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The purpose of the current study was to examine latent profiles of temperament based on fine-grained temperament dimensions and to examine associations between profile membership and adolescent depression. Based on consistent profiles that have emerged within the person-centered literature, *Typical*, *Dysregulated*, *Well-regulated*, *Over-controlled*, *Under-controlled*, and/or *Bold/Surgent* profiles were hypothesized to emerge. *Dysregulated* and *Over-controlled* profiles were hypothesized to predict the greatest increase in depressive symptoms, *Under-controlled* profile was hypothesized to predict the next greatest increase in depressive symptoms, and *Well-regulated* profile was hypothesized to predict the lowest increase in depressive symptoms. In the large-scale, longitudinal study from which the current secondary analyses were drawn, mother-child dyads came into the laboratory when youth were 10 and 15 years old (N = 319, 175 girls, 144 boys, 65.5% White, 27.6% Black, 4.1% Mixed, 1.9% Other). Mothers completed the Children's Behavior Questionnaire (CBQ), a measure of temperament at 10 years of age (M_{age} = 10.67 years) and adolescent youth completed the Children's Depressive Inventory (CDI), a self-report measure of depressive symptoms at 15 years of age (M_{age} = 15.63 years). Factor analyses revealed 10 alternative fine-grained dimensions of temperament (i.e., Frustration-Disappointment, Discomfort, Fear, Soothability, Under-control, Shyness, Smiling, Focus-Control, Low Intensity Pleasure, and Perceptual Sensitivity). Tests of measurement invariance revealed that the majority of fine-grained dimensions were invariant across boys and girls. A latent profile analysis revealed three distinct profiles of temperament: *Average*, *Regulated*, and *Dysregulated*. Profiles did not concurrently or prospectively predict depressive

symptoms. There were no sex differences. Potential interpretations and contributions to the literature are discussed.

Keywords: temperament, adolescent depression, latent profile analysis

THE PROOF IS IN THE PROFILE: PATTERNS OF TEMPERAMENT PREDICTING ADOLESCENT DEPRESSION

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CHAPTER I: LITERATURE REVIEW

Significance of Adolescent Depression

Adolescence is a period of increased vulnerability for the development of depression. The prevalence of depression rises sharply as children transition to adolescence with an estimated 3.1 million adolescents aged 12 to 17 years in the United States experiencing at least one major depressive episode (NIMH, 2018). Adolescent depression is associated with a host of negative outcomes, including increased substance use, poor academic performance, as well as increased suicidal ideation and suicide attempts (Bridge et al., 2006; Glied & Pine, 2002). Moreover, adolescent depression is a major risk factor for adult depressive and anxiety disorders with notable impairments in interpersonal, career, and physical health domains of functioning (Giaconia et al., 2001; for a review, see Johnson et al., 2018). Given the global burden of disease associated with depression, research elucidating the antecedent factors that contribute to the development of adolescent depression is crucial for both intervention and prevention efforts.

The field of Developmental Psychopathology emphasizes equifinality in the development of depression (Cicchetti & Rogosch, 1996), such that there is no *one* pathway to developing depression but rather a myriad of complex interactions across multiple levels of analysis (e.g., genetic, physiological, neural, social, cultural) contributes to its onset. Notwithstanding the multifaceted etiology of this disorder, certain factors and processes during childhood can increase the likelihood of developing depression in adolescence. While some environmental factors contribute to substantial risk for adolescent depression above and beyond individual factors, such as chronic poverty, maltreatment, and trauma (see LeMoult et al., 2020 for a meta-analysis), temperament serves as one potential source of individual vulnerability in the development of adolescent depression.

Temperament and Adolescent Depression

Temperament refers to individual differences in both reactivity and regulation that are biologically based, evident as early as infancy, and are relatively stable over time (Nigg, 2006). The current study focuses on Rothbart and colleagues' conceptualization of temperament which consists of 3 broadband factors of Negative Emotionality (NE), Positive Emotionality (PE), and Effortful Control (EC) and their associated fine-grained dimensions (Rothbart & Bates, 1998). The reactivity factors include NE and PE which refer to the propensity to experience frequent and intense negative and positive emotions, respectively. NE includes fine-grained dimensions such as sadness, anger/frustration, fear, and discomfort, which can be further distinguished into dominant (e.g., anger/frustration) versus submissive emotions (e.g., sadness, fear). PE includes affective (e.g., smiling/laughter) and behavioral fine-grained dimensions (e.g., activity level, impulsivity, approach). Lastly, EC refers to those self-regulatory processes that modulate reactivity. EC includes cognitive (i.e., attentional focusing) and behavioral fine-grained dimensions (i.e., inhibitory control). See Table A1 in Appendix A for a list of temperament factors and descriptions of their fine-grained dimensions.

