictor and the outcome in the 2nd model was virtually unchanged when the hypothesized mediator was included (.11 to .07). Similarly, in the 3rd model, the total effect of the predictor on the outcome (.03) was virtually unchanged from the direct effect (.02). In both mediation models, neither the total effect nor the direct effect of the predictor on the outcome was significant (all *ps* > .09).

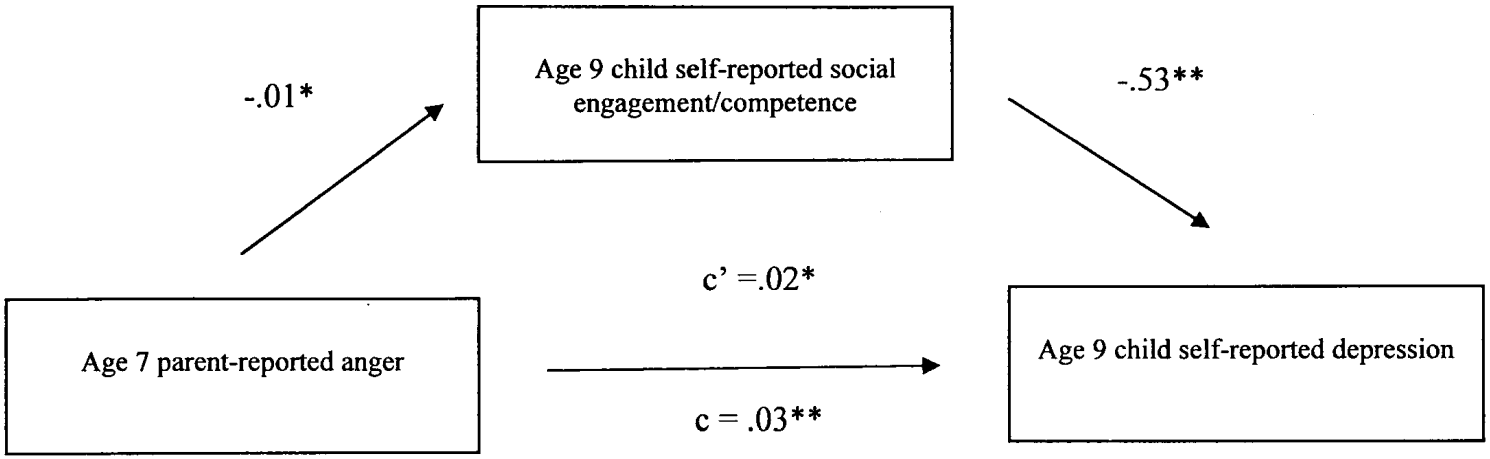

Figure 3. Parent reported anger predicting age 9 child-reported depression with child self-report engagement/competence as mediator.
$^{**}p < .01$, $^{*}p < .05$, $^{\dagger}p < .10$
Note: Age 7 child self-reported depression included as a covariate.

anger on children's age 9 depressive symptoms (controlling for age 7 depressive symptoms) mediated by child-reported social engagement/competence, with a point estimate of .007 and 95% CI [.000, .019]. The direct effect of parent-reported anger on child-reported depressive symptoms was also significant, indicating that this link was only partially mediated by child social engagement/competence.

Discussion

The findings of this study highlight the importance of child temperament and social engagement/competence in internalizing disorder risk in middle childhood. The hypothesis that temperament would predict social competence in middle childhood was generally supported; in particular, a consistent negative relationship between anger and child self-reported social engagement/competence was identified for both parent- and laboratory- reported child temperament. Interestingly, measures of anger were also associated with lower social fear/avoidance to a laboratory stressor. As anger has been linked to poor peer relations (Eisenberg et al., 1993; Sallquist et al., 2009), our findings are consistent with research linking anger and child social competence. However, our study may provide more fine-grained clues about the specific effects of children's anger on children's social competence. Based on our findings, anger is unlikely to predispose to poor interpersonal relationships by leading children to withdraw from social opportunities, as we found negative associations between anger and indices of social competence that tapped fear/anxiety in social contexts. Instead, child anger may predispose these children to behave in an overly assertive or aggressive manner with peers. Future research should link multiple measures of temperament to more direct measures of children's peer interactions to further explore this likely possibility.

Laboratory fear was negatively correlated with parent-reported social engagement/competence and positively correlated with TSST peak cortisol reactivity at a trend level. There was also a trend level negative correlation between laboratory sadness and child self-reported social competence. Previous work examining temperament associations with child social engagement/competence has generally examined broad measures of NE that aggregate across anger, sadness, and fear (Coplan et al., 2009; Sallquist et al., 2009). While NE was predictive of an array of measures of child social engagement/competence, our findings suggest that specific facets often show stronger relationships with certain indices of social competence. For example, associations between child NE and cortisol reactivity to stress may be missed in studies using broad measures of NE; as such, our findings suggest the importance of looking at both broad and narrow facets of traits in predicting children's emerging social competence.

