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Reactive and Regulatory Temperament Traits as Predictors of Depressive Symptoms in Middle Childhood

Yuliya Kotelnikova
The University of Western Ontario

Supervisor
Dr. E.P. Hayden
The University of Western Ontario

Joint Supervisor
Dr. P.A.Vernon
The University of Western Ontario

Graduate Program in Psychology

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REACTIVE AND REGULATORY TEMPERAMENT TRAITS AS PREDICTORS OF DEPRESSIVE SYMPTOMS IN MIDDLE CHILDHOOD

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Yuliya Kotelnikova

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CERTIFICATE OF EXAMINATION

Co-Supervisor

_____
Dr. Elizabeth P. Hayden

Co-Supervisor

_____
Dr. P. Anthony Vernon

Supervisory Committee

_____
Dr. David J.A. Dozois

Examiners

_____
Dr. David J.A. Dozois

_____
Dr. Richard W. J. Neufeld

_____
Dr. William Avison

The thesis by

Yuliya Kotelnikova

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Abstract

Although a large literature has examined temperament in adult and adolescent depression, few studies have investigated temperamental precursors of depressive symptoms in young children over time. I evaluated the role of positive and negative emotionality (PE, NE) and effortful control (EC) in predicting initial levels and change in depressive symptoms in middle childhood. Measures of child temperament (laboratory observations and maternal reports) and depressive symptoms were collected from 205 seven-year-olds who were followed up one and two years later. A steeper increase in self- and mother-reported depressive symptoms was found for children lower in laboratory-assessed EC and higher in laboratory NE. Mother-reported EC and PE interacted to predict changes in child self-reported depressive symptoms: lower PE predicted increases in child self-reported depressive symptoms in the context of lower EC. Findings support the investigation of interactions between reactive and regulatory temperament traits in predicting child depressive symptoms.

Keywords: temperament; effortful control; tripartite model; depressive disorders; middle childhood; structural equation modelling, latent growth curves

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Introduction

The concept of *temperament* dates at least back to 5th century B.C.; even at this early date, there was an interest in linking temperament to physical and mental health (Digman, 1994; Clark & Watson, 2008). Around the turn of the last century, the work of eminent psychopathologists, such as Kraepelin, echoed this ancient interest by linking temperament to risk for mood disorder (Kraepelin, 1904a; 1904b). However, despite this longstanding interest in the role of temperament in risk for disorder, contemporary diagnostic systems have not incorporated a temperamental framework toward the classification of psychopathology. Based on what is known about the current revision process, however, the upcoming DSM-5 appears to address this omission by highlighting the major role that temperament traits play in an array of disorders. Specifically, Axis II personality disorders, currently conceptualized as categorical constructs, will likely be dimensionalized to reflect what are viewed as their temperamental bases (i.e., their associations with negative affectivity, detachment, antagonism, disinhibition vs. compulsivity, and psychoticism; Krueger, 2005). Similarly, the revision of DSM-IV will also likely provide greater acknowledgement of the role of temperament in emotional (Goldberg, Krueger, Andrews, & Hobbs, 2009) and externalizing disorders (Krueger & South, 2009). The increased emphasis on temperament in diagnosis begs for additional empirical examinations of the developmental associations between temperament and psychopathology, with the goal of deepening our understanding of when and how temperamental risk for disorder unfolds and potential factors moderating this risk. This,

in turn, may inform early prevention and intervention strategies focused on mitigating the effects of temperamental risk and the fostering of potential protective characteristics (Khosla, 2006; Trosper, Buzzella, Bennett, & Ehrenreich, 2009; Kochanska, Murray, & Coy, 1997).

The current project contributes toward this goal, taking a multi-trait, multi-method longitudinal approach to testing associations between temperament and symptoms of depression in middle childhood. Depression is one of the most common and debilitating psychological disorders (Hysenbegasi, Hass, & Rowland, 2005; Mittal, Fortney, Pyne, Edlund, & Wetherell, 2006; Patten et al., 2006), and while the onset of depression typically occurs in adolescence and early adulthood (Gollan, Raffety, Gortner, & Dobson, 2005; Roberts, Lewinsohn, Hops, & Andrews, 1991), depressive symptoms in childhood hold clear prognostic power for later depressive disorder (Ialongo, Edelsohn, Werthamer-Larsson, & Crockett, 1993; Ialongo, Edelsohn, & Kellam, 2001; Luby, 2010). Thus, the identification of predictors of early symptoms can help in the development of targets for prevention.

To provide a theoretical framework for this research, I will first review the literature on the structure of adult and child temperament, with the goal of identifying core reactive and regulatory traits that have emerged as central to modern theories of temperament across the lifespan. Next, I will review the extant literature indicating that these core traits play a key role in adult disorders, especially depression. I will then review the work on this question in adolescence and childhood, a body of research that has been clearly less extensively developed. Finally, I will review the small literature on the dynamic relationships between reactive and regulatory temperament traits and

psychopathology in children and adults, with the goal of arguing that a better understanding of interactions between traits is critical for the development of comprehensive models of the temperamental bases of depression risk.

Structure of Temperament

A vast body of research has accrued on both the nature and structure of adult personality and temperament.[1] During the 20th century, taxonomies of adult temperament and personality were developed through structural analysis; these produced an array of models that differed somewhat in terms of the number of core traits identified (e.g., McCrae & Costa, 1987, 1997; Tellegen, 1985; Watson & Clark, 1993). However, there is general consensus that many of these models are not mutually exclusive and can be arranged hierarchically (Markon, Krueger, & Watson, 2005). At the broadest level, Markon et al. (2005) and others (e.g., Digman, 1997; Zuckerman, Kuhlman, & Camac, 1988) have reduced adult temperament to two super-factors, alpha and beta, with alpha comprised of disinhibition and negative emotionality (with fear, anger, and sadness as the lower-order facets of NE), and beta comprised of positive emotionality (PE). At this level, these two-factor models are broadly consistent with three-factor temperament models (e.g., Tellegen, 1985; Eysenck, 1967, Watson & Clark, 1993) comprised of PE, NE, and disinhibition. Furthermore, disinhibition can be further parsed into (low) agreeableness and (low) conscientiousness from the Five Factor Model (FFM; Digman, 1990; McCrae & Costa, 1987, 1997), and PE can be divided into two facets that represent

[1] While temperament and personality were historically considered distinct, albeit related, constructs, many experts agree that emotional predispositions are central to both domains (Allport, 1937; Clark & Watson, 2003; Digman, 1994), and that distinctions between the two constructs are less pronounced than previously thought. In particular, comparable heritability and stability estimates are reported for personality and temperament traits (e.g., De Pauw & Mervielde, 2010; Jang, McCrae, Angleitner., Riemann, & Livesley, 1998; Saudino, 2005). Hence, relevant research on both is considered in this paper and the terms will be used interchangeably throughout with a few exceptions.

extraversion and openness to experience, also from the FFM (Markon et al., 2005). Many studies of self-reported adult temperament have yielded findings consistent with the aforementioned structure (Clark & Watson, 2008; DeYoung, 2006; Digman, 1997; Markon, 2009; McCrae et al., 2008; Zuckerman, Kuhlman, & Camac, 1988; Zuckerman, Kuhlman, Thornquist, & Kiers, 1991).

Thus, while a number of compatible models of temperament exist, for the purposes of the current research project, I focused on the Big Three model of Clark and Watson (1991, 1993) for two key reasons. First, this model has driven a great deal of contemporary research on temperament-psychopathology links (e.g., Clark, 2005; Watson, Gamez, & Simms, 2005). Even though this research has focused largely on adults and, to a lesser extent, adolescents, drawing upon this body of work provides the basis for relatively clear-cut predictions regarding how these traits may be related to symptoms in childhood. Second, using this model allows us to establish developmental continuity with current structural models of child temperament, an important issue in the extant literature (e.g., Shiner, 2010). More specifically, while there has been significantly less work on the nature and structure of child temperament, current data support the existence of the Big Three in childhood, or possibly four factors that resemble the Big Three and an additional factor representing trait-like differences in affiliation (Ahadi, Rothbart, & Ye, 1993; Rothbart, Ahadi, Hershey, & Fisher, 2001; Simonds & Rothbart, 2004). Thus, this review and the current research focus on the Big Three traits and their related facets as relevant as a means of linking the somewhat disparate literatures on child and adult temperament, and on adult temperamental risk for psychopathology.

The Big Three model emphasizes the importance of three broad super-factors:

neuroticism/negative emotionality (NE), extraversion/positive emotionality (PE), and disinhibition versus constraint (DvC; Clark & Watson, 1991; 1999; Watson & Clark, 1993). NE reflects differences in the extent to which individuals perceive their environment as threatening, problematic, and distressing; this dimension incorporates the affective facets of fear, anger, and sadness (Clark & Watson, 1991). PE reflects individual differences in the disposition to experience positive emotions and engage the environment; high scorers approach their environment with energy, joy, enthusiasm, delightfulness and cheerfulness, and they also tend to seek the company of others (Clark & Watson, 1991). Overall, emotional tendencies form the core of PE and NE, making these traits particularly suitable for research on risk for mood disorders, which are characterized by high levels of negative emotions and low levels of positive emotions (Clark, 2005). DvC reflects differences in the tendency to act in an under-controlled (i.e., impulsive, reckless behaviours, the tendency to seek immediate gratification) versus an over-controlled (i.e., risk aversive and avoidant behaviour) manner (Watson & Clark, 1993); this trait is thought to play a fundamental regulatory role with respect to PE and NE (Carver, Johnson, & Joormann, 2009; Clark & Watson, 1999).

As mentioned previously, the Big Three are useful from the perspective of tracing the developmental continuity of temperament traits. In contemporary research on child temperament, the most widely used model comes from Rothbart and colleagues (2007), which conceptualizes child temperament in terms of individual differences in emotional reactivity and self-regulation (i.e., the ability to modulate reactive processes). This model is based on factor-analytic studies that derived three broad dimensions of child temperament: extraversion/surgency, negative affectivity, (i.e., the aforementioned

reactive dimensions of temperament), and effortful control (EC; the regulatory dimension; Ahadi, Rothbart, & Ye, 1993; Rothbart, Ahadi, Hershey, & Fisher, 2001). In this model, EC is defined in this as the efficiency of executive attention, including the ability to inhibit the dominant response and activate the subdominant response in order to respond most appropriately to a given situation (Rothbart and Bates, 2006). This model of child temperament shows significant overlap with the aforementioned three-factor models of adult temperament and specifically with the model proposed by Watson and Clark (1993; 1999).

Reactive Temperament Traits and Psychopathology in Adults

A key goal of personality research is to predict important outcomes; indeed, models that lack the capacity to do so are limited in value. One important outcome for which temperament should hold relevance is mental health. There are multiple models that attempt to capture the relationship between temperament and psychopathology (Widiger & Smith, 2008) and specifically between temperament and mood disorders (Klein, Durbin, & Shankman, 2009). These frameworks propose that temperament and disorder may be linked through a variety of mechanisms, including (1) common causes, (2) temperament as a precursor for mood disorders, (3) temperament predisposing to the development of mood disorders, (4) temperament having pathoplastic effects on mood disorders, (5) temperament features as *forms frustes* of the disorders, and (6) temperament features as complications or scars of mood disorders (Klein et al., 2009). Both the common cause and precursor models posit that temperament and mood disorders arise from the same etiological processes (e.g., shared genetic factors), although the precursor model views temperament as an early manifestation that precedes onset of

disorder. In the predisposition model, temperament features are similarly held to precede the onset of disorder; however, in contrast to the precursor model, temperament and psychopathology are not determined by the same etiological processes and, therefore, temperament features are assumed to have direct causal influences on disorders. The pathoplasticity model is similar to the predisposition model in that both propose that temperament influences mood disorders; however, in the former model, temperament influences the expression of the disorder after its onset, rather than influencing the likelihood of onset in the first place. The notion that temperament traits are forms frustes suggests that aspects of temperament represent a form of disorder themselves (e.g., NE and depression fall on the same continuum, varying in terms of severity). The last model reverses the direction of causality, proposing that mood disorders shape personality/temperament traits by virtue of their state effects on levels of traits, or that disorder leads to long-term changes in personality (Klein et al., 2009). The complication aspect of this model argues that, although psychopathology affects personality during a mood disorder episode, personality traits return to their typical state after the disorder subsides. However, the scar aspect of this model suggests that the experience of psychopathology causes longstanding changes in personality (Klein et al, 2009). Designing studies that can fully differentiate among these models is difficult, and the models are not mutually exclusive; certainly, combinations of these are possible and other relationships between disorder and temperament not articulated here may exist. However, longitudinal, prospective work could play a key role in providing support for models that propose that temperamental risk emerges prior to the onset of disorder, which would provide greater support for some of these models than others.

With respect to specific examples of these models, the tripartite model of the relationship between temperament and disorder has become arguably the most highly influential framework in the field. An example of the common cause perspective, this model was developed in light of the pervasive comorbidity found between depressive and anxious disorders to explain shared and unique factors in these conditions; more specifically, this model emerged in large part based on genetic studies indicating that anxiety and depressive symptoms correlated because of a genetic factor they shared with neuroticism/NE[2] (Kendler, Neale, Kessler, & Heath, 1993). At the same time, lower levels of PE were posited to differentiate between anxiety and mood disorders, conferring a relatively specific vulnerability to the latter. Thus, NE was thought to be related to both anxiety and depression, whereas lower PE was held to be related to depression only (Clark & Watson, 1991). Clark and Watson (1991) also initially included physiological hyperarousal as a primary aspect of the model and a specific risk factor for anxiety disorders; however, the non-hierarchical linear structure of the three factors was not supported (Brown, Chorpita, Barlow, 1998). Brown and colleagues (1998) suggested that physiological hyperarousal should be considered a lower order facet of NE, rather than a primary temperament dimension in its own right. In response, Mineka, Watson, and Clark (1998) modified the initial model, reducing the role of physiological hyperarousal by relating it to the etiology of panic disorder only.