As temperament reflects an individual's pattern of emotional and behavioral responding across situations and across time, it has clear implications for both future adjustment and maladjustment. Several developmental theories have been proposed to explain the association between temperament and depression (see Nigg, 2006; Shiner & Caspi, 2003). The current paper is rooted in the developmental psychopathology framework of risk and resilience, where temperament factors serve as an early diathesis for disorder, placing individuals at risk for or protection against the development of depression during adolescence.

While individual differences in temperament may be captured as early as infancy, middle childhood may serve as an important developmental period for measuring temperament. The most rapid maturation of the EC system occurs during early childhood (Calkins, 2007), as youth gain increasing control of their attentional and behavioral responses, particularly with exposure to new contexts (e.g., pre-school) and developmental demands (e.g., following instructions, practicing social display rules). Relative to infancy and early childhood, greater stability in temperament is expected during middle childhood due to the maturation of biological systems underlying self-regulation (Shiner & Caspi, 2003). Moreover, prior to the period of early and middle adolescence wherein the prevalence of depression rises dramatically, individual differences in reactivity and regulation during middle childhood are theorized to lay the groundwork for risk and resilience in multiple domains of adjustment (Scott et al., 2016).

Temperament Main Effects to Depression

The majority of research examining links between temperament and adolescent depression has focused on the main effect associations between temperament factors and depressive symptoms. With regard to the reactivity factors, the Tripartite Model (Clark & Watson, 1991) serves as the most prominent theory. Clark and Watson (1991) theorized that *high* NE and *low* PE serve as underlying vulnerabilities to depression. That is, individuals with a propensity towards frequent and intense negative emotions are more susceptible to experiencing enduring levels of depressed mood and individuals with a propensity towards low positive emotions are more susceptible to experiencing anhedonia. With regard to the regulation factor, *low* EC is theorized to contribute to depression due to persistent difficulties enacting attentional and behavioral strategies to reduce emotional distress (Compas et al., 2004; Lengua & Long, 2002).

Several decades of research lends support for the Tripartite Model, with more robust associations between high NE and depressive outcomes. High NE has been consistently linked to concurrent and prospective depressive symptoms and diagnoses among adolescent and adult samples (for a review of the Tripartite Model see Anderson & Hope, 2008; see Klein et al., 2011). Despite modest associations between low PE and depressive outcomes, longitudinal evidence between low PE predicting depression is weak (for a review, see Klein et al., 2011). Research examining associations between low EC and depressive outcomes is more limited and mixed, with some studies supporting concurrent associations (de Boo & Kolk, 2007; Loukas & Robinson, 2004; Muris et al., 2008) and other studies finding null effects (Loukas & Murphy, 2007; Loukas & Roalson, 2006). Taken together, while high NE has been identified as a risk factor in the development of adolescent depression, there is more limited support for the direct effects of low PE and low EC. Based upon these collective findings, PE and EC have been theorized to exert interactive rather than additive effects towards depression risk and resilience via their interactions with NE.

Research on 2-way Temperament Interactions to Depression

Research on 2-way temperament x temperament interactions has primarily focused on the interactions between NE x PE as well as NE x EC. Both the Tripartite Model (Clark & Watson, 1991) and the Broaden & Build Theory of Positive Emotions (Fredrickson, 2004; Tugade & Fredrickson, 2004) are two prominent theories for understanding the NE x PE interaction. As Clark & Watson (1991) do not clarify whether the relation between NE and PE is additive versus interactive, several researchers have tested the interactive relation between these two factors in order to assess whether a pattern of "dual reactivity risk" (i.e., high NE and low PE) contributes to depression. On the other hand, the Broaden and Build Theory of Positive Emotions

emphasizes the protective role of high PE, such that positive emotions allow individuals to "bounce back" from negative emotional experiences. Lastly, Muris & Ollendick (2005) theorized the moderating role of EC in the link between NE and internalizing outcomes (i.e., depression, anxiety), such that difficulties disengaging and shifting attention away from negative emotions may sustain these emotions over time and thereby contribute to greater internalizing problems.

The cumulative research on NE x PE interactions provides evidence of dual reactivity risk, where low PE is a significant moderator in the association between high NE and depressive outcomes. Specifically, the combination of high NE and low PE is linked to concurrent depressive symptoms, prospective increases in depressive symptoms, as well as a greater likelihood of receiving a depression diagnosis among adolescent samples (Dougherty et al., 2010; Joiner & Lonigan, 2000; Loney et al., 2006; Vasey, Harbaugh, Mikolich, et al., 2013; Van Beveren et al., 2016; Wetter & Hankin, 2009; for reviews, see Anderson & Hope, 2008; Klein et al., 2011). This literature also provides longitudinal support for the Broaden and Build Theory of Positive Emotions, such that high PE buffers against the deleterious effects of high NE by attenuating increases in depressive symptoms over time.