In contrast to laboratory NE, laboratory PE was positively associated with laboratory social engagement/competence, and negatively correlated with social fear/avoidance behaviors during the TSST. PE was unrelated to parent- or child self-reported social engagement/competence. This is consistent with other studies of laboratory assessed PE and social competence (Denham et al., 2003; Sallquist et al., 2009) in preschool samples, and extends this work to an older sample of children. However, this may also reflect the fact that children who expressed PE during their age 7 assessment, which also entailed interacting with an experimenter, may be more likely to express PE during the similar context of the TSST. Parent-reported surgency was related solely to parent-reported child social competence at age 9. Hence, we did not find cross-method associations between PE/surgency and measures of social competence. Although

this does not preclude a main effect of PE in predicting children's social competence, the pattern of findings we obtained could be attributable to method variance.

Laboratory BI was significantly, positively correlated with peak cortisol reactivity to the TSST, and showed a trend-level negative correlation with parent-reported child social engagement/competence. However, given that the majority of work linking temperament to social competence has found BI to predict lower social competence (Bohlin et al., 2005; Kochanska, 1998; Rubin et al., 1997; Coplan et al., 2009), one might have expected to find even more relationships between BI and other measures of social competence. One potential explanation for why we did not is how the laboratory-assessed BI scale was constructed in this sample. The two tasks in this study coded for BI were both designed to elicit inhibition in the context of novel stimuli, not novel persons. In much of this area of research, measures of BI differ across studies in the extent to which they tap inhibition in social versus non-social contexts (Volbrecht & Goldsmith, 2010; Kertes et al., 2009). Future research is needed to clarify whether differences in how BI is elicited determines whether it is associated with children's social competence.

Parent-reported shyness predicted an array of measures of children's social competence, including those derived from sources other than parents, such as TSST social fear/avoidance, TSST social interest/engagement, and peak cortisol reactivity. This finding is consistent with the larger literature on shyness and low social engagement/competence (Broberg, 1993; Kochanska & Radke-Yarrow, 1992; Reznick et al., 1986; Rubin et al., 1997), as well as the limited work on child temperament and cortisol reactivity (Kertes et al., 2009). However, the current findings extend this work into older samples of children, which is critical as our work suggests that young child

may not simply "grow out of" shyness, and may indeed continue to experience potentially harmful psychophysiological correlates of this trait (i.e., heightened cortisol reactivity; Gunnar & Donzella, 2002). As middle childhood represents a critical period in terms of children's emerging social development (Rubin et al., 1993), and as this age group is relatively neglected in literature in on temperament and social competence, the current study is an important addition to literature on this topic.

Interactions Among Temperament Traits in Predicting Social Competence.

Another purpose of this study was to examine potential temperament trait interactions predicting measures of social competence. A significant interaction was found was between laboratory NE and PE predicting child self-reported social engagement/competence. The effect of NE on children's social competence was only found to be significant at higher levels of PE; at lower levels of PE, NE was unrelated to social competence. This interaction may reflect deficits in general emotional regulation, which may in turn affect children's ability to interact appropriately with their peers. This is reasonably consistent with some previous work showing that both high intensity PE and NE been linked to decreased social skills (Sallquist et al., 2009). However, relatively few studies have examined temperament traits predicting social competence in this age group (e.g., Sallquist and colleagues, 2009); and no study has tested interactions between temperament traits in predicting child social competence. In addition, Sallquist and colleagues differed from the current study in how they operationalized child social competence, using only a single measure based on classroom behavior, which may be primarily of relevance with respect to risk for externalizing problems, rather than internalizing symptoms (Booth-LaForce & Oxford, 2008; Rubin et al., 2009). Thus, the

present study adds significantly to the existing literature in furthering the understanding of the interactive effects of temperament contribute to an array of measures of social competence.

In addition, a significant interaction was observed between laboratory BI and laboratory PE in predicting peak cortisol reactivity to a socially evaluative challenge task, the TSST. The effect of BI on children's peak cortisol was only found to be significant at moderate to lower levels of PE; at higher levels of PE, BI was unrelated to peak cortisol. Although higher levels of BI traditionally has been associated with risk for anxiety disorders and lower PE with depression, the finding in the current study suggests this combination of high BI and low PE may represent an important risk for later disorder, due to the known associations between cortisol reactivity and depression and anxiety. Considering that cortisol reactivity to stress is a known marker of risk for both depression and anxiety (Condren et al., 2002; Kallen et al., 2008; Vreeburg et al.. 2009; Vreeburg et al., 2010), our findings suggest initial temperamental pathways that contribute to the development of this reactivity. It is unclear how this interaction may relate to affective disorders given the lack of association with symptoms in the current study, though one hypothesis is that this combination of high BI and low PA may be of particular relevance to the development of social anxiety in adolescence. It is also possible that high cortisol reactivity only influences emerging psychopathology in the context of negative life events or other stress (Hammen, 2005; Kercher & Rapee, 2009), a possibility we plan to examine in future research.