The latest extensions of Clark and Watson's initial work (1991) have broadened its scope. Clark (2005) proposed an integrative hierarchical framework relating temperament traits to Axis I (e.g., depressive, anxiety, and substance use disorders) and

[2] PE, NE, and EC show close conceptual links to an array of traits (Klein et al., 2009); for example, NE is closely related to neuroticism and negative affect. For the sake of conciseness, I will refer to these traits as NE, PE, and EC throughout the remainder of this thesis.

Axis II conditions to capture within and between-Axes comorbidity. Specifically, NE appears to be a broad underlying dimension of both internalizing (encompassing primarily anxiety and depressive disorders) and externalizing (encompassing substance use disorders and antisocial behaviour/antisocial personality disorder) psychopathology (Clark, 2005; Krueger, Caspi, Moffitt, & McGee, 1996; Watson et al., 2005), which explains the high rates of comorbidity within and between these two spectra (Kendler, Prescott, Myers, & Neale, 2003). However, while NE shows broad predictive power for psychopathology in general; accumulating evidence suggests that it is more strongly associated with some types of disorders than others. More specifically, NE is correlated most strongly and consistently with disorders characterized by subjective distress and dysphoria than with other types of dysfunction (Watson et al., 2005). Thus, among the mood and anxiety disorders, NE is most strongly related to disorders characterized by chronic, pervasive distress (e.g., depression and GAD), moderately related to syndromes characterized by more specific and limited forms of distress (e.g., panic disorder, social phobia), and only weakly related to syndromes characterized primarily by behavioral avoidance (e.g., the animal and blood-injection subtypes of specific phobia; Watson et al., 2005). Similarly, the relevance of lower PE for disorders other than depression has also been expanded (Brown et al., 1998; Clark, 2005; Watson & Clark, 1994; Watson et al., 2005). Most notably, markers of PE are most strongly and consistently correlated with anhedonia, a prominent feature of major depression, social phobia, and schizophrenia/schizotypy (Clark, 2005; Watson et al., 2005; Watson, Kotov, & Gamez, 2006).

The extant literature provides extensive support for the role of self-reported NE and PE in the etiology of depressive and other symptoms in adult samples both

concurrently, longitudinally, and across genders and cultures (Beck et al., 2003; Cook, Orvaschel, Simco, Hersen, & Joiner, 2004; Joiner, 1996; Jolly & Dykman, 1994; Jolly & Kramer, 1994; Philipp, Washington, Raouf, & Norton, 2008; Teachman, Siedlecki, & Magee, 2007; Watson et al., 1995). More specifically, multiple studies of factor analyses of self-reported temperament and symptoms have provided evidence that NE is a broad factor related to an array of forms of psychopathology; these same studies implicate specific associations between PE and depression (e.g., Beck et al., 2003; Cook et al., 2004; Joiner, 1996; Phillip et al., 2008; Watson et al., 1995). Beck et al. (2003) reported consistent findings in a sample of older adults, and Teachman et al. (2007) reported that these relationships between PE, NE and symptoms were stable across age in a large, cross-sectional, community sample of adults aged 18-93. Finally, Philipp et al. (2008) provided evidence of the applicability of the tripartite model to African-American, Hispanic, and Asian groups. In conclusion, a significant degree of support has emerged linking NE and PE to depression in an array of samples diverse with respect to adult age and ethnicity.

Reactive Temperament Traits and Psychopathology in Youth

While this review and work in the field has focused largely on links between temperament and adult psychopathology, work with younger samples, particularly longitudinal work, may better differentiate between the various possible models relating temperament and symptoms (Klein et al., 2009). In particular, as depressive disorders often onset in adolescence (Lewinsohn, Hops, Roberts, Seeley, & Andrews, 1993; Roberts et al., 1991), examining associations between temperament and symptoms in childhood may be especially useful.

Most of the evidence for the role of NE and PE in the etiology of youth depression comes from concurrent questionnaire assessments of community and psychiatric samples (e.g., Chorpita, Albano, & Barlow, 1998; Chorpita, Daleiden, Moffitt, Yim, & Umemoto, 2000; Crook, Beaver, & Bell, 1998; Daleiden, Chorpita, & Lu, 2000; Joiner, Catanzaro, & Laurent, 1996; Joiner & Lonigan, 2000; Kiernan, Laurent, Joiner, Catanzaro, & McLachlan, 2001; Laurent, Joiner, & Catanzaro, 2011; Lonigan, Carey, & Finch, 1994; Lonigan, Hooe, David, & Kistner; 1999; Lonigan, Phillips, & Hooe, 2003; Muris, Schmidt, Merckelbach, & Schouten, 2001; Phillips, Lonigan, Driscoll, & Hooe, 2002). For example, Lonigan et al. (1999; 2003) examined the joint structure of self-reported temperament and anxious and depressive symptoms in two community samples of 9-11- and 12-17-year-olds. Their findings indicated positive associations between higher NE and both depression and anxiety and positive associations between lower PE and depression only, measured both concurrently and across a one-year follow-up. Supportive evidence also comes from studies using parent reports of child PE, NE, and symptoms (e.g., Phillips et al., 2002, who examined a sample of 9-17-year-olds). Finally, converging evidence has been obtained by Chorpita et al. (2000), Daleiden et al. (2000), and Lu et al. (2010) in several samples of 8-16-year-olds using self-report measures of temperament and parent and self-reports of symptoms. Thus, self-reported NE has been consistently found to be a non-specific factor for depression in both child and adult samples. Consistent with the adult literature (Clark, 2005), some findings in child samples implicate lower self-reported PE in depressive and other symptoms (Chorpita, Plummer, & Moffitt, 2000).

However, there are some significant limitations to this body of research. In particular, much of the support for the tripartite model in youth comes from studies of samples of older children and adolescents, i.e., 12-17 years of age (Lonigan et al., 1999; Turner & Barrett, 2003). Considering the significant increase in depression prevalence that emerges in adolescence (Lewinsohn, et al., 1993; Roberts et al., 1991), testing models of risk in this age group may be less useful for establishing temporal precedence than studies of younger children, begging the question of why more investigators have not explored associations between temperament and depression in younger samples. Also remarkable is the absence of multi-wave studies that would facilitate the use of advanced statistical modeling techniques (Singer & Willett, 2003).

The lack of a substantial body of research on links between child temperament and symptoms may stem from the issue of temperament trait assessment that arises in children. While self-report is largely accepted as the gold standard in research on adult personality (although see Borkenau, Riemann, Angleitner, & Spinath, 2001, Durbin, Schalet, Hayden, Simpson, & Jordan, 2009, and Furr & Funder, 2007 for important examples of observational work on adult personality), no consensus with respect to methodology has emerged in research on child temperament. Most research on child temperament has relied on parent report methods, which yield a number of advantages. For example, such methods capitalize on parents' extensive exposure to their children's behavior across diverse settings, and they are affordable and efficient to administer (Rothbart et al., 2001; Rothbart & Bates, 2006). However, parent reports of child temperament likely capture both objective aspects of child behavior as well as parental bias (Durbin, Hayden, Klein, & Olino, 2007; Hayden, Durbin, Klein, & Olino, 2010;

Rothbart & Bates, 2006) and parent reports of child temperament have typically shown poor convergent validity with teacher reports and observational and laboratory measures (Durbin et al., 2007; Seifer, Sameroff, Barrett, & Krafchuk, 1994), poorer predictive validity for later psychological adjustment (Mesman & Koot, 2000), and evidence of dysphoria-related parental bias (De Los Reyes & Kazdin, 2005; Youngstrom, Izard, & Ackerman, 1999). Several authors have asserted that parents' responses may be influenced by their own moods and desire to maintain a stable view of their children's temperament/ personality (Bates, 1994; Kagan, 1998; Durbin & Wilson, 2011), and some (e.g., Kagan, 1998) have called for greater use of alternative approaches, such as observational measures. Despite being expensive and time-consuming to administer, laboratory measures of child temperament (e.g., Goldsmith, Reilly, Lemery, Longley, & Prescott, 1995) may have significant advantages over parent reports, such as the use of standardized stimuli, specific coding procedures that minimize rater bias, and permitting the observation of child behaviors that may be present at a lower rate in naturalistic settings (Durbin et al., 2007).

To date, there are only a few studies investigating the relationship between temperament assessed in laboratory settings and markers of child depression risk (e.g., Durbin, Klein, Hayden, Buckley, & Moerk, 2005; Olino, Klein, Dyson, Rose, & Durbin, 2010) and even fewer that have looked at the relationship between laboratory-assessed temperament and child depressive symptoms (Dougherty, Klein, Durbin, Hayden, & Olino, 2010; Dougherty et al., 2011). Durbin et al. (2005) found that lower positive emotionality in preschoolers was associated with maternal mood disorder, a known marker of risk for an array of child problems, including depression. Olino et al. (2010)

found that higher negative emotionality and behavioral inhibition in preschoolers were also associated with parental mood disorders but only when these children had high and moderate levels of positive emotionality. Finally, Dougherty et al. (2010), reported results from a longitudinal study of preschoolers who were followed up at ages 7 and 10. These authors found that at age three, laboratory-assessed dysphoria and lower exuberance were associated with children's symptoms of depression, while laboratory-assessed fear, lower exuberance, and lower sociability were associated with child symptoms of anxiety. Moreover, they found that children with both higher mother-reported NE and lower mother-reported PE at age three showed the steepest increase of depressive symptoms over time. These findings indicate that lower PE and/or lower PE in combination with higher NE represent a significant risk factor for child depressive symptoms.

Regulatory Temperament Traits and Psychopathology

Similar to the extant literature on NE and PE (i.e., reactive traits), much of the research on EC and related traits in adulthood has explored its direct associations with psychopathology. Specifically, Clark (2005) reviewed the literature linking EC-like traits and their lower-order facets with externalizing forms of psychopathology, such as substance use disorders, antisocial behaviour/PD, and borderline PD (Kendler et al., 2003; Krueger, Caspi, Moffitt, & Silva, 1998; Krueger, 1999; Krueger et al., 2002; Lynam, Leukefeld, & Clayton, 2003; Watson, 2005; Vollebergh et al., 2001). Krueger et al. (2002) provided a brief review of the extant literature linking impulsivity and novelty-seeking with antisocial PD, criminal behavior, and substance use disorders. They noted that longitudinal studies indicate that these disinhibitory traits precede and predict behaviors related to antisocial PD (e.g., delinquency, antisocial and criminal behavior), as well as substance use disorders. There is also a significant amount of evidence that

deficits in EC are related to children's externalizing symptoms both concurrently and across time (e.g., Eisenberg et al., 2009; Kochanska & Knaack, 2003; Lengua, 2006; Lengua, West, & Sandler, 1998; Nigg et al., 2002; Nigg, Silk, Stavro, & Miller, 2005; Oldehinkel, Hartman, Ferdinand, Verhulst, & Ormel, 2007; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005; Rydell, Berlin, & Bohlin, 2003; Spinrad et al., 2007).

However, associations between EC and related traits and depression are far less clear and are debated in the field. More specifically, some researchers (e.g., Eisenberg et al., 2001; Eisenberg et al., 2005; Eisenberg et al., 2009; Lengua, 2006; Muris, 2006; Muris, de Jong, & Engelen, 2004; Oldehinkel et al., 2007; Zeman, Shipman, & Suveg, 2002) suggest that lower EC is related to elevated internalizing symptoms, while others (e.g., Murray & Kochanska, 2002; Oosterlaan, Logan, & Sergeant, 1998; Rydell et al., 2003) find either no relationship or evidence that *higher* EC is a risk factor for developing internalizing symptoms. For example, in a study of preschool children, Murray and Kochanska (2002) found a positive relation between EC and children's depressive symptoms; as opposed to other studies cited above, these authors used laboratory measures of EC. At the same time, Eisenberg et al. (2005) found that maternally-reported EC was negatively related to depressive symptoms in preschoolers, but not 2 years later in middle childhood. Thus, empirical associations between EC and depressive symptoms in childhood are mixed.

This inconsistency may stem from the possibility that EC works in conjunction with other traits, such as PE and NE, in relating to depression risk. Carver and colleagues (2009) recently proposed a two-part model describing how EC may relate to both internalizing and externalizing symptoms. In this model, individuals who are temperamentally approach-oriented (i.e., higher in PE) who also have a limited capacity

to regulate such tendencies due to lower EC are likely to develop externalizing problems. At the same time, individuals who are characterised by blunted approach orientation (i.e., lower in PE) and are at the same time lower in EC rendering them unable to override their lack of motivation to approach rewards are predisposed to developing depression. Similarly, Carver et al. (2009) suggested that anxiety is a product of an over-active threat-oriented system (i.e., these individuals would be higher on NE) and deficits in EC. A similar view has been expressed by Derryberry and Rothbart (1997), who suggested that children with higher levels of aggression and lower levels of EC are likely to develop more externalizing symptoms, while children with higher levels of fear and lower levels of EC are likely to develop symptoms of anxiety. Based on the extant literature on reactive temperament traits and symptoms (Clark, 2005) and the two-process model suggested by Carver et al. (2009), EC may interact with NE and PE in predicting development of internalizing disorders in childhood. Thus, in accordance with the model suggested by Watson and Clark (1991), interactions between EC and NE would be relevant to both anxiety and depression, while interactions between EC and PE may particularly be relevant to the latter. Lower EC and higher NE would represent a broad risk factor for both anxiety and depression, while lower PE would remain specific to depression. Thus, higher NE and lower EC children would be equally likely develop either anxious or depressive symptoms, while children lower on PE and EC would be particularly at risk for developing depression.