The contrasting findings with respect to PE interacting with other temperament traits in predicting social competence are of interest as no other studies have examined

such associations between temperament traits across different methods of assessing social competence. With respect to NE and child social engagement/competence, high PE appears to exacerbate the risk conferred by NE. In contrast, PE seems to confer a protective effect in the context of high BI and cortisol reactivity. It is possible that in children already high in NE, PE compounds or is a marker of greater emotional dysregulation that leads to poorer social competence. In contrast, in high BI children, higher PE may serve as a buffer against physiological correlates of high BI. In this case, it appears as though PE can both buffer the negative effects of some temperament traits while exacerbating the negative effects of other traits.

We found that laboratory measures of NE and BI interacted with PE to predict two measures of social competence. However, a similar pattern of interaction was not obtained for parent-reported temperament trait interactions. One reason for this discrepant pattern of findings across methods is that our measures of PE were different across the two measures: the TMCQ yields a measure of surgency, which taps additional content including activity level and assertion/dominance. It would be of interest to see if using a measure of parent-reported positive emotionality more similar to that assessed by lab based measures would show similar interactive affects with NE and BI in predicting child social engagement/competence and peak cortisol reactivity.

Mediation analyses

We found partial support for social competence mediating temperamental vulnerability to anxiety and depression. As there were few significant associations between child temperament and symptoms found in this study, many of the temperament-symptom associations that were expected for mediation analyses could not be tested.

There was, however, significant mediation of child self-reported social engagement/competence between parent-reported anger and child self-reported depressive symptoms, indicating that child social engagement/competence may be an important mediator at older ages when anxiety and depressive disorders are more common. The finding in relation to anger and social competence and child depressive symptoms suggests possible intervention strategies, such as those targeting children's expressions of anger in their interactions with peers. As no other studies have examined how social competence may mediate temperamental vulnerability to internalizing disorders, future replication of this work will be needed to clarify the associations between temperament and social competence in internalizing disorder risk.

Associations between temperament and internalizing symptoms.

Associations between measures of temperament and children's symptoms of anxiety and depression were not a primary focus of this paper. However, some surprising findings emerged. Laboratory measures of child temperament at age 7 had few significant correlations with child symptoms at age 9. Laboratory PE was unexpectedly significantly positively correlated with child self-reported anxiety; however, as internalizing and externalizing disorders in childhood are often comorbid (Fanti & Henrich, 2010; Lilienfeld, 2003) one possible explanation for this surprising finding is that this association may be attributable to children's externalizing symptoms. Future analyses should be conducted that control for co-ocurring externalizing symptoms in the analyses of links between temperament and internalizing symptoms. Also, the large number of tests we conducted, this may have been simply a chance finding.

Parent-reported measures of child NE and anger were significantly positively

correlated with parent-reported depressive symptoms and both child self-reported depressive and anxiety symptoms. Significant correlations were also observed for parent-reported fear and parent-reported anxiety symptoms and parent-reported shyness and parent-reported depression and anxiety symptoms. Parent-reported anxiety was positively related to parent-reported anxiety at trend level. There were no significant correlations for parent-reported surgency and child symptoms. Associations with parent-reported NE and lower order NE scales were in the expected direction, with higher NE related to higher reported symptoms at follow up. As NE is generally thought of a general risk factor for depression and anxiety (Clark & Watson, 1991; Clark et al., 1994), it is not surprising that there were associations for NE and both anxious and depressive symptoms across observers. The lack of support for parent-reported shyness and parent-reported surgency across most measures of child symptoms was surprising, as both have been linked to child internalizing problems (De Pauw & Mervielde, 2010; Philips et al., 2002; Rubin et al., 1995).

The lack of support for associations between laboratory-assessed temperament and depression and anxiety across methods may be attributed to the low base rate of symptoms in the sample, as well as the limited sample of behavior obtained by laboratory measures. Further follow-ups when children are older are important as risk for internalizing disorders greatly increases throughout adolescence (Compas et al., 2004; Hankin et al., 1998) at which point individual differences in child temperament may better differentiate between children who are at greater risk for disorder.

Study Strengths and Limitations

A strength of this study was the multi-method, multi-informant longitudinal

design. Our sample, which was large for a study of this kind, appeared to be representative of the London, ON, community from which it was recruited. This study is also one of few examining temperament trait interactions in predicting child social competence, psychophysiological reactivity, and internalizing symptoms. Our laboratory measures of child social engagement/competence and social fear/avoidance behaviors are unique in that behavioral responses to the TSST have been largely ignored. Only one known study has coded child behavior during the TSST (Schlotz, Jones, Phillips, Godfrey, & Phillips, 2010), and that study coded physical activity rather than differences in social engagement/competence. Although no significant direct associations were observed between observed social engagement/competence and peak cortisol reactivity, future analyses will examine how these behavioral differences may relate to cortisol trajectories across the task.

Another strength of this study is the high degree of experimental control exerted over the cortisol sampling procedures. As previously mentioned, few studies have found reliable cortisol increases in response to the TSST in the age group which may due to differences in methodology (Gunnar et al., 2009). Lopez-Duran and colleagues (2009) have reported a consistent decline in cortisol levels following arrival to a laboratory setting in children suggesting arrival at a novel laboratory setting is associated with some level of stress. As many studies utilizing the TSST with children obtain baseline cortisol samples immediately upon the child's arrival to the laboratory, some of the inconsistencies found across studies in children's reactivity to this task in middle childhood may partially be attributable to improper cortisol sampling methods. To control for this, there was a 30-minute period prior to collection of the baseline cortisol sample

during which time children played with a quiet activity or watched a movie. In addition, all children completed lab visits within the early afternoon to control for natural diurnal cortisol variations.

Our study did have several significant limitations. First, while we did use a multi-method approach to study constructs, some constructs were more closely related across measures than others. For example, we did not have a parent-reported measure of BI or PE, and therefore used shyness and surgency instead. Although BI and shyness and PE and surgency are related, they are not identical constructs. In order for research on child temperament to progress, it will be critical for investigators to work toward developing conceptually similar measures across multiple methods. Similarly, our measure of laboratory social competence/engagement is arguably more accurately framed as a measure of social interest than social skills per se. Ideally we would have collected observational measures of participants interacting with peers, or peer evaluations of participants' social competence; however, the already extensive data collection battery made the collection of such measures impractical. Also, despite the relatively lengthy two-year follow-up in this study, participants were still relatively young for examining depression, which typically emerges in adolescence and early adulthood (Compas et al., 2004; Hankin et al., 1998). This has important implications for our ability to detect associations between temperament and social competence and children's depressive symptoms. It is possible, for example, that age 7 temperament and age 9 social competence will show stronger links to emerging depression when our participants are further into the age of risk for depressive disorder. Further follow-up of this sample is important toward investigating this possibility. We focused on predicting social

competence at age 9, although it is possible that some children had already developed poor social competence at age 7. However, few measures of social competence are known to be valid when used with children as young as 7. It is therefore unclear whether measures collected at earlier ages would have relevance for children's internalizing disorder risk.

We did not test moderated mediation, or the possibility that our mediation models might differ across subgroups of children in our sample. For example, child sex may be an important moderator of the mediation of temperamental risk for internalizing symptoms by social competence. Although there has not been evidence that overall levels of social competence differ between boys and girls, lower social competence may have particularly negative consequences for boys (Rubin et al., 2009). Boys with high social withdrawal, but not girls, have been found to have higher daytime cortisol levels, greater peer rejection, and have higher self-reported depressive symptoms (Dettling et al., 1999; Gazelle & Druhen, 2009; Gazelle & Ladd, 2003). Reasons for potential gender differences are unclear, though one hypothesis for why social competence may be differentially associated with later adjustment for boys and girls is that shyness and withdrawal may be viewed as more normative when exhibited by girls than for boys (Coplan et al., 2001; Degnan & Fox, 2007). Consistent with this idea, studies have found parents of reticent children react more harshly to these behaviors when they are exhibited by boys than by girls (Rubin et al., 2009).This limited literature suggests that low social competence may predict relatively poorer outcomes for boys than girls. Similarly, temperament traits may moderate mediation of other traits, social competence, and symptoms; for example, PE may moderate mediations of NE and child social competence

and symptoms such that at lower levels of PE, the association between NE and symptoms mediated by social competence is stronger or weaker. Finally, we conducted many exploratory analyses which increases the possibility that some findings reported here are due to chance. Hence, replication of this work is important.

Future Directions

Future longitudinal research following children across adolescence when depression and anxiety disorders become more prevalent is necessary to identify if social competence mediates temperamental vulnerability to depression and anxiety over this period of higher risk. Additionally, future research is needed to further understand temperament trait interactions and risk for disorder. Although this study found evidence for interactions between NE and PE in relation to child social engagement/competence and BI and PE in relation to cortisol reactivity to a social stressor, we did not find any direct associations with symptoms. As children in this sample are still below the age at which children reach diagnostic criteria for these disorders, future research examining if these temperament combinations identified, high PE and high NE and high BI and low PE, have relatively specific risk in terms of internalizing disorders in general or as previously mentioned, social anxiety disorders in particular would be of interest.

The results of the present study examined temperament trait associations with peak cortisol reactivity to a social stressor, the TSST. There are however, multiple ways of examining differences in psychophysiological reactivity to stressors such as individual differences in cortisol trajectories, more specifically differences in rate of increase in cortisol in response to a stressors and how quickly individuals return to baseline levels following a stressor. Future research would be needed to examine associations with child

temperament and temperament trait interactions with cortisol trajectories following social stressors and how this relates to depression and anxiety symptoms in middle childhood and adolescence.

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Appendix A

Table 10

Study measures collected at age seven and age nine.