Despite this theoretical interest and the intuitive appeal of these interactive models, very few empirical studies have tested such models. The small literature on interactions between reactive traits and EC in predicting child symptoms is based on

questionnaire reports of temperament (e.g., Lonigan & Vasey, 2009; Lonigan, Vasey, Phillips, & Hazen, 2004; Mezulis, Simonson, McCauley, & Vander Stoep, 2011; Muris, Meesters, Blijlevens, 2007; Oldehinkel et al., 2007). For example, in a cross-sectional sample of 9-13-year-olds, Muris et al. (2007) found that higher self-reported fear (an NE facet) and lower self-reported EC were associated with internalizing symptoms, while higher self-reported anger/frustration, another facet of NE, and lower self-reported EC were associated with externalizing symptoms. Oldehinkel et al. (2007) found a similar pattern of results across time in a sample of 11-year-olds followed up at age thirteen. Lonigan and Vasey (2008) found that, in a large cross-sectional study of 4^{th}-12^{th} graders, self-reported EC moderated the association between self-reported NE and attentional biases; more specifically, only children with higher self-reported NE and lower self-reported EC showed attentional bias to threat stimuli, a bias associated with both anxiety and depression (Lonigan et al., 2004). However, more recently, Mezulis et al. (2011) failed to replicate the moderating effect of self-reported EC on self-reported NE or PE in predicting depressive symptoms concurrently in a large community sample of 12-year-olds. Similarly, their replication attempts failed when predicting symptoms assessed at the age of 14 and 15 years. Overall, the extant literature on whether EC moderates associations between reactive temperament traits and symptoms in childhood is limited and somewhat inconsistent, and based fully on non-observational measures of temperament. Further, the literature on interactions between reactive and regulatory temperament traits in predicting symptoms for adults is even more limited, however, both studies were consistent in finding moderating effects of EC on associations between

reactive temperament traits and internalizing symptoms (Derryberry & Reed, 2002; Dinovo & Vasey, 2011).

Present Study

The present study seeks to address several gaps in the extant literature on temperament and depression. First, the important developmental period of middle childhood has been largely ignored by researchers interested in temperamental risk for depression. Middle childhood is associated with increased interpersonal and self-regulatory demands (Angold, Costello, Erkanli, & Worthman, 1999; Lansford, Malone, Dodge, Pettit, & Bates, 2010; Turner & Cole, 1994), and precedes a time of marked increases in depressive symptoms (Lewinsohn et al., 1993); hence, this may be a time when associations between putative risk markers and depressive symptoms are more readily identified. Second, very few studies have examined how laboratory measures of child temperament relate to depressive symptoms, an important omission given the important advantages of this assessment approach relative to parent reports. Another critical omission is the lack of studies examining associations between temperament and depressive symptoms over time, especially using multiple waves of assessment. Such approaches may provide greater insights into causal processes, decrease measurement error, and permit the analyses of depression trajectories over time. Finally, few studies have tested theoretically important interactions between reactive and regulatory temperament traits.

Thus, the goal of the current investigation was to characterize the role of reactive and regulatory child temperament traits (i.e., NE, PE, and EC) in predicting initial levels and change in depressive symptoms in middle childhood, using a multi-informant, multi-

method approach to the assessment of temperament and depressive symptoms. I examined this question in a sample of 205 children who participated in three waves of data collection at ages 7, 8, and 9. I had several hypotheses based on existing work on the role of temperament in depression in adults, adolescents, and children. First, I expected that higher NE at baseline would be associated with higher levels of depressive symptoms concurrently and steeper increases in depressive symptoms over time (Chorpita et al., 2000; Daleiden et al., 2000; Lonigan et al., 1999, 2003). At the same time, I predicted that lower PE measured at baseline would be associated with higher levels of depressive symptoms concurrently and a steeper increase in depressive symptoms over follow-ups (Chorpita et al., 2000; Clark, 2005; Dougherty et al., 2010). Given the mixed evidence with regard to the role of EC in internalizing symptoms, I did not make firm predictions about associations between this trait and depressive symptoms. However, I planned to test whether EC moderated associations between children's reactive traits and symptoms, predicting that lower EC would interact with both lower PE and higher NE to predict elevated depressive symptoms concurrently and greater increases across time (Carver et al., 2009).

Method

Baseline Assessment

Participants.

A community sample of 205 7-year-old children (46% boys, $M_{age =}$ 7.41 years, SD = .30) and their parents ($M_{\text{age mothers}}$ = 37.48 years, SD = 8.96; $M_{\text{age fathers}}$ = 40.43 years, SD = 11.50) were recruited through a psychology department database of research volunteers, and advertisements placed in local newspapers and online. The Peabody

Picture Vocabulary Test, Fourth Edition (PPVT-IV; Dunn & Dunn, 2007) was administered as a general screener of the cognitive functioning of participants. Children performed within the normal range (M = 111.92; SD = 12.15), and boys and girls scored equivalently, t (202) = 1.13, *ns*. Child participants were Caucasian (n = 179; 89%), Asian (n = 4; 2%) or from other ethnic groups (n = 17; 9%). Approximately half of the families participating (50.30%) reported a family income ranging from $40,000-$100,000; 26.80% of families reported a family income greater than $100,000, and 15.20% of families reported a family income of less than $40,000. These sample characteristics are comparable to data pertaining to race and income from the 2006 census for the London, Ontario area from which families were recruited (Statistics Canada, 2008).

Assessment of child temperament.

Laboratory temperament assessment.

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 positive and negative emotionality and were intended to simulate naturalistic events encountered by children in everyday life (e.g., being allowed to play with a novel toy, interacting briefly with a stranger, or attempting to complete a frustrating puzzle). Tasks 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 (Fear, 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 interact with each object.

Racing Cars (Anger, Sadness, PE). The child was given photographs of a desirable toy (a remote-controlled race car) and 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 requested toy was given to the child.

Stranger Approach (Fear). The child was left alone in the main experimental area to play with a toy golf set. Following a short delay, a friendly, unfamiliar male research assistant entered the room. The stranger talked to 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 contained pieces that did not fit together. After 3 minutes, the experimenter returned and explained that she had accidentally 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.

Object Fear (Fear). 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. 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 inter-rater reliability (minimum ICC =.80) for all episodes. Half of all coders' affect coding was also coded by the master coder, and if the ICC for a given episode was below .80, the episode was discussed and final consensus ratings were made.

Each instance of facial, bodily, and vocal positive affect, fear, sadness, and anger exhibited by children in each episode was rated on a 3-point scale as low, moderate, or high. The number of instances of moderate and high behaviours 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 behaviours were summed separately within each channel (facial, bodily, vocal)

across the seven episodes, standardized, 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 (α = .75) NE (α = .52), anger (α = .52), fear (α = .57) and sadness (α = .60), but consistent with other studies using laboratory measures of temperament (e.g., Dougherty et al., 2011; Durbin et al., 2005; Durbin et al., 2007). In addition to affective codes, a single rating on a three-point scale was made for the behavioral variables of impulsivity and compliance for each episode; these ratings were aggregated across all episodes to obtain total lab impulsivity and compliance scores. Impulsivity (α =.77) was based on the child's tendency to respond and/or act without reflection. Compliance (α = .58) was based on the amount of "rule-breaking" behaviors, the persistence of the noncompliance, and the degree to which these behaviors were judged to reflect an intentional unwillingness to comply with the experimenter's suggestions or requests. Subsequently, impulsivity was reverse scored and z-score transformed and aggregated with compliance which was also z-score transformed to obtain a laboratory measure of EC.

Temperament in Middle Childhood Questionnaire (TMCQ).

The TMCQ (Simonds & Rothbart, 2004) is a 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 (CBQ; Rothbart et al., 2001). For the present study, our focus was on NE, EC, and PE; thus, we drew upon a recent factor analysis of the TMCQ to derive measures of these traits (Simonds, 2006). A total of 17 sub-scales were derived; these sub-scales can be aggregated into four higher order factors: negative

affectivity, EC, surgency, and affiliation. The negative affectivity (NA) factor included the following TMCQ scales: anger/frustration (α =.81), discomfort (α = .72), fear (α = .72), sadness (α =.77), and soothability, reverse-scored (α = .71). The EC factor consisted of inhibitory control (α = .74), attentional focusing (α =.90), low intensity pleasure (α =.61), perceptual sensitivity (α =.80), and activation control (α =.80). The TMCQ does not have a scale or factor that specifically assesses children's expressions of positive affect. However, the factor analysis yielded a factor that showed reasonable conceptual overlap with trait PE, labeled *surgency* by Simonds (2006). This factor is the aggregate of the high intensity pleasure (α =.83), activity (α = .88), assertion/dominance (α =.71), impulsivity (α = .88), and reverse-scored shyness (α = .85) scales. Internal consistencies were moderate to good for surgency, NA, and and EC (Cronbach's αs = .88, .77, and .90, respectively). Unfortunately, due to the paucity of extant literature on the psychometric properties on the TMCQ, it is hard to evaluate the statistics obtained for this measure in the current study.

Table 1 lists mother-reported and laboratory temperament traits that comprised PE, NE, and EC in this study. TMCQ NA will be referred to as NE for the rest of this manuscript for the sake of efficiency. However, as our laboratory measure of PE and the TMCQ surgency scale share relatively less overlap, I will continue to refer to these by their different labels.

Table 1

Measures of the Big Three Temperament Traits

Temperament Trait	Mother-Reports	Laboratory-assessed
Surgency/PE	TMCQ Surgency Facets include: Activity, Dominance, Impulsivity, High Intensity Pleasure, Shyness (reversed)	Laboratory PE (facial, bodily, and vocal)
NE	TMCQ NA Facets include: Fear Anger Sadness Discomfort Soothability (reversed)	Laboratory NE Facets include: Fear (facial, bodily, and vocal) Anger (facial, bodily, and vocal) Sadness (facial, bodily, and vocal)
EC	TMCQ EC Facets include: Inhibitory Control, Attentional Focusing, Low Intensity Pleasure, Perceptual Sensitivity, Activation Control	Laboratory EC: global ratings of compliance + impulsivity (reversed)

Note. TMCQ - Temperament in Middle Childhood Questionnaire; PE – positive emotionality; NE – negative emotionality; EC – effortful control

Assessment of child depressive symptoms.

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 and both of their parents completed questionnaires assessing children's symptoms of depression. For each self-report measure, a research assistant read items aloud to the child and recorded children's responses. During the same visit, parents also completed the TMCQ which was described above. Only mother reports of child temperament and symptoms were used for the current project.

The Depression Self Rating Scale (DSRS; Birleson, 1981) is a 24-item self-report measure of depression in children and youth (Asarnow & Carlson, 1985; Kazdin & Petti, 1982). DSRS scores demonstrated good internal consistency (Cronbach's α = 0.73). The average scores in the current sample (see Table 2) were comparable to that observed in other nonclinical samples (e.g., Asarnow & Carlson, 1985; Hayden, Klein, Durbin, & Olino, 2006). A cut-off score of 17 has been identified as indicative of clinical levels of depression (Asarnow & Carlson, 1985).

The Child Behavior Checklist (CBCL/4-18; Achenbach, 1991) is a widely used measure designed to identify social, emotional, and behavioural problems in children, and was used as a measure of child psychopathology. 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, 2005), they are less useful for differentiating between specific subtypes of

dimensions of internalizing problems (Lengua, Sadowski, Friedrich, & Fisher, 2001). Therefore, an alternative scale score derived to be consistent with DSM-IV diagnostic criteria for depressive disorders was used (Lengua et al., 2001), hereafter referred to as maternal reported depression or the CBCL/Lengua depression scale. The internal consistency of maternally-reported child depressive symptoms was moderate (Cronbach's $\alpha = 0.64$). Average scores for mother-reported symptoms of child depression were low (see Table 2) and consistent with published means reported for a community sample (Lengua et al. 2001). Previously reported means in clinical samples have ranged from 5 and above on the CBCL/Lengua depression scale (Lengua et al., 2001).

Follow-up Assessments

Of the initial sample of 205 families, 181 (88.3%) participated in a follow-up home visit a year after the baseline assessment, when children were an average of 8.48 years old ($SD = .32$). Children and both of their parents completed the same questionnaires on child symptoms as at baseline. Only mother reports of child symptoms were used for the current project. Comparing participants who participated in the first follow-up to those who did not, showed no significant differences in proportion of male participants, depressive symptoms, or family income (all $ps > .37$). However, children who participated in the second follow-up had higher PPVT scores than those who did not, $F(1, 202) = 4.63$, $p = .03$.

A third assessment occurred at a psychology research laboratory when children were an average of 9.63 years old ($SD = .38$); 171 children (83% of the original sample) and their primary caregiver participated. We again compared participants who completed the third assessment to those who completed the baseline assessment only, and found no

significant differences in proportion of male participants, PPVT scores, depressive symptoms, or family income (all *ps* > .19). During the age 9 laboratory visit, children completed several laboratory tasks that will not be discussed further here. At this follow-up, we collected informant data only from the primary caregiver (21 of whom were fathers; 12%) who accompanied children to the laboratory visit.

At both follow-up visits, children completed the DSRS again with the help of an experimenter and parents completed the CBCL. The DSRS showed acceptable internal consistency at the first (Cronbach's α =.72) and second follow-up (Cronbach's α = .86). The internal consistencies of the Lengua depression scale were also moderate at the first and second follow-ups (Cronbach's α = .71 and Cronbach's α =.73 respectively). Average scores for child self-reported and mother-reported depressive symptoms were low and consistent with non-clinical samples (see Table 2).

Results

Correlational Analyses

Table 2 outlines bivariate correlations between mother-reported and child self-reported symptoms of depression across time. Both mother-reported and child self-reported symptoms of depression were significantly correlated at all assessments, i.e., child self-reported depressive symptoms were correlated at each assessment, as were mother-reported scores. However, mother-reported and child self-reported symptoms of depression did not generally show significant contemporaneous associations with each other, consistent with previous reports showing low convergence between child and parent reports of depressive symptoms (De Los Reyes & Kazdin, 2005). There was one exception to this tendency: child self-reported depressive symptoms were moderately

correlated with maternal reports of child depressive symptoms at the second follow-up. With respect to demographic variables, child sex was unrelated to child depressive symptoms at all time points. Family income at baseline was negatively related at a trend level to mother-reported child depressive symptoms at the second follow-up. This trend finding suggests that children from families with higher levels of income at baseline showed lower levels of mother-reported depressive symptoms during the second follow-up. Children's PPVT scores at baseline were significantly, negatively correlated with child self-reported symptoms of depression at the second follow-up, and significantly, positively correlated with family income.