Method	*Child age*	
	Age 7	*Age 9*
Laboratory observations	Temperament: PE, NE, BI (Lab-Tab)	Social competence: Social engagement/competence and social fear/avoidance during TSST Cortisol reactivity to the TSST
Parent-report	Temperament: TMCQ (NE, Anger, Fear, Sadness, Shyness, Surgency) Symptoms: CBCL (Depression & Anxiety)	Social competence: SSIS social engagement/competence Symptoms: CBCL (Depression & Anxiety)
Child-report	Symptoms: DSRS (Depression) RCMAS (Anxiety)	Social competence: SSIS social engagement/competence Symptoms: DSRS (Depression) RCMAS (Anxiety)

Appendix B

II. Cortisol Sampling & Trier Social Stress Task (two RAs, table and chairs, clipboards, cortisol sampling materials and sampling sheet, RA script and subtraction checklist).
Note: this task is video recorded, and occurs in the main experimental area.
Collect the baseline sample in the main lab area 30 minutes after the child has arrived, noting the time on the cortisol sampling sheet. Next, say the following to the child:

Guess what? We want to see how good you are at telling stories. I am going to tell you the very beginning of a story. Then I am going to give you three minutes to think about a good middle and end of the story. There are two story experts here today, and I want you to finish telling the story to them, making it as exciting as possible. You should try to do better than all the other children we've had come in to tell stories. Get ready to listen, here's the very beginning of the story: "Yesterday my best friend Robert and I went home from school. Suddenly, we had the idea to visit Mr. Greg who lived in the big old house located in the dark forest near our town. Mr. Greg was a crazy old man and our parents didn't like the idea that we sometimes went visiting him. There was a rumor in town that there was a mystery about the old house. When we arrived at the house we were surprised that the door was open. Suddenly we heard a strange noise and cautiously, we entered the dark hall. . ." Go ahead and plan what you want to tell to the judges.

After a three minute pause (or less, if the child says s/he does not need more time) to

allow the child to plan, go to the door and call in the two RAs, who should enter quietly and sit behind a table with clipboards and pens. Prior to the task, make sure that the RAs know to maintain a serious, unsmiling demeanor until the task is complete. One of the RAs will lead the child through the rest of the task.

Appendix C

Trier Social Stress Test Script

Two RAs, table and chairs, clipboards, cortisol sampling materials and sampling sheet, A script and subtraction checklists, camera, microphone.

One RA delivers all the prompts to the child. The other will pretend to operate the video camera. This RA should pretend to turn the camera on upon entering the room, and should also pretend to turn the microphone on and hand it to the child before the other RA proceeds with the instructions.

> *Wait in the hall for the main experimenter to invite you into the lab. When cued, walk quietly and with a stern demeanour toward the table and sit. Say to the child:*
>
> Okay, we are ready to hear your story now.
>
> *Begin timing, endeavouring to have the child tell the story for five minutes. If the child indicates that s/he is finished before five minutes have elapsed, say to him/her in a neutral tone:*
>
> Please go on. We need to hear a longer story.
>
> *Deliver additional prompts as needed.*
>
> Okay, we are ready to hear your story now.
>
> *If the child continues to be unresponsive, after an additional 20-second delay, you can prompt as follows:*
>
> Remember, the children were walking down the dark hall of Mr. Greg's house. What do you think happened next?
>
> *After a minimum of four minutes, 45 seconds of story time (if the child goes over five minutes, jump in during a pause with the next set of instructions), say to the child:*
>
> Now we would like you to do some math. Starting with the number 758, we want you to count down by subtracting the number 7. Do this as fast and as accurately as possible.
>
> *If the child makes a mistake, ask him/her to restart at 758, saying:*
>
> Stop, please start again.

If the child says nothing, after a 20-second delay, you can repeat the initial instructions. If they remain silent after 10 seconds, you can prompt them by saying:

So for the first number it would be 751. What would come next?

If the child makes 5 errors in a row or cannot continue after fewer mistakes, stop that child and say:

Okay. Now we would like you to start with the number 307 and count down by subtracting by the number 3. Do this as fast and as accurately as possible.

If the child says nothing, after a 20-second delay, you can repeat the initial (easier) instructions. If they remain silent after 10 seconds, you can prompt by saying:

So the first number would be 304. What would come next?

After a minimum of 4 minutes, 45 seconds of time, say the following to the child:

Good. Now we'd like you to tell us about yourself. What kinds of things do you really like?

What kinds of things do you really not like?

What kind of a kid are you? How would you describe yourself to someone who doesn't know you very well?

What would you like people to know about you and your personality?

Repeat questions as needed to prompt the child to continue. After a minimum of 4 minutes, 45 seconds, say the following to the child, in an enthusiastic tone:

You did a really great job of telling a story, doing math, and telling us about yourself! Thanks!