Table 2

Bivariate Correlations Between Mother-Reported and Child Self-Reported Depressive Symptoms Across Time

	1	2	3	4	5	6	7	8	9	*M*	*SD*
1. DSRST1	--	.35**	.27**	.10	.10	.07	-.09	.02	-.04	12.95	5.50
2. DSRST2		--	.33**	.03	.12	.18*	-.12	-.09	-.20**	13.49	5.00
3. DSRST3			--	.09	.10	.17*	-.09	-.13	-.03	14.53	7.15
4. CBCLDepT1				--	.53**	.44**	.04	-.06	-.11	1.38	1.87
5. CBCLDepT2					--	.67**	.04	-.11	-.05	1.45	2.07
6. CBCLDepT3						--	-.02	-.14†	-.08	1.72	2.45
7. Child sex							--	-.06	-.09	--	--
8. Income								--	.18*	3.63	1.18
9. PPVT									--	111.92	12.15

Note: † $p < .10$ * $p < .05$ ** $p < .01$; DSRS – The Depression Self Rating Scale; CBCL Dep – The Child Behaviour Checklist Lengua depression scale; child sex : 0 = boys , 1 = girls; family income was coded as follows: 1 = < $20,000; 2 = $20,001-40,000; 3 = $40,001-70,000; 4 = $70,001-100,000; 5 = > $100,000; PPVT – Peabody Picture Vocabulary Test

Table 3 shows bivariate correlations between mother-reported (TMCQ) and laboratory temperament traits, as well as all temperament measures and demographic variables. Within-method correlations showed a significant, negative relationship between mother-reported EC and NE and surgency. Similarly, laboratory EC was significantly, negatively correlated with laboratory PE and NE. Between-method correlations showed significant, albeit modest, associations between mother-reported surgency and laboratory PE, mother-reported and laboratory NE, and mother-reported and laboratory EC, and mother-reported EC was negatively related at a trend level with laboratory NE. Previous work with younger children showed generally comparable, albeit slightly more modest, associations across different temperament assessment methods of conceptually similar traits (Durbin et al., 2007; Hayden et al., 2005). Girls were rated as significantly lower on surgency by mothers, and were lower on laboratory NE. Child sex was also related to both measures of EC, such that girls were higher on both mother-reported and laboratory EC. These results are consistent with the extant literature on sex differences in child temperament for both maternal reports and observational measures (Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006; Olino, Durbin, Klein, Hayden, & Dyson, in press). Children's PPVT scores at baseline also showed a significant positive association with laboratory PE. Finally, family income level at baseline was negatively related at a trend level to mother-reported child NE and positively related at a trend level to laboratory-assessed child EC (see Table 3).

Table 3

Bivariate Correlations Between Mother-Reported and Laboratory Temperament Traits at Baseline

	1	2	3	4	5	6	7	8	9	*M*	*SD*
1. TMCQSurg	--	-.04	-.27**	.18*	.01	-.32**	-.18*	.06	-.08	129.21	18.53
2. TMCQNE		--	-.39**	-.02	.23**	-.06	.08	-.13†	-.05	68.08	19.97
3. TMCQEC			--	-.05	-.13†	.25**	.25**	.11	.05	166.81	17.73
4. LPE				--	.09	-.38**	-.02	-.03	.15*	0	.82
5. LNE					--	-.23**	-.15*	.01	.04	0	.46
6. LEC						--	.27**	.13†	.01	0	1.69
7. Child Sex							--	-.06	-.09	--	--
8. Income								--	.18*	3.63	1.18
9. PPVT									--	111.92	12.15

Note: † $p < .10$ * $p < .05$ ** $p < .01$; child sex was coded as 0 for boys and 1 for girls; family income at baseline was coded as follows: 1 = < $20,000; 2 = $20,001-40,000; 3 = $40,001-70,000; 4 = $70,001-100,000; 5 = > $100,000; TMCQ - Temperament in Middle Childhood Questionnaire; TMCQSurg, NE, EC – mother-reported child surgency, NE, and EC; LPE, LNE, LEC – laboratory-assessed child PE, NE, and EC; PPVT – Peabody Picture Vocabulary Test

Table 4 shows bivariate correlations between both child temperament and children's self and mother-reported symptoms of depression at all waves of assessment. Mother-reported EC showed the most stable pattern of associations with depressive symptoms across time and across informants: it was negatively correlated with child self- and mother-reported symptoms of depression at all time points. Mother-reported NE was positively correlated with child self-reported depression at the second follow-up and with mother-reported child depressive symptoms across all time points. Mother-reported surgency was significantly, and unexpectedly, positively correlated with mother-reported child depressive symptoms at the first follow-up. Laboratory EC was negatively correlated with child self-reported depressive symptoms at the second follow-up, and at a trend level with child-self reported depressive symptoms at the first follow-up. Laboratory NE was positively correlated at a trend level with mother-reported child depressive symptoms at baseline, was unexpectedly *negatively* correlated with mother-reported child depressive symptoms at the second follow-up. Finally, in contrast to hypotheses, laboratory PE showed no significant associations with child self-reported or mother-reported symptoms at any time points.

Table 4

Bivariate Correlations Between Temperament Traits and Child Depressive Symptoms

	DSRST1	DSRST2	DSRST3	CBCLDepT1	CBCLDepT2	CBCLDepT3
1. TMCQSurg	.09	.11	.10	.11	.15*	.07
2. TMCQNE	.09	-.05	.16*	.51**	.30**	.24**
3. TMCQEC	-.26**	-.23**	-.28**	-.26**	-.21**	-.17*
4. LPE	.02	.04	.10	.07	-.02	.03
5. LNE	.05	.08	.06	.12†	-.08	-.16*
6. LEC	-.04	-.14†	-.18*	-.04	.01	-.02

Note: † $p < .10$* $p < .05$ ** $p < .01$; TMCQ - Temperament in Middle Childhood Questionnaire; TMCQSurg, NE, EC – mother-reported child surgency, NE, and EC; LPE, LNE, LEC – laboratory-assessed child PE, NE, and EC; DSRS – The Depression Self Rating Scale; CBCLDep – The Child Behaviour Checklist Lengua depression scale

Modeling Change Across Time: Latent Growth Curves

Latent growth curve (LGC) modeling was used to model the relationship between child temperament and depressive and anxious symptoms over time. LGC permits the examination of intra-individual (within-person) change over time, as well as inter-individual (between-person) variability in intra-individual change. When investigating inter-individual differences in intra-individual change across time, Kline (2011) recommended a two-step approach: first, a basic LGC framework is used to evaluate the intra-individual change across time; second, time-variant or invariant predictors of the inter-individual differences can be introduced into the model.

In LGC, measured variables are comprised of repeated measures of the same variable; in the present case, these are mother-reported and child self-reported symptoms of depression measured at three different time points. Two latent factors are specified to represent aspects of change: the intercept, which represents the level of the outcome measure at which the time variable equals zero (in the present case, baseline assessment), and the slope, which represents the linear rate at which the outcome measure changes. As rates of child depressive symptoms tend to rise during middle childhood, albeit typically remaining below clinical thresholds (Lewinsohn et al., 1993), I hypothesized a linear growth model across the three time points for both informants of child depressive symptoms. The increasing means of depressive symptoms at the three time points provided additional evidence for linear growth (see Table 2).

Figure 1 shows a basic LGC showing change in depressive symptoms across the three time points. Latent variables are represented as ellipses, observed variables are represented as rectangles, and error terms are represented as circles. Parameters estimated

include the mean intercept and slope (i.e., mean initial levels and mean level of change over time), the intercept and slope variances and covariance between the two, and error term variance that is assumed to remain constant over repeated assessments (Kline, 2011; Preacher, Wichman, McCallum, & Briggs, 2008). Loadings on the intercept factor are fixed to 1 to represent the influence of a constant on the repeated measures. Loadings on the slope factor are fixed to a linear progression (0 for baseline, 1 for the first follow-up, and 2 for the second follow-up) to represent linearly increasing growth over time. The slope loadings are set to begin at 0 to indicate that the first occasion of measurement represents the initial response. A basic LGC assumes time-structured data, i.e., that all data have been collected on the same occasions for all individuals (in the present case, at ages 7, 8, and 9). Parameter estimation in LGC is traditionally accomplished with maximum likelihood estimation, the use of which assumes that measured variables are multivariate normally distributed. To address missing data, the full information maximum likelihood method was used for estimating the partially complete data, which is considered to be more efficient and less biased than other methods of dealing with missing data, such as deletion or imputation (Preacher et al., 2008).

Analyses were conducted using Mplus statistical software (Muthen & Muthen, 1998-2011). Mplus provides model fit statistics that reflect the overall fit of the proposed model to the data. The following statistics were examined to assess model fit: the Comparative Fit Index (CFI; Bentler, 1990) and the root-mean-square error (RMSEA; Steiger & Lind, 1980). Conventional goodness-of-fit criteria suggest that values close to .95 for the CFI and values between .06-.08 for the RMSEA indicate a good model fit (e.g., Hu & Bentler, 1999). However, these are rough guidelines to be interpreted in

conjunction with other features of the data, and in light of the research domain in question (Marsh, Hau, & Wen, 2004; Marsh et al., 2010). For example, Hopwood and Donnellan (2010) recommended more lenient criteria to assess model fit in temperament research.

Child Depressive Symptoms: Intra-Individual Differences.

A basic LGC for children's self-reported depressive symptoms indicated that both the mean intercept and slope were significantly different from zero (*M* intercept = 12.90, $p < 0.001$; *M* slope = .80, $p = .01$); the positive slope also indicates an increase in symptoms across time. Both the intercept and slope variance were significant (intercept variance =10.84, $p < .001$; slope variance = 5.61, $p = .01$), indicating that additional predictors of inter-individual intercept and slope variability could be added. The overall model fit for an LGC with a linear slope trajectory was acceptable: RMSEA = .10 and CFI = .80.

A basic LGC for children's mother-reported depressive symptoms indicated that the mean initial (baseline) status was significantly different from zero (*M* intercept = 1.36, $p < .001$); the mean slope, while positive and thus suggesting linear growth, was only marginally significant (*M* slope = .16, $p = .07$). Both the intercept and slope variance were significant (intercept variance =2.04, $p < .001$; slope variance = .60, $p = .03$), indicating that additional predictors of inter-individual intercept and slope variability could be added. The overall model fit for an LGC with a linear slope trajectory was very good: RMSEA < .001 and CFI = 1.00.

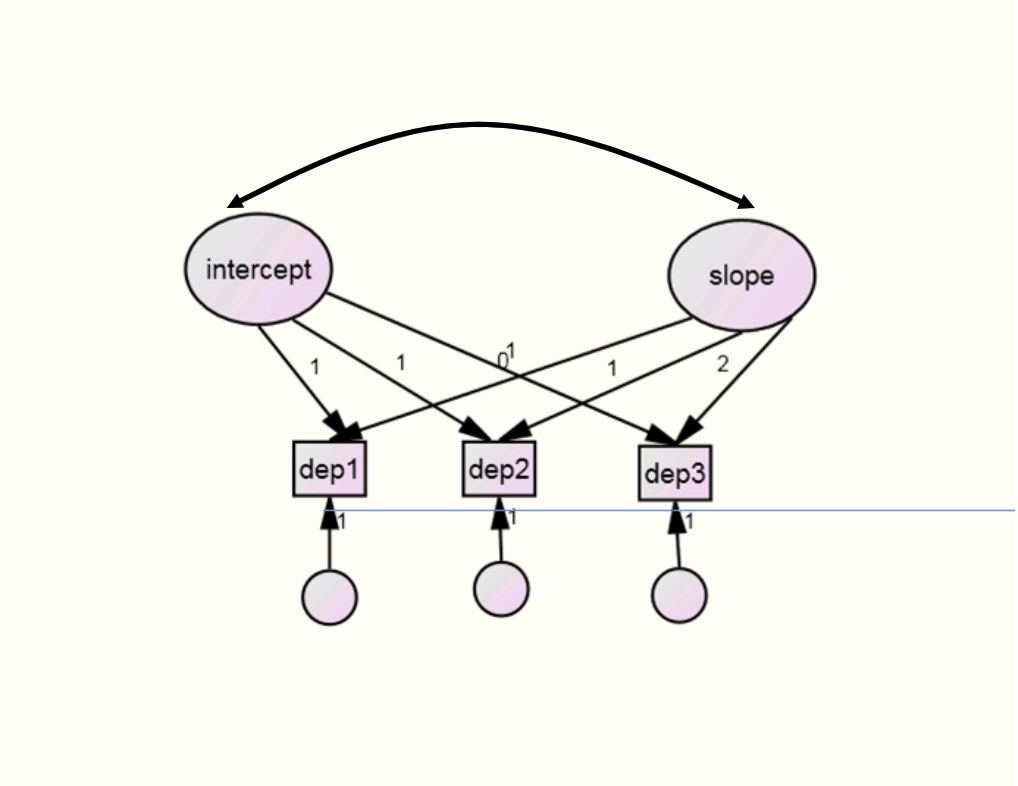

Figure 1. Basic LGC showing change in depression across time; restricted parameters are marked with respective numbers, e.g., intercept loadings are fixed to 1, slope loadings are fixed to 0, 1, and 2; the rest of the parameters are freely estimated.

Child Depressive Symptoms: Inter-Individual Differences.

Figure 2 shows an LGC with three time-invariant predictors of intercept and slope as well as their two interaction terms. As before, parameters estimated include mean intercept and slope (sample mean initial status and sample mean level of change over time when time-invariant predictor is 0), the intercept and slope residual error terms and covariance between the two, and error term variance that is assumed to remain constant over repeated measurements. Finally, the ten regression paths between the time-invariant predictors and intercept and slope are estimated as well.

In total, I tested four models predicting mother-reported child depressive symptoms and child self-reported depressive symptoms. In these models, predictors were laboratory or maternally-reported NE, PE (or surgency), and laboratory or maternally-reported EC, as well as the hypothesized interactions between each measure of NE and EC, and PE (or surgency) and EC. To test interactions in predicting initial symptoms and change over time, a stepwise approach similar to that used in hierarchical regression was used (Aiken & West, 1991). Each predictor variable was centered as necessary and interaction terms were formed as the product of the two centered predictors (Aiken & West, 1991). For the sake of parsimony and to conserve power, nonsignificant interaction terms were dropped from final models. Any significant interaction terms were interpreted by plotting the equations and conducting post-hoc analyses of simple slopes (i.e., by re-centering the variables involved in creating the interaction terms at +1*SD* and -1*SD* above the means for those traits; Aiken & West, 1991). The models were then re-run with these re-centered variables to obtain the mean intercepts and slopes for depressive symptoms across time at + and – 1*SD* on both the relevant reactive trait and EC.

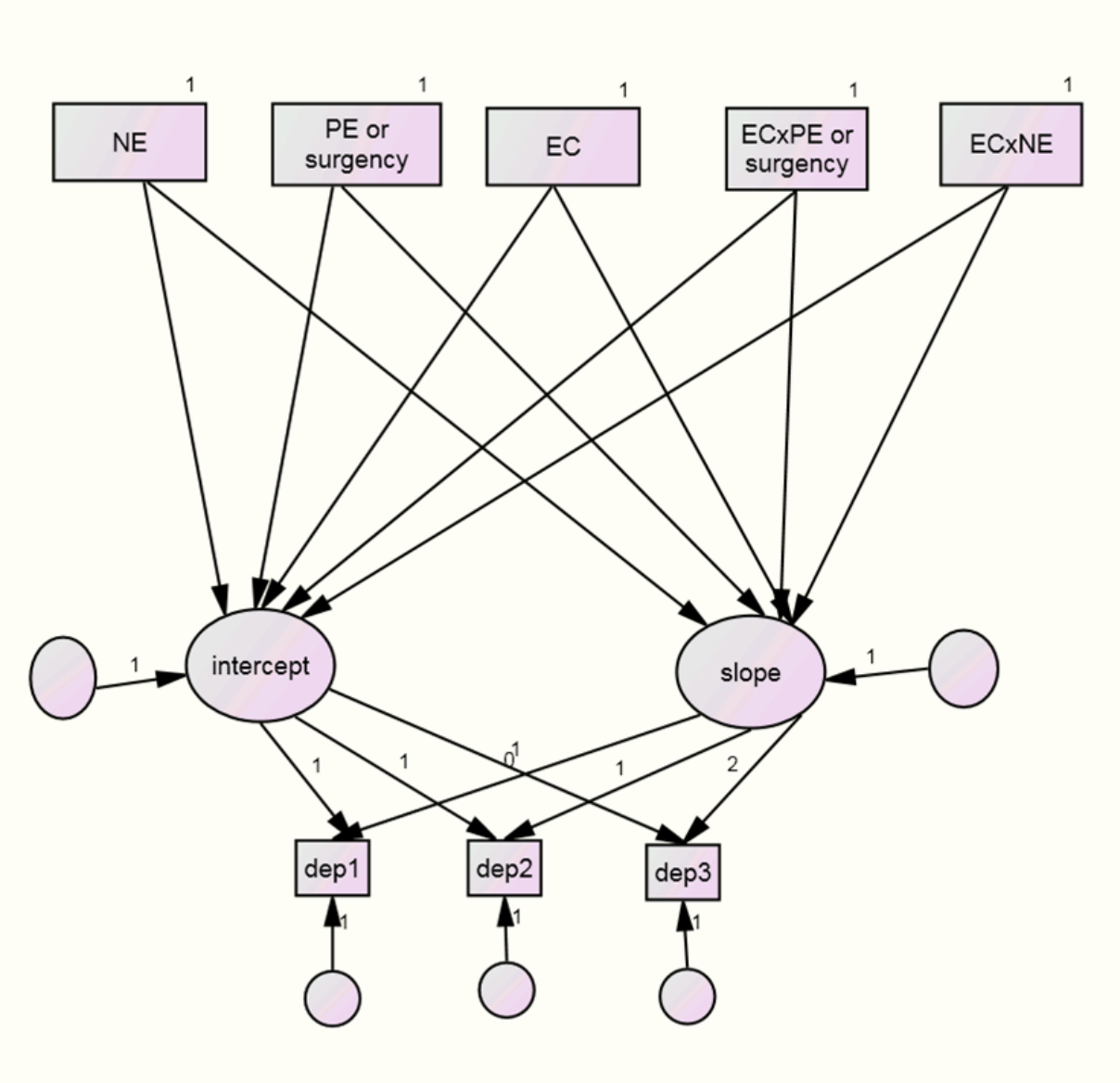

Figure 2. LGC with three time-invariant predictors (NE, PE or surgency, and EC) and two time-invariant interaction terms

Temperament and Inter-Individual Differences in Child Self-Reported Depressive Symptoms.

Due to the pattern of significant correlations between child sex and both mother-reported and laboratory-assessed temperament traits (see Table 3), child sex was added to all initial models as a covariate. Although it did not emerge as a significant predictor of the intercept or slope for child self-reported depressive symptoms, all models for this outcome variable showed a better fit when child sex was included, so it was retained in final models. When added as covariates, neither family income nor children's PPVT scores at baseline had any significant effect on the model fit or parameters, so these were not included in final models. A full model for inter-individual differences in child self-reported depression with child sex and laboratory temperament traits (NE, PE, and EC), the EC-NE interaction, and the EC-PE interaction as predictors showed that neither the EC-NE nor the EC-PE interaction terms was significant; thus, these interactions were removed from the final model and only main effects of the three traits were tested .This model was an acceptable fit to the data (see Table 5). None of the laboratory-assessed traits predicted children's self-reported baseline levels of depressive symptoms. However, laboratory EC emerged as a marginally significant (p = .07) predictor of slope. Figure 3 presents a plot of laboratory EC at +/- 1SD as it relates to child self-reported symptoms of depression over time. This figure shows that children lower on laboratory EC at baseline showed a steeper increase in self-reported symptoms of depression across time than children higher in laboratory EC. This statement was also verified using simple slope analysis (Aiken & West, 1991; see Figure 3).

Table 5

LGM Parameter Estimates for Laboratory Temperament Traits Predicting Child Self-Reported Depressive Symptoms Across Time

	RMSEA	CFI	Res. Variance: I	Res. Variance: S	Estimate for: I	*SE*	S	*SE*
Model:	.06	.89	10.56**	5.31*				
Child Sex					-.87	.77	.09	.60
LNE					.44	.79	.06	.71
LPE					.06	.45	.15	.30
LEC					-.01	.21	-.30†	.16

Note. † $p < .10$; * $p < .05$; ** $p < .01$; LNE, LPE, LEC – laboratory-assessed NE, PE, and EC; Est. for I and Est. for S show unstandardized regression coefficients of time invariant predictors on intercept and slope; *SE* – standard error of the estimate; Res. Variance – residual variance for intercept and slope; Estimate for S on LEC is marginally significant (p =.07)

Figure 3. Laboratory EC Predicting Changes in Child Self-Reported Depressive Symptoms Across Time

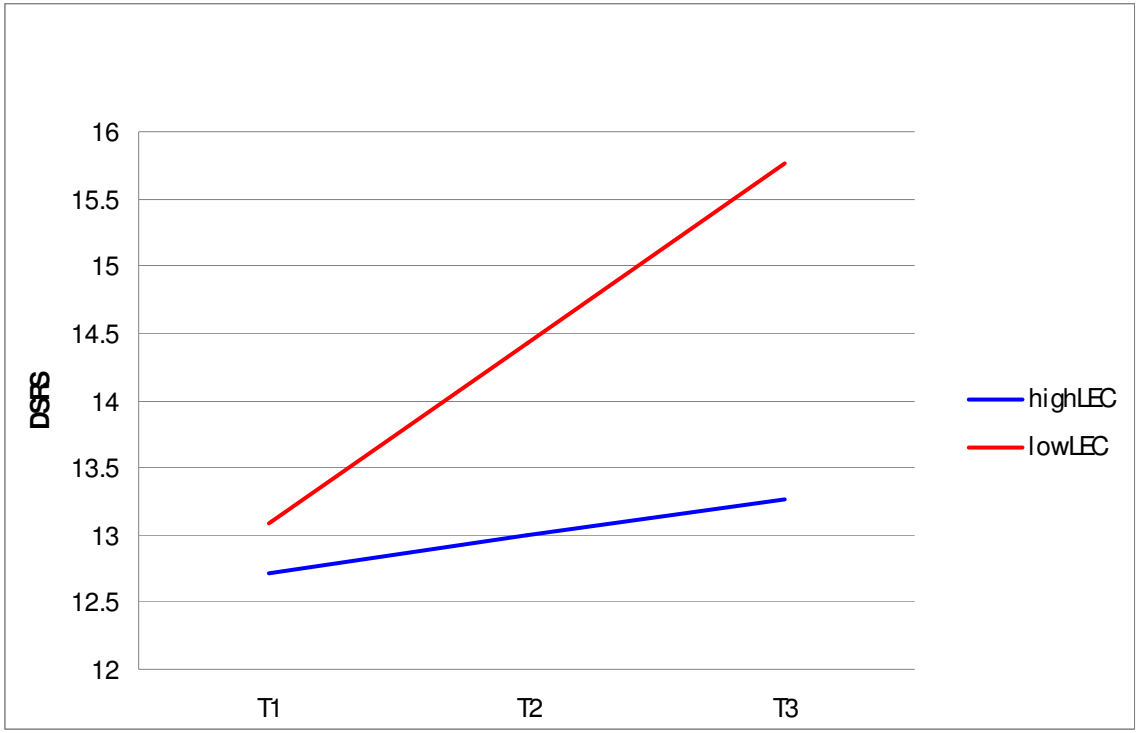

Figure 3. Plot of laboratory EC at +/-1*SD* as it relates to changes in child self-reported depressive symptoms across time; highLEC: laboratory EC at +1 *SD*; lowLEC: laboratory EC at -1*SD*; y axis – child self-reported depression measured by DSRS scores; this graph and simple slope analyses indicated that children who scored lower on laboratory EC at baseline showed a steeper increase in their self-reported symptoms of depression across time.

It is evident from the graph that children who scored lower (-1*SD*) on laboratory EC at baseline showed a steeper increase in their self-reported symptoms of depression across time than children who scored higher (+1*SD*) on laboratory EC at baseline. This statement was also verified using the simple slope analysis (Aiken & West, 1991). Having re-centered the data at +/- 1*SD*, I re-ran the models with laboratory EC as a predictor of change in child self-reported depression. The results indicated that the average slope of the trajectory of child self-reported depression across time was significant at laboratory EC centered at -1*SD* (*M* slope =1.31; $p < .01$), but not at laboratory EC centered at +1*SD*.

A model including child sex and all mother-reported temperament traits (NE, surgency, and EC) and their interactions (EC-NE and EC-surgency) as predictors of child self-reported depression was also a good fit (see Table 6). TMCQ EC was a significant negative predictor of child self-reported symptoms of depression at baseline (see Table 6); no other terms were significant. With respect to change over time, significant effects were found for the interaction between TMCQ surgency and EC and the TMCQ NE – EC interaction (the latter at a trend level; p=.07). Thus, the model with all main effects and the two interaction terms was retained. The interactions are depicted separately to ease comprehension (see Figures 4 and 5). Figure 4 shows the trajectories of depressive symptoms of children at higher and lower levels of TMCQ EC and NE, as well as results of simple slope analyses. Figure 5 shows the interaction between mother-reported surgency and EC in predicting child self-reported depression symptoms across time, and the simple slope analyses.

Table 6
LGM Parameter Estimates for Mother-Reported Temperament Traits Predicting Child Self-Reported Depressive Symptoms Across Time

	RMSEA	CFI	Res. Variance:		Estimate for:			
			I	S	I	*SE*	S	*SE*
Model:	.06	.88	8.94*	4.93*				
Child Sex					-.13	.74	-.27	.62
TMCQNE					-.02	.02	.02	.02
TMCQSur					.00	.02	.01	.02
TMCQEC					-.08**	.03	-.01	.02
TMCQNExEC					-.01	.01	.01†	.01
TMCQSurxEC					-.01	.01	.01*	.01

Note. † $p < .10$ * $p < .05$ ** $p < .01$; TMCQ - Temperament in Middle Childhood Questionnaire; TMCQNE, TMCQSur, TMCQEC – mother-reported NE, surgency, and EC; Est. for I and S show unstandardized regression coefficients of time invariant predictors on intercept and slope; *SE* – standard error of the estimate; Res. Variance – residual variance for intercept and slope; Estimate for S on TMCQNE-EC interaction was marginally significant (p=.07); the model with two interaction terms was retained as the final model

Figure 4. TMCQ NE - TMCQ EC Interaction Predicting Changes in Child Self-Reported Depressive Symptoms Across Time