Appendix D

Episode Start Time: Episode Stop Time: Total Time (secs):

TSST-C STORY

SNUM: CODER: Date:

Positive affect	***Low***	***Mod***	***High***	**Overall score**
Facial PA				
Vocal PA				
Bodily PA				
Negative affect	**Low**	***Mod***	***High***	
Facial fear				
Facial sadness				
Facial anger				
Vocal fear				
Vocal sadness				
Vocal anger				
Bodily fear				
Bodily sadness				
Bodily anger				

Behavioral ratings	
Story Interest/engagement	
Activity level/vigor	
Anticipatory NE	
Initiative vs. passivity	
Sociability	
Compliance	
Impulsivity	
Persistence	

Experimenter Prompts: _____

1. Average affective state and range of affective state:

-5	-4	-3	-2	-1	0	1	2	3	4	5
extremely negative		quite negative		slightly negative	neutral	slightly positive		quite positive		extremely positive

a.) During the episode, the highest positive emotional expression the child displays for a noticeable period of time is (this number may be negative): _____

b) During the episode, the highest negative emotional expression the child displays for a noticeable period of time is (this number may be positive): _____

c.) Throughout the episode, the child's typical emotional expression (the average degree of positivity or negativity that they display throughout the episode) is: _____

2. Frequency/intensity ratings:
   A.) Frequency with which the child exhibits the affective state to any degree:

0	1	2	3	4
never	<1/2 episode	about ½ episode	about ¾ episode	almost all of episode

B.) Intensity = typical intensity of the affective state, when it occurs: (also consider the speed with which the child reacts affectively to events and the speed with which their emotional expressions peak and fade)

1	2	3	4
slight	moderate	high	very high

Rate the following affective states for frequency & intensity. [examples and descriptors of relevant behaviors follow each, and are ordered according to intensity, with behaviors suggesting higher intensity ratings listed at the end of the list.]

1. *Ecstatic/excited* (high intensity smiling, laughter, excited verbalizations, bodily enthusiasm)

   Frequency _____ Intensity _____

2. *Happy* (smiling, pleasure vocalizations, laughter)

   Frequency _____ Intensity _____

3. *Contentment* (quiet pleasure, head tilting, low intensity smiling, low pleasure/enjoyment vocalizations)

   Frequency _____ Intensity _____

4. *Afraid* (bodily posture, wary vocalizations, fearful facial affect)

   Frequency _____ Intensity _____

5. *Angry/irritable* (postural anger, mild anger vocalizations, strong anger vocalizations, angry facial affect)

   Frequency _____ Intensity _____

6. *Nervous/tense* (body posture, constricted vocalizations, wary facial affect)

   Frequency _____ Intensity _____

7. *Sad/dejected*(droopy or sad posture, mild sad vocalizations, strong sad vocalizations, sad facial affect)

   Frequency _____ Intensity _____

SOCIABILITY SUBTYPES RATING

Rate the child's standing on each of the 3 key dimensions of sociability on the following scale:

-5	-4	-3	-2	-1	0	1	2	3	4	5
extremely low		quite low		slightly low	neutral	slightly high		quite high		extremely high

1. *Low versus high dominance or surgency* – the degree of power assumed by the individual in the interaction (i.e., passivity versus assertiveness) _____

2. *Low versus high warmth* – the degree of warmth or affiliation the person displays in the interaction; (i.e., affiliation versus hostility) _____

3. *Low versus high social interest* – the degree of interest and energy the person invests in social interaction; (i.e., outgoing versus avoidant) _____

Rate the degree to which the child exhibits each of the following social styles during the episode on this scale:

0	1	2	3	4
none	slightly	somewhat	quite a bit	very much

Affiliative

Behaviors: social reciprocity, eye contact, social referencing, asking & answering questions, initiating interaction, invitations to play, giving praise, etc. _____

2. Assertive

Behaviors: making requests or demands, offering suggestions, drawing attention to self _____

Domineering/pushy

Behaviors: making demands, active noncompliance, arguing with experimenter _____

4. Hostile/aggressive

Behaviors: physical or verbal aggression to mom or experimenter, angry comments directed at experimenter _____

Avoidant

Behaviors: lack of eye contact, social referencing, little response to praise, no initiation of interaction & little social reciprocity_____

Socially anxious/meek

*Behaviors: nervous smiling, sad response to criticism, submissive behavior*_____

TSST-C MATH

Positive affect	***Low***	***Mod***	***High***	**Overall score**
Facial PA				
Vocal PA				
Bodily PA				
Negative affect	**Low**	***Mod***	***High***	
Facial fear				
Facial sadness				
Facial anger				
Vocal fear				
Vocal sadness				
Vocal anger				
Bodily fear				
Bodily sadness				
Bodily anger				

Behavioral ratings	
Math Interest/engagement	
Activity level/vigor	
Anticipatory NE	
Initiative vs. passivity	
Sociability	
Compliance	
Impulsivity	
Persistence	

Experimenter Prompts: _____

3. Average affective state and range of affective state:

-5	-4	-3	-2	-1	0	1	2	3	4	5
extremely negative		quite negative		slightly negative		neutral positive		slightly	quite positive	extremely positive

a.) During the episode, the highest positive emotional expression the child displays for a noticeable period of time is (this number may be negative): _____

c) During the episode, the highest negative emotional expression the child displays for a noticeable period of time is (this number may be positive):

_____

d.) Throughout the episode, the child's typical emotional expression (the average degree of positivity or negativity that they display throughout the episode) is:

_____

4. Frequency/intensity ratings:
   C.) Frequency with which the child exhibits the affective state to any degree:

0	1	2	3	4
never	<1/2 episode	about ½ episode	about ¾ episode	almost all of episode

   D.) Intensity = typical intensity of the affective state, when it occurs: (also consider the speed with which the child reacts affectively to events and the speed with which their emotional expressions peak and fade)

1	2	3	4
slight	moderate	high	very high

Rate the following affective states for frequency & intensity. [examples and descriptors of relevant behaviors follow each, and are ordered according to intensity, with behaviors suggesting higher intensity ratings listed at the end of the list.]