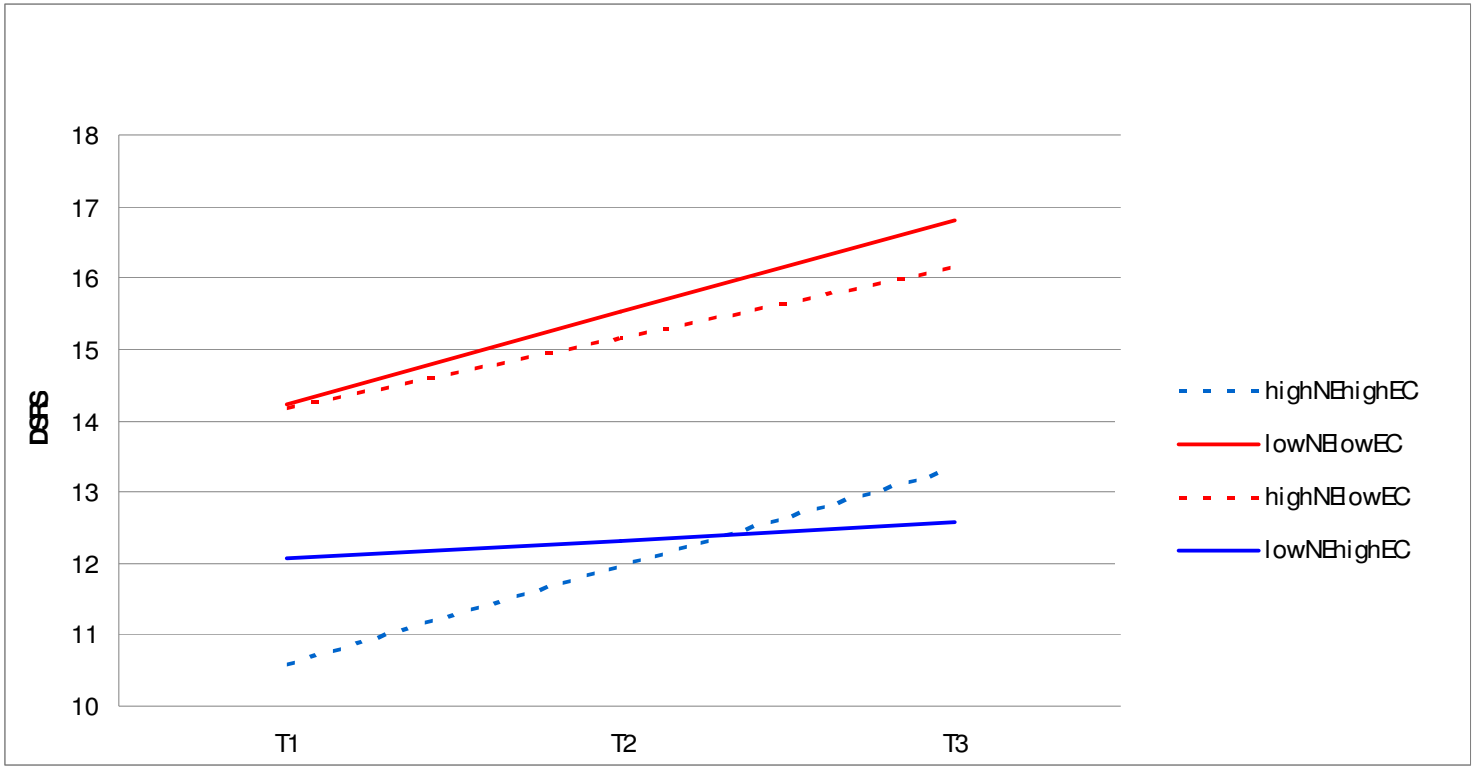

Figure 4. Plot of TMCQ NE at +/-1*SD* interacting with TMCQ EC at +/-1*SD* in predicting changes in child-self-reported depressive symptoms across time; highNEhighEC: mother-reported NE and EC plotted at +1*SD*; lowNElowEC: mother-reported NE and EC plotted at -1*SD*; highNElowEC: mother-reported NE plotted at +1*SD* and mother-reported EC plotted at -1*SD*; lowNEhighEC: mother-reported NE plotted at -1*SD* and mother-reported EC plotted at +1*SD*; y axis – child self-reported depression measured by the DSRS scores.

Simple slope analyses indicated that children who scored higher on both mother-reported NE and EC at baseline showed a significant increase on their depression symptoms over time (*M* slope = 1.36; $p = .03$), while children who scored lower on both of these traits showed a marginally significant increase on these symptoms (*M* slope = 1.25; $p = .08$). Similarly, children who scored higher on mother-reported NE and lower on mother-reported EC at baseline also showed a strong trend-level increase in their self-reported depressive symptoms across time (*M* slope = 1.12; $p = .05$), while children who scored higher on mother-reported EC and lower on mother-reported NE at baseline did not.

Figure 5. TMCQ Surgency - TMCQ EC Interaction Predicting Changes in Child Self-Reported Depressive Symptoms Across Time

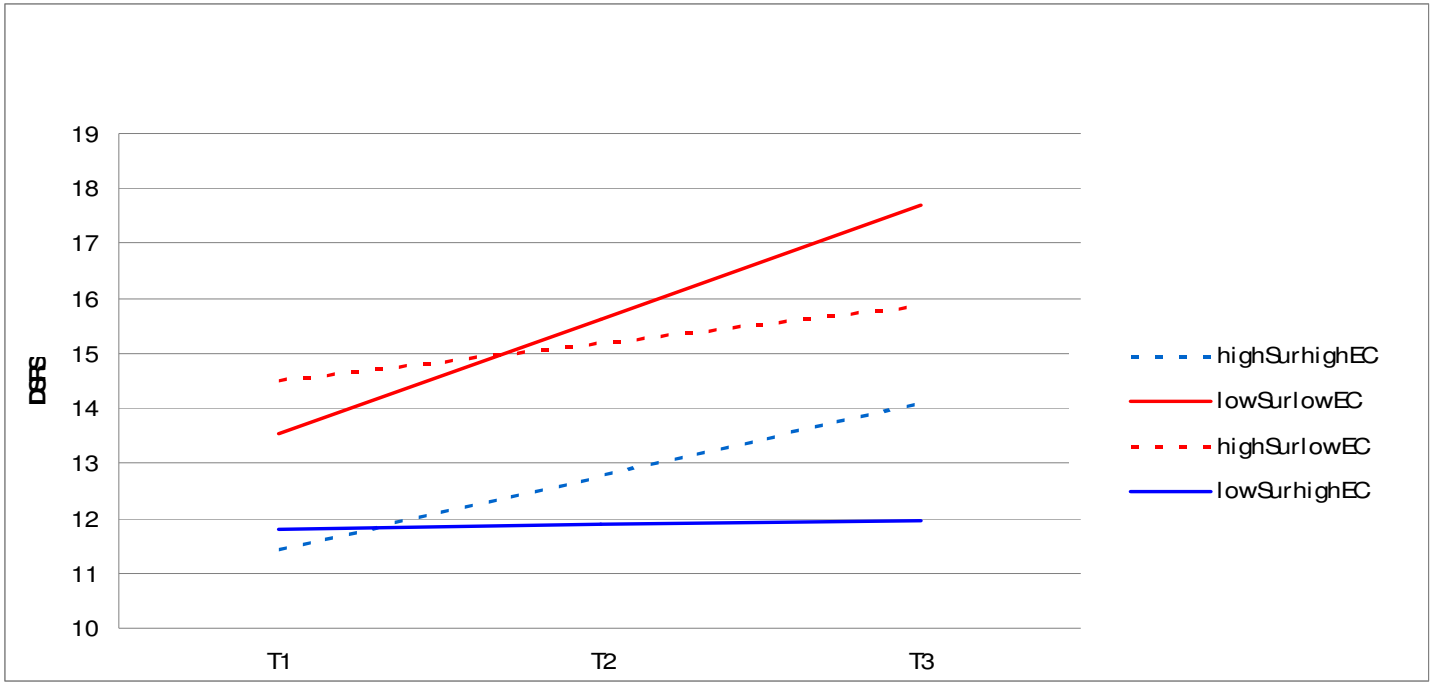

Figure 5. Plot of TMCQ surgency at +/-1*SD* interacting with TCMQ EC at +/-1*SD* in predicting changes in child-self reported depressive symptoms; highSurhighEC: mother-reported surgency and EC plotted at +1*SD*; lowSurlowEC: mother-reported surgency and EC plotted at -1*SD*; highSurlowEC: mother-reported srugency plotted at +1*SD* and mother-reported EC plotted at -1*SD*; lowSurhighEC: mother-reported surgency plotted at -1*SD* and mother-reported EC plotted at +1*SD*; y axis – child self-reported depression measured by the DSRS scores.

Simple slope analyses indicated that children who scored lower on both mother-reported surgency and EC increased significantly on their self-reported symptoms of depression across time (*M* slope = 2.82; $p = .01$). The same pattern of results was marginal for children who scored higher on both of those traits (*M* slope = 1.52; $p = .07$). Children who were lower on mother-reported surgency and higher on EC maintained stable lower levels over the course of the study. Similarly, children who scored higher on mother-reported surgency and lower on mother-reported EC at baseline did not show a significant increase in their self-reported depressive symptoms.

Temperament and Inter-Individual Differences in Mother-Reported Child Depressive Symptoms.

All of the models for mother-reported child depressive symptoms were initially tested with child sex as a covariate due to a significant pattern of correlations between child sex and both mother-reported and laboratory-assessed temperament traits (see Table 3). However, child sex did not emerge as a significant predictor of either intercepts or slopes in any of the laboratory of mother-reported temperament models; similarly, it did not improve model fit. Therefore, child sex was removed from the final models to increase parsimony. Similarly, family income or children's PPVT scores at baseline did not have any significant effect on model fit or parameters. A full model with laboratory temperament traits (NE, PE, and EC) and EC-NE as well as EC-PE interactions as predictors of mother-reported child depressive symptoms showed that neither of the interactions was a significant predictor of intercept or slope (see Table 7). Having removed the nonsignificant interaction terms, I re-ran the final model with main effects of temperament only; model fit was very good (see Table 7). Neither of the laboratory-assessed temperament traits emerged as significant predictors of mother-reported children's depressive symptoms at baseline. Surprisingly, laboratory NE was a significant negative predictor of change in mother-reported child depressive symptoms across time (see Table 7). Figure 6 shows a plot relating higher (+1SD) and lower (-1SD) laboratory NE to changes in mother-reported child depressive symptoms across time as well as the simple slope analyses.

Table 7

LGM Parameter Estimates for Laboratory Temperament Traits Predicting Mother-Reported Child Depressive Symptoms Across Time

	RMSEA	CFI	Res. Variance: I	Res. Variance: S	Estimate for: I	*SE*	S	*SE*
Model:	<.001	1	1.98**	.51*				
LNE					.45	.33	-.67**	.19
LPE					.09	.19	-.08	.11
LEC					.02	.09	-.07	.05

Note. * $p < .05$ ** $p < .01$; LNE, LPE, LEC – laboratory-assessed NE, PE, and EC; Est. for I and Est. for S show unstandardized regression coefficients of time invariant predictors on intercept and slope; *SE* – standard error of the estimate; Res. Variance – residual variance for intercept and slope

Figure 6. Laboratory NE Predicting Changes in Mother-Reported Child Depressive Symptoms Across Time

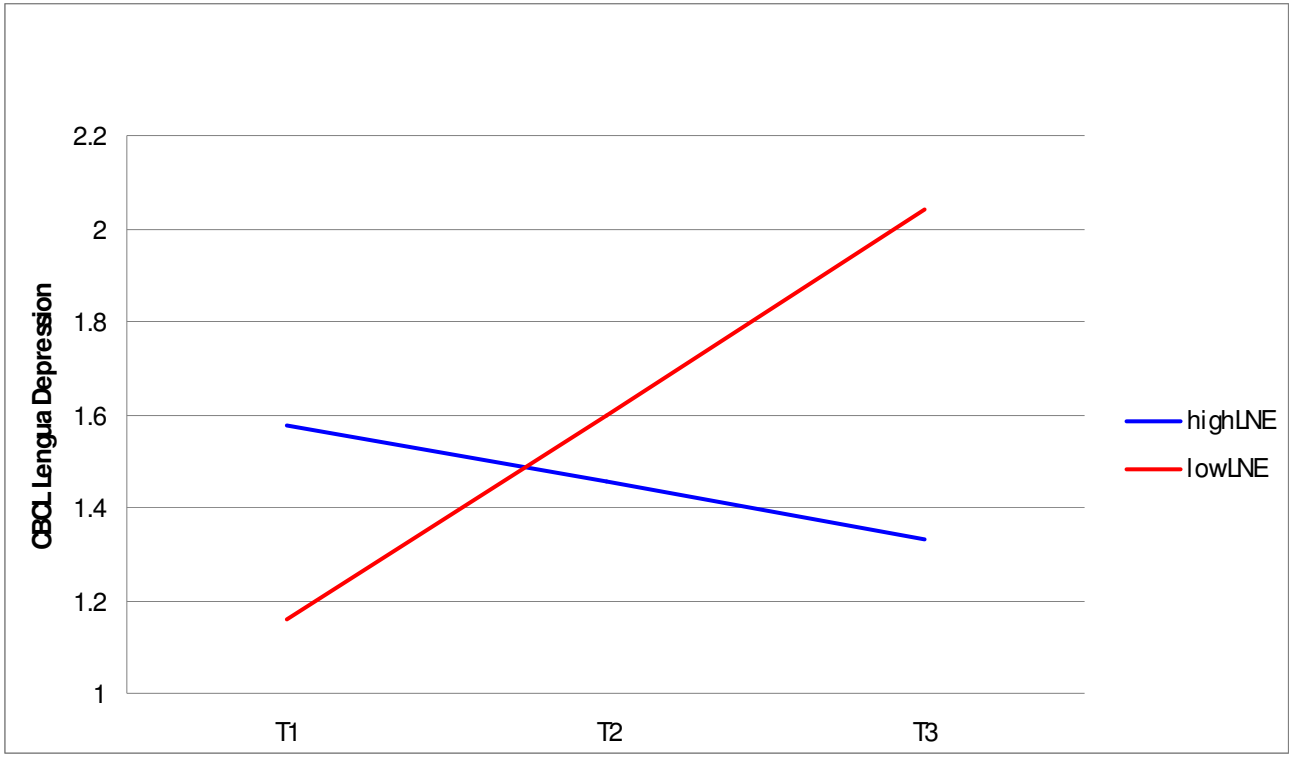

Figure 6. Plot of laboratory NE at +/-1*SD* as it relates to changes in mother-reported child depressive symptoms across time; highLNE: laboratory NE at +1 *SD*; lowLNE: laboratory NE at -1*SD*; y axis – child depressive symptoms measured by the CBCL Lengua depression scale

Simple slope analyses indicated that children who scored lower on laboratory NE at baseline showed a significant increase on mother-reported symptoms of depression (*M* slope =.44; $p<.01$); while children who scored higher on laboratory NE at baseline did not.