8. *Ecstatic/excited* (high intensity smiling, laughter, excited verbalizations, bodily enthusiasm)

   Frequency _____ Intensity _____

9. *Happy* (smiling, pleasure vocalizations, laughter)

   Frequency _____ Intensity _____

10. *Contentment* (quiet pleasure, head tilting, low intensity smiling, low pleasure/enjoyment vocalizations)

    Frequency _____ Intensity _____

11. *Afraid* (bodily posture, wary vocalizations, fearful facial affect)

    Frequency _____ Intensity _____

12. *Angry/irritable* (postural anger, mild anger vocalizations, strong anger vocalizations, angry facial affect)

    Frequency _____ Intensity _____

13. *Nervous/tense* (body posture, constricted vocalizations, wary facial affect)

Frequency _____ Intensity _____

14. *Sad/dejected*(droopy or sad posture, mild sad vocalizations, strong sad vocalizations, sad facial affect)

Frequency _____ Intensity _____

SOCIABILITY SUBTYPES RATING

Rate the child's standing on each of the 3 key dimensions of sociability on the following scale:

-5	-4	-3	-2	-1	0	1	2	3	4	5
extremely low		quite low		slightly low	neutral	slightly high		quite high		extremely high

5. *Low versus high dominance or surgency* – the degree of power assumed by the individual in the interaction (i.e., passivity versus assertiveness) _____

6. *Low versus high warmth* – the degree of warmth or affiliation the person displays in the interaction; (i.e., affiliation versus hostility) _____

7. *Low versus high social interest* – the degree of interest and energy the person invests in social interaction; (i.e., outgoing versus avoidant) _____

Rate the degree to which the child exhibits each of the following social styles during the episode on this scale:

0	1	2	3	4
none	slightly	somewhat	quite a bit	very much

1. Affiliative

Behaviors: social reciprocity, eye contact, social referencing, asking & answering questions, initiating interaction, invitations to play, giving praise, etc. _____

2. Assertive

Behaviors: making requests or demands, offering suggestions, drawing attention to self _____

Domineering/pushy

Behaviors: making demands, active noncompliance, arguing with experimenter _____

Hostile/aggressive

Behaviors: physical or verbal aggression to mom or experimenter, angry comments directed at experimenter _____

Avoidant

Behaviors: lack of eye contact, social referencing, little response to praise, no initiation of interaction & little social reciprocity_____

Socially anxious/meek

*Behaviors: nervous smiling, sad response to criticism, submissive behavior*_____

TSST-C TALK ABOUT SELF

Positive affect	***Low***	***Mod***	***High***	**Overall score**
Facial PA				
Vocal PA				
Bodily PA				
Negative affect	**Low**	***Mod***	***High***	
Facial fear				
Facial sadness				
Facial anger				
Vocal fear				
Vocal sadness				
Vocal anger				
Bodily fear				
Bodily sadness				
Bodily anger				

Behavioral ratings	
Interest/engagement	
Activity level/vigor	
Anticipatory NE	
Initiative vs. passivity	
Sociability	
Compliance	
Impulsivity	
Persistence	
Self-description complexity/richness	
Self-description positivity	

Experimenter Prompts: _____

5. Average affective state and range of affective state:

-5	-4	-3	-2	-1	0	1	2	3	4	5
extremely negative		quite negative		slightly negative	neutral	slightly positive		quite positive		extremely positive

a.) During the episode, the highest positive emotional expression the child displays for a noticeable period of time is (this number may be negative): _____

d) During the episode, the highest negative emotional expression the child displays for a noticeable period of time is (this number may be positive): _____

e.) Throughout the episode, the child's typical emotional expression (the average degree of positivity or negativity that they display throughout the episode) is: _____

6. Frequency/intensity ratings:
E.) Frequency with which the child exhibits the affective state to any degree:

0	1	2	3	4
never	<1/2 episode	about ½ episode	about ¾ episode	almost all of episode

F.) Intensity = typical intensity of the affective state, when it occurs: (also consider the speed with which the child reacts affectively to events and the speed with which their emotional expressions peak and fade)

1	2	3	4
slight	moderate	high	very high

Rate the following affective states for frequency & intensity. [examples and descriptors of relevant behaviors follow each, and are ordered according to intensity, with behaviors suggesting higher intensity ratings listed at the end of the list.]