A model including all mother-reported temperament traits (NE, surgency, and EC) and the two hypothesized interactions showed that the interaction between NE and EC was a marginally (p=.07) significant predictor of change in mother-reported child depressive symptoms across time. The nonsignificant interaction term between the TMCQ surgency and the TMCQ EC was removed from the final model, which was a very good fit to the data (see Table 8). TMCQ NE emerged as a significant positive predictor of the mother-reported child depressive symptoms at baseline, indicating that children who were rated by their mothers as higher on NE were also rated as higher in depressive symptoms. An interaction between TMCQ NE and TCMQ EC again emerged as a marginally (p=.08) significant predictor of change in mother-reported child depressive symptoms across time and as fully significant predictor of their baseline status. A plot of this interaction and results of the simple slope analyses can be found in Figure 8.

Table 8

LGM Parameter Estimates for Mother-Reported Temperament Traits Predicting Mother-Reported Child Depressive Symptoms Across Time

	RMSEA	CFI	Res. Variance:		Estimate for:			
			I	S	I	*SE*	S	*SE*
Model:	<.001	1	1.10**	.51*				
TMCQNE					.04**	.01	-.01	.01
TMCQEC					-.01	.01	-.01	.01
TMCQNExEC					-.01*	<.01	<.01†	<.01

Note. † p <.10 * p < .05 ** p < .01; TMCQ - Temperament in Middle Childhood Questionnaire; TMCQNE, TMCQSur, TMCQEC – mother-reported NE, surgency, and EC; Est. for I and S show unstandardized regression coefficients of time invariant predictors on intercept and slope; *SE* – standard error of the estimate; Res. Variance – residual variance for intercept and slope; Estimate for S on TMCQNExEC was marginally significant (p=.08)

Figure 7. TMCQ NE - TMCQ EC Interaction Predicting Changes in Mother-Reported Child Depressive Symptoms Across Time

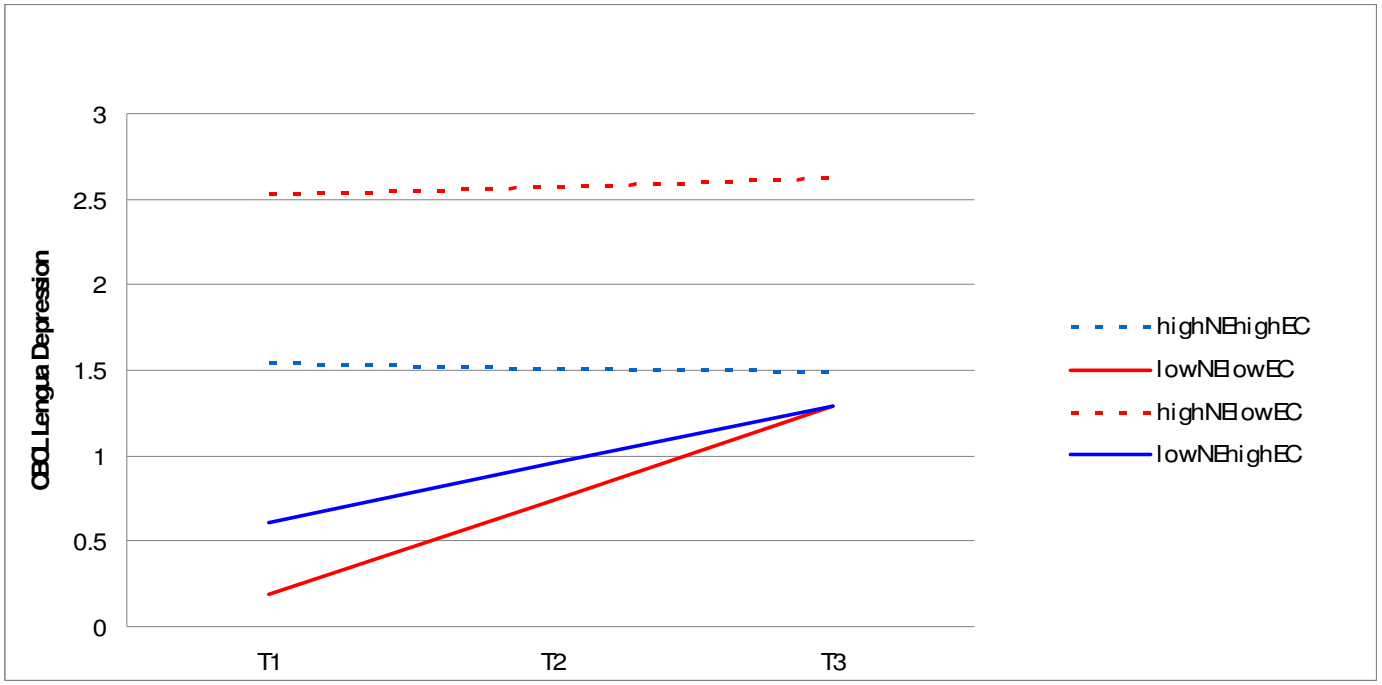

Figure 7. Plot of TMCQ NE at +/-1*SD* interacting with TMCQ EC at +/-1*SD* in predicting changes in mother-reported child depressive symptoms across time; highNEhighEC: mother-reported NE and EC plotted at +1*SD*; lowNElowEC: mother-reported NE and EC plotted at -1*SD*; highNElowEC: mother-reported NE plotted at +1*SD* and mother-reported EC plotted at -1*SD*; lowNEhighEC: mother-reported NE plotted at -1*SD* and mother-reported EC plotted at +1*SD*; y axis – child depressive symptoms measured by the CBCL Lengua depression scale

Simple slope analyses indicated that children who scored lower on both mother-reported NE and EC at baseline showed a significant increase on mother-reported child depressive symptoms (*M* slope = .67; *p* = .01), while children who scored higher both on those traits did not, they showed a stable higher level of mother-reported child depressive symptoms. Children who scored lower on mother-reported NE and higher on mother-reported EC at baseline showed a significant increase in mother-reported child depressive symptoms across time (*M* slope = .21; *p* = .02). At the same time, children who scored higher on mother-reported NE and lower on mother-reported EC at baseline showed the highest but stable level of mother-reported depressive symptoms.

Discussion

Although a large empirical literature has developed over the past few decades relating temperament to depression, very few studies have focused on such links in middle childhood, a critical period for understanding emerging depression risk. Furthermore, previous work has neglected potentially important interactions between temperament traits in predicting depression risk (Carver et al., 2009). The present study addressed this gap by examining the relationship between reactive (i.e., NE and PE/surgency) and regulatory (i.e., EC) temperament traits and child depressive symptoms, using a multi-method approach to assessing both temperament and depressive symptoms. Findings indicated that temperament was related to children's depressive symptoms through both main and interactive effects, although the pattern of findings differed depending on the method of temperament assessment and the source of information on children's symptoms. However, considering the generally low degree of convergence found between different approaches to measuring both, temperament and depressive symptoms in the present study, as well as in others (e.g., Dougherty et al., 2010), such discrepant results are unsurprising.

Laboratory EC emerged as a significant predictor of change in child self-reported symptoms across time; simple slope analyses indicated that children who were rated as lower on laboratory EC at baseline showed a steeper increase in their self-reported depressive symptoms across time. Furthermore, maternal reports of EC suggested an inverse relationship between TMCQ EC at baseline and child self-reported symptoms of depression: children who were rated higher on EC by their mothers showed lower levels of self-reported depressive symptoms at baseline. These findings are consistent with the

literature suggesting that lower levels of EC represent a risk marker for depression (Eisenberg et al., 2001; Eisenberg et al., 2007; Eisenberg et al., 2009; Lemery et al., 2002; Lengua, 2006; Muris, 2006; Muris et al., 2004; Oldehinkel et al., 2007; Zeman et al., 2002). While EC is known to be fairly stable, there is ample evidence for both naturalistic change and the effects of specific programs designed to enhance EC-like abilities (Rueda, Posner, & Rothbart, 2005; van Veen & Carter, 2002). Our findings suggest the possible merits of implementing prevention and intervention programs that focus on fostering EC competencies in children as a means of reducing depression risk.

EC also showed interactive relationships with both PE and NE in predicting depressive symptoms. First, consistent with recent theory (Carver et al., 2009), children who scored lower on both mother-reported surgency and EC increased significantly in self-reported symptoms of depression across time. Carver et al. (2009) proposed that such a relationship might emerge when children with a blunted approach-oriented response (i.e., lower surgency) also show a deficit in the capacity to upregulate low responsivity to rewards (i.e., lower EC). This PE-NE interaction was found only for maternally-reported temperament, not for laboratory-assessed traits. In contrast to the laboratory measure of PE, which was defined solely in terms of emotional expression, the TMCQ surgency trait represents a broader and more heterogeneous construct (see Table 1), and includes facets such as high intensity pleasure and activity. These may map more closely onto reward responsivity as described in Carver and colleagues' model, thus explaining why evidence was found for interaction using the TMCQ and not laboratory measures.

Our analyses also indicated that EC interacted with NE in predicting depressive symptoms; more specifically, children who scored higher on mother-reported NE and

lower on mother-reported EC at baseline showed a significant at a trend level increase in their self-reported depressive symptoms across time. These results are also consistent with Carver and colleagues' (2009) suggestion that over-active avoidance sensitivity (i.e., higher NE) may lead to developing internalizing symptoms when regulatory skills are inadequate. While this interaction (i.e., maternally-reported NE-EC) was significant at a trend level for mother-reported child depressive symptoms as well, a different pattern of relationships between traits emerged: children lower on both mother-reported NE and EC at baseline showed a significant increase on mother-reported child depressive symptoms, whereas children who scored higher on both traits showed a stable, high level of mother-reported child depressive symptoms. Children who scored lower on mother-reported NE and higher on mother-reported EC at baseline showed a significant increase in mother-reported child depressive symptoms across time. At the same time, children who scored higher on mother-reported NE and lower on mother-reported EC at baseline showed the highest but stable level of mother-reported depressive symptoms. However, in analyses predicting both measures of depression, children who were higher in NE and lower in EC tended to exhibit the highest levels of depressive symptoms across the duration of the study.

Children who were rated lower on laboratory NE at baseline showed a steeper increase on mother-reported symptoms of depression across time. While contrary to hypotheses, these findings may reflect a ceiling effect. More specifically, children who were rated higher on laboratory NE at baseline were already relatively high on depressive symptoms, and thus were perhaps less likely to sharply increase in depressive symptoms. In contrast, children who were rated lower on laboratory NE at baseline experienced an

increase in self-reported depressive symptoms that was typical for the sample as a whole, and often found in samples of children this age (Lewinsohn et al., 1993; Roberts et al., 1991).

Despite the extant research implicating PE in depression risk (Brown et al., 1998; Clark, 2005; Lonigan et al., 1999, 2003; Phillips et al., 2002; Watson et al., 2005; Watson & Clark, 1994), no main effects were found for either laboratory-assessed child PE or mother-reported child surgency predicting initial levels or change in children's depressive symptoms. However, some findings suggest that longitudinal associations between PE and depressive symptoms are weaker or less conclusive than those found for other temperament traits (e.g., Anderson & Hope, 2008; Clark, 2005; De Bolle & De Fruyt, 2010; Kendler, Gatz, Gardner, & Pederse, 2006). Specifically, some of the previous studies with children (e.g., Chorpita et al., 2000) have found that low PE was also related to symptoms of social phobia. Since anxiety often precedes depression in youth (Cole, Peeke, Martin, Truglio, & Seroczynski, 1998; Keenan, Feng, Hipwell, & Klostermann, 2009; Pine, Cohen, Gurley, Brook, & Ma, 1998), it is possible that we might have found stronger effects for lower PE had we been predicting anxious, rather than depressive, symptoms.

Low correlations were found between child self-reported depressive symptoms and mother-reported child depressive symptoms, consistent with extant literature (De Los Reyes & Kazdin, 2005). Among other factors, maternal depression and anxiety symptoms (Briggs-Gowan, Carter, & Schwab-Stone, 1996; De Los Reyes & Kazdin, 2005) as well as personality traits (Durbin & Wilson, 2011) have been identified as contributors to maternal bias when reporting child depressive symptoms. The possibility of maternal bias

calls for the use of other informants on children's depressive symptoms, especially children themselves. Despite previous concerns with regards to children's capacities to accurately self-report on their depressive symptoms (Achenbach, McConaughy, & Howell, 1987; Measelle, John, Ablow, & Cowan, 2005), studies have shown that children as young as six are capable of validly reporting on the key aspects of depression (Luby, Belden, Sullivan, & Spitznagel, 2007). As a result, child self-reported levels of depression may be more accurate than maternal reports in some cases.

Additionally, cross-method correlations showed modest associations between mother-reported surgency and laboratory PE, mother-reported and laboratory NE, and mother-reported and laboratory EC. These findings are consistent with prior research; however, it appears that in the present study the correlations between laboratory and mother-reported temperament traits are perhaps slightly higher than the ones reported previously in younger children (e.g., Durbin et al., 2007; Hayden et al., 2005). It is possible that as children get older and their personality traits become more adult-like in their expression, informants (e.g., children's parents) can more readily recognize and report on these traits. Longitudinal research using a multi-method approach is needed to fully test this possibility.

Study Strengths

This study addresses several important gaps in the extant literature on child temperament and psychopathology. First, we examined children during middle childhood, a period associated with increased interpersonal and self-regulatory demands (Angold et al., 1999; Lansford et al., 2010; Turner & Cole, 1994) which precedes a time of marked increases in depressive symptoms; despite its relevance, it has nevertheless

been largely ignored by researchers investigating child temperament as a risk factor for depression. Second, I used laboratory measures to assess child temperament. This assessment approach confers multiple advantages relative to parent reports, such as the use of standardized stimuli, specific coding procedures that minimize rater bias, and the facilitation of the observation of child behaviors that may be present at a lower rate in naturalistic settings (Durbin et al., 2007). Third, this study examined associations between temperament and depressive symptoms over time using multiple waves of assessment. The availability of multiple waves of data and the need to examine complicated theoretical questions allowed me to use the structural equation modeling approach. This approach to data analysis confers multiple advantages such as estimation of missing data using maximum likelihood algorithm and flexibility in modeling slopes piece by piece (Kline, 2011).Similarly, despite the difficulty of maintaining participant enrolment in a longitudinal study that spanned over the years, attrition rate was kept to a minimum in this study (12% of the original sample was lost between baseline and the first follow-up and only 5% was lost between the first and the second follow-up). Another important strength of this study is that theoretically important interactions between reactive and regulatory temperament traits were tested in predicting depression; to date, these have largely been neglected in the literature. Investigating these interactions provides a better understanding of the complexities of the relationship between child temperament and emerging depressive symptoms.