15. *Ecstatic/excited* (high intensity smiling, laughter, excited verbalizations, bodily enthusiasm)

    Frequency _____ Intensity _____

16. *Happy* (smiling, pleasure vocalizations, laughter)

    Frequency _____ Intensity _____

17. *Contentment* (quiet pleasure, head tilting, low intensity smiling, low pleasure/enjoyment vocalizations)

    Frequency _____ Intensity _____

18. *Afraid* (bodily posture, wary vocalizations, fearful facial affect)

    Frequency _____ Intensity _____

19. *Angry/irritable* (postural anger, mild anger vocalizations, strong anger vocalizations, angry facial affect)

    Frequency _____ Intensity _____

20. *Nervous/tense* (body posture, constricted vocalizations, wary facial affect)

    Frequency _____ Intensity _____

21. *Sad/dejected*(droopy or sad posture, mild sad vocalizations, strong sad vocalizations, sad facial affect)

    Frequency _____ Intensity _____

SOCIABILITY SUBTYPES RATING

Rate the child's standing on each of the 3 key dimensions of sociability on the following scale:

-5	-4	-3	-2	-1	0	1	2	3	4	5
extremely low		quite low		slightly low	neutral	slightly high		quite high		extremely high

Low versus high dominance or surgency – the degree of power assumed by the individual in the interaction (i.e., passivity versus assertiveness) _____

Low versus high warmth – the degree of warmth or affiliation the person displays in the interaction; (i.e., affiliation versus hostility) _____

Low versus high social interest – the degree of interest and energy the person invests in social interaction; (i.e., outgoing versus avoidant) _____

Rate the degree to which the child exhibits each of the following social styles during the episode on this scale

0	1	2	3	4
none	slightly	somewhat	quite a bit	very much

1. Affiliative
   Behaviors: social reciprocity, eye contact, social referencing, asking & answering questions, initiating interaction, invitations to play, giving praise, etc. _____
2. Assertive
   Behaviors: making requests or demands, offering suggestions, drawing attention to self _____
3. Domineering/pushy
   Behaviors: making demands, active noncompliance, arguing with experimenter _____
4. Hostile/aggressive
   Behaviors: physical or verbal aggression to mom or experimenter, angry comments directed at experimenter _____
5. Avoidant
   Behaviors: lack of eye contact, social referencing, little response to praise, no initiation of interaction & little social reciprocity_____
6. Socially anxious/meek
   *Behaviors: nervous smiling, sad response to criticism, submissive behavior*_____

Office of Research Ethics
The University of Western Ontario
Room 4180 Support Services Building, London, ON, Canada N6A 5C1
Telephone: (519) 661-3036 Fax: (519) 850-2466 Email: ethics@uwo.ca
Website: www.uwo.ca/research/ethics

Use of Human Subjects - Ethics Approval Notice

Principal Investigator: Dr. E.P. Hayden
Review Number: 12279S **Revision Number:** 14
Review Date: November 05, 2009 **Review Level:** Expedited
Protocol Title: Child Temperament and Individual Differences in Information Processing
Department and Institution: Psychology, University of Western Ontario
Sponsor:
Ethics Approval Date: November 11, 2009 **Expiry Date:** June 30, 2010
Documents Reviewed and Approved: Revised study methodology. Letter of Information and Consent.
Documents Received for Information:

This is to notify you that The University of Western Ontario Research Ethics Board for Non-Medical Research Involving Human Subjects (NMREB) which is organized and operates according to the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans and the applicable laws and regulations of Ontario has granted approval to the above referenced revision(s) or amendment(s) on the approval date noted above.

This approval shall remain valid until the expiry date noted above assuming timely and acceptable responses to the NMREB's periodic requests for surveillance and monitoring information. If you require an updated approval notice prior to that time you must request it using the UWO Updated Approval Request Form.

During the course of the research, no deviations from, or changes to, the study or consent form may be initiated without prior written approval from the NMREB except when necessary to eliminate immediate hazards to the subject or when the change(s) involve only logistical or administrative aspects of the study (e.g. change of monitor, telephone number). Expedited review of minor change(s) in ongoing studies will be considered. Subjects must receive a copy of the signed information/consent documentation.

Investigators must promptly also report to the NMREB:

a) changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) all adverse and unexpected experiences or events that are both serious and unexpected;
c) new information that may adversely affect the safety of the subjects or the conduct of the study.

If these changes/adverse events require a change to the information/consent documentation, and/or recruitment advertisement, the newly revised information/consent documentation, and/or advertisement, must be submitted to this office for approval.

Members of the NMREB who are named as investigators in research studies, or declare a conflict of interest, do not participate in discussion related to, nor vote on, such studies when they are presented to the NMREB.

Chair of NMREB: Dr. Jerry Paquette

Ethics Officer to Contact for Further Information			
☑ Grace Kelly (grace.kelly@uwo.ca)	☐ Janice Sutherland (jsutherl@uwo.ca)	☐ Elizabeth Wambolt (ewambolt@uwo.ca)	☐ Denise Grafton (dgrafton@uwo.ca)

This is an official document. Please retain the original in your files.

cc: ORE File

Western

Office of Research Ethics

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