Study Limitations and Future Directions

Despite the multiple strengths, the present study also has limitations. Most importantly, although I investigated temperament traits as risk factor for developing

depressive symptoms, I did not account for other relevant risk factors. Abela and Hankin (2008) also identified stressful life events and anxious symptoms as potent predictors of later depressive symptoms. Stressors tend to precede the onset of elevated depressive symptoms during adolescence (Grant et al., 2003). Similarly, anxiety is highly comorbid with depression during adolescence (Angold et al. 1999; Steer, Clark, Kumar, & Beck, 2008) and tends to precedes depression in youth (Cole et al., 1998; Keenan et al., 2009; Pine et al., 1998). Due to the limitations of our sample size, child anxious symptoms were not included in models. Similarly, I did not investigate interactions between reactive temperament traits (i.e., NE and PE) due to limited power. Future studies of larger samples that incorporate both anxious symptoms and comorbid externalizing symptoms and investigate all possible interactions between temperament traits are needed. Although we aimed to examine temperament-depressive symptom associations in a sample prior to the age of risk for most cases of depression, as we did not conduct lifetime clinical interview assessments to rule out previous episodes, it is possible that some children in our study were either currently depressed or had previously experienced depression. Thus, while our findings can be interpreted as tentatively supportive of models that posit prospective temperament-depression associations consistent with a predisposition or precursor model (Klein et al., 2009), we cannot rule out the possibility of prior depression having influenced children's temperament.

Another limitation of the current project is related to the assessment of temperament traits in this study. One of the goals of the study was to evaluate any differences in how laboratory and mother-reported temperament traits would act as predictors of child depressive symptoms. I used the TMCQ and a modified set of

laboratory tasks based on the Lab-TAB (Goldsmith et al., 1995) to derive laboratory PE, NE, and EC (see Table 1). Unfortunately, the TMCQ surgency scale does not include emotion-based facets that would show greater conceptual overlap with the laboratory PE scale.

Conclusion and Implications

The current study supports the notion that EC is an important moderator of temperamental risk for depressive symptoms. As children develop, the increased capacity to regulate emotion and behaviour is crucial to their successful adaptation (Rothbart, Sheese, & Posner, 2007). A variety of computerized programs have been developed toward the goal of fostering children's executive attention, a near-neighbor construct to EC (Rueda et al., 2005), and studies have provided some support for efficacy of these programs (van Veen & Carter, 2002). While such programs have not had depression prevention as a primary target, it may be the case that they would be effective in contributing toward this goal. Certainly, replication of the current findings is important, but such work may help identify children at particularly high risk for depression by virtue of other temperament traits, such as low surgency or high NE, who could be targeted for preventative efforts focusing on improving EC skills.

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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.

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Room 4180 Support Services Building, London, ON, Canada N6A 5C1
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Use of Human Subjects - Ethics Approval Notice

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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.

YULIYA KOTELNIKOVA
CURRICULUM VITAE

Education

Sept. 2010 – Present	Master of Science in Clinical Psychology University of Western Ontario
Sept. 2005 – June 2009	Honours Bachelor of Science (Psychology Research Specialist) (High Distinction), University of Toronto
Aug. 2000 – Dec.2003	International Business Diploma (High Honours), Centennial College

Quantitative Training

2012	International Workshop on Statistical Genetics and Methodology of Twin and Family Studies: The Introductory Course
2012	Structural Equation Modeling Graduate course taken at the University of Western Ontario
2011	Introduction to Structural Equation Modeling Workshop offered by a guest instructor Dr. T. M. Olino at the University of Western Ontario
2009	Quantitative Training for Underrepresented Groups (Toronto, ON)

Clinical Training

Jan. 2012 – Apr.2012	Adult Assessment Practicum Supervisor: Dr. Michael Harnadek University Hospital, London, ON, Canada Population: older adults Type of assessments: cognitive, Axis I diagnoses
Jan. 2012 – present	Child Assessment Practicum Supervisor: Dr. Karen Bax Centre for Children and Families in the Justice System of the London Family Court Clinic, London, ON, Canada Population: children and youth in forensic settings Type of assessments: trauma informed, cognitive, Axes I and II diagnoses

Research Scholarships & Fellowships

2012-2016	Social Sciences and Humanities Research Council (SSRHC) Doctoral Fellowship
2011-2012	Children's Health Research Institute (CHRI) Graduate Fellowship
2011-2012	Ontario Graduate Scholarship
2010-2011	Joseph-Armand Bombardier Master's Research Scholarship awarded by the Social Sciences and Humanities Research Council
2010-2011	Ontario Graduate Scholarship
2010-present	Western Graduate Research Scholarship awarded by the University of Western Ontario

Academic Awards

2009	Certificate of Academic Excellence Awarded by the Canadian Psychological Association to an honours thesis student on the recommendation of the University of Toronto, Department of Psychology
2009	The Erik Jackman Scholarship in Psychology Awarded to a Trinity college (University of Toronto) student with the highest CGPA in psychology research specialist program
2009	The Trinity College Scholar (University of Toronto) Awarded based on academic merit
2006, 2009	University of Toronto Dean's List Awarded to top 10% of University of Toronto students with CGPA of 3.5/4 or higher
2002, 2003	Centennial College: International Students' Excellence Award Awarded to an international student with the highest CGPA

Travel Awards

2011	Behavior Genetics Association (BGA) Travel Bursary
2009	Quantitative Training for Underrepresented Groups (QTUG) Stipend
2007	Social Sciences and Humanities Research Council Travel Award

Memberships in Professional Societies

2010 – present	Society for a Science of Clinical Psychology (Student Member)
2010 – present	Society for Research in Psychopathology (Associate Member)
2011 – present	Association for Psychological Science (Student Member)

Professional Service

Hayden, E.P. & **Kotelnikova, Y.** (2012). Peer commentary on "The developmental origins of personality vulnerabilities to psychopathology: A review of theory and research", *Canadian Psychology.*

Hayden, E. P. & **Kotelnikova, Y.** (2011). Peer commentary on "A multitrait-multimethod approach of youth distress: An analysis of self-, mother-, and friend-reports", *Journal of Abnormal Child Psychology.*

Kotelnikova, Y. & Ragsdale, K. (2010). Interview with Dr. Thomas Oltmanns, 2009 SRP president, *Society for Research in Psychopathology Student Driven Publication*

Publications

Kotelnikova, Y. (2011). Review of Personality science: Three approaches and their applications to the causes and treatment of depression, by M. Zuckerman, Washington, DC: American Psychological Association, *Personality and Individual Differences, 51,* 877-878.

Kotelnikova, Y. & Tackett, J.L. (2009). Personality and cultural correlates of childhood psychopathology. *Journal of Undergraduate Life Sciences, 3*, 26-30.

Manuscripts in Preparation

Kotelnikova, Y., Mackrell, S. V.M., Jordan, P., & Hayden, E.P. (in preparation). Reactive and regulatory temperament traits as predictors of internalizing symptoms in middle childhood.

Kotelnikova, Y., Olino, T.M., Mackrell, S. V.M., Jordan, P. L., & Hayden, E.P. (in preparation). Structure of observed temperament in middle childhood.

Presentations

Kotelnikova, Y., Mackrell, S.V.M., Jordan, P.L., & Hayden, E.P. (2012, October). *Effortful control and cognitive vulnerability to depression in middle childhood: A multi-method, longitudinal study.* Poster to be presented at the Society for Research in Psychopathology annual meeting, Ann Arbor, Michigan, USA.

Kotelnikova, Y., Mackrell, S.V.M., Veselka, L., Aitken Schermer, J., Hayden, E.P., & Vernon, P.A. (2011, June). *Non-adaptive personality traits and the Dark Triad: A behavior genetic investigation into the relationship between the two domains.* Poster presented at the Behavior Genetics Association's 41st Annual Meeting, Newport, RI, USA.

Mackrell, S.V.M., **Kotelnikova, Y**, Veselka, L., Aitken Schermer, J., & Vernon, P.A. (2011, June). *A behavioral genetic study of sub-clinical personality disorders and trait emotional intelligence.* Poster presented at the Behavior Genetics Association's 41st Annual Meeting, Newport, RI, USA.

Kotelnikova, Y., Veselka, L., Aitken Schermer, J., Hayden, E.P., & Vernon, P.A. (2011, June). *Non-adaptive personality traits and the Dark Triad: An investigation into the relationship between the two domains.* Poster presented at the Canadian Psychological Association 72nd Annual Convention, Toronto, ON, Canada.

Kotelnikova, Y., Mackrell, S. V.M., Jordan, P., & Hayden, E.P. (2011, May). *Temperament traits as predictors of change in internalizing problems in middle childhood.* Poster presented at the Association for Psychological Science 23rd Annual Convention, Washington DC, USA.

Kotelnikova, Y. & Tackett, J.L. (2010, October). *Values as predictors of psychopathology in a multicultural Canadian sample.* Poster presented at the Society for Research in Psychopathology Annual Meeting, Seattle, WA, USA.

Kotelnikova, Y. & Tackett, J.L. (2009, August). *Personality and the 10 universal values: An integrated hierarchical approach.* Poster presented at the Quantitative Training for Underrepresented Groups, Toronto, ON, Canada.

Kotelnikova, Y. & Tackett, J.L. (2009, July). *Integrating personality and values for a better understanding of cross-cultural differences.* Poster presented at the Annual Conference for the Association of Research in Personality, Evanston, IL, USA.

Tackett, J.L. & **Kotelnikova, Y.** (2009, July). *Assessing personality in middle childhood: Evidence from a multi-method, multi-informant, multi-trait study.* Talk presented at the Annual Conference for the Association of Research in Personality, Evanston, IL, USA.

Kotelnikova, Y. (2009, May). *Estimation of food intake in restrained and unrestrained eaters.* Talk presented at the 39th Annual Ontario Psychology Undergraduate Thesis Conference, Hamilton, ON, Canada.

Kotelnikova, Y. (2009, April). *Estimation of food intake in restrained andunrestrained eaters.* Poster presented at the University of Toronto Undergraduate Thesis Poster Day, Toronto, ON, Canada.

Kotelnikova Y. & Tackett, J.L. (2008, October). *Personality correlates of cross-cultural differences in childhood psychopathology.* Poster presented at the Mechanisms of Change in Developmental Psychopathology Symposium, Toronto, ON, Canada.

Kotelnikova Y. & Tackett, J.L. (2008, July). *Personality correlates of cross-cultural differences in childhood psychopathology.* Poster presented at the 14th European Conference on Personality, Tartu, Estonia.

Kotelnikova Y. (2008, May). *Personality correlates of cross-cultural differences in childhood psychopathology.* Talk presented at the 38th Annual Ontario Psychology Undergraduate Thesis Conference, St. Catharines, ON, Canada.

Current Research Projects

1. Master's thesis: Temperament traits are predictors of change in internalizing problems in middles childhood (a multi-trait, multi-method longitudinal study)
    - Supervisor: Dr. E. P. Hayden (University of Western Ontario)
2. Continuity of temperament structure in childhood
    - Supervisor: Dr. E. P. Hayden (University of Western Ontario)
    - Collaborators: Dr. T.M. Olino (University of Pittsburgh Medical Center) and Dr. D. N. Klein (Stony Brook University)
3. A multi-method investigation of temperamental emotionality in families
    - Supervisors: Dr. E. P. Hayden and Dr. P. A. Vernon (University of Western Ontario)
    - Collaborator: Dr. C. E. Durbin (Michigan State University)

Research Experience

2009-2010 — Lab Manager: Personality Across Development Lab (University of Toronto)
Supervisor: Dr. J.L. Tackett

- Administration and data management of a large-scale (n=350) longitudinal study involving community participants

2007-2009 — Research Assistant: Personality Across Development Lab (University of Toronto)
Supervisor: Dr. J.L. Tackett

- Independent study: Personality, cultural value systems and their role in development of internalizing and externalizing spectra of psychopathology
- Independent study: Personality and cultural correlates of child psychopathology
- Data collection: structured diagnostic clinical interviews with children and their parents from the community
- Research ethics protocol preparation
- Training and supervision of junior research assistants

2008-2009 — Honours Thesis Student
Supervisor: Dr. C.P. Herman (University of Toronto)
Thesis: Estimation of food intake in restrained and unrestrained eaters

- Protocol preparation, data collection, analyses, and comprehensive report writing for study (n = 140) involving undergraduate student participants

2008 — Mini-Thesis Student
Supervisor: Dr. P. Lockwood
Mini-Thesis: Social comparisons in new migrants

- Data collection, analyses, and report writing for a study (n=100) involving undergraduate student participants

2006 — Research Assistant: Fiction Exposure Study
Supervisor: Dr. R Mar (York University)

- Data collection: administration of standardized behavioral tasks with community participants (children 4-6 years old)

Teaching Experience

2012	Guest Lecture: Personalities of Famous People Special Topics in Clinical Psychology: Personality and Developmental Psychopathology (PSY 4390) Course Instructor: Dr. E. P. Hayden University of Western Ontario
2011	Graduate Teaching Assistant The Psychology of Prosocial and Antisocial Behavior (PSY 3720) Course Instructor: Dr. D. Hazlewood University of Western Ontario
	Graduate Teaching Assistant Introduction to Social Psychology (PSY 2720, online course) Course Instructor: C. Wilbur (Ph.D. candidate) University of Western Ontario
2010	Graduate Teaching Assistant Introduction to Psychology (PSY 1000) Course Instructor: Dr. L. Fazakas-DeHoog University of Western Ontario