Lastly, in the only prospective study to examine temperament and depression at different developmental stages, Dougherty et al. (2010) found that high NE and low PE measured in early childhood predicted higher depressive symptoms at age 10 but not at age 7, suggesting that this temperament combination does not appear to exert its influence on depression until towards the end of middle childhood and into early adolescence. This finding may be related to the increased prevalence of depressive symptoms within the population starting from the end of middle childhood relative to earlier developmental periods. In sum, among youth with a propensity to experience frequent and intense negative emotions, those who experience fewer positive

emotions are placed at heightened risk for the development and maintenance of depressive outcomes whereas those who experience greater positive emotions are protected against increases in depressive outcomes.

Relative to research on NE x PE interactions, research on NE x EC interactions is more limited and mixed. While some studies found concurrent associations between high NE and low EC (Verstraeten et al., 2009; Yap et al., 2011), other studies found null results for the hypothesized interaction (de Boo & Kulk, 2007; Mezulis & Rudolph, 2012; Mezulis et al., 2011). Furthermore, longitudinal evidence for this interaction has yet to emerge. Given the robust findings related to dual reactivity risk, it is plausible that a significant relation between NE and EC exists at certain levels of PE. Consistent with this idea, Dinovo & Vasey (2011) emphasized the importance of examining the interaction between all three temperament factors, whereby EC interacts with dual reactivity risk to predict outcomes of depression.

Research on 3-way Temperament Interactions to Depression

Dinovo & Vasey (2011) were the first to theorize and test a 3-way interaction between all temperament factors. They proposed that EC would either exacerbate or attenuate dual reactivity risk, such that youth with high EC may be more successful in disengaging attention away from negative emotions and engaging in more helpful approach behaviors. On the other hand, youth with low EC who have difficulties with self-regulation may maintain or heighten their emotional distress and disengage from approach behaviors. Based on this theoretical premise, a small but burgeoning body of research on 3-way interactions has revealed that certain temperament combinations confer differential levels of risk and resilience in depression outcomes (Dinovo & Vasey, 2011; Vasey, Harbaugh, Lonigan, et al., 2013; Vasey et al., 2014; Van Beveren et al., 2019).

Several consistent patterns of results have emerged from this literature. These studies support the "triple risk combination," where a pattern of high NE, low PE, and low EC was associated with the highest level of concurrent as well as prospective increases in depressive symptoms among samples ranging from early adolescence to young adulthood years (N = 447 in Dinovo & Vasey, 2011; N = 1,897 in Vasey, Harbaugh, Lonigan, et al., 2013; N = 353 in Vasey et al., 2014). These studies also support the "triple protection combination," where a pattern of low NE, high PE, and high EC was associated with the lowest level of concurrent as well as no prospective increases in depressive symptoms. Taken together, the triple risk combination confers greatest risk towards depression whereas the triple protection combination confers protection against the development and maintenance of depression.

In a more recent prospective study conducted by Van Beveren et al. (2019), a pattern referred to as the "over-controlled combination" (i.e., high NE, low PE, high EC) predicted the largest increase in depressive symptoms followed by the triple risk combination among a sample of middle childhood and early adolescent youth. The authors concluded that EC may show a *quadratic* relation with dual reactivity risk during the middle childhood and early adolescent years, such that both high and low levels of EC interact with dual reactivity risk to contribute to increases in depressive symptoms. They postulated that "over-control" of self-regulation, as reflected in greater cognitive and behavioral control, may lead to an increased likelihood in developing depression via exhaustion and rigidity of self-regulation over time among emotionally challenged youth. Therefore, both the triple-risk combination and over-controlled combination appear to be problematic prior to middle adolescence. The authors also found support for the "under-controlled combination," such that a pattern of high NE, high PE, and low EC was associated with the next greatest increase in depressive symptoms among the sample. It

is worth noting that these combinations emerged within a relatively small sample of youth in middle childhood ($N = 211$), therefore more research is needed to replicate associations between over-controlled and under-controlled combinations with depressive outcomes.

In sum, the growing literature on 3-way interactions provides initial support for the theory proposed by Dinovo & Vasey (2011). While prior research on 2-way interactions supports dual reactivity risk in both concurrent and prospective increases in depression, EC further moderates this relation to predict differential levels of depression risk and resilience. Given research showing that subthreshold symptoms of depression during the end of middle childhood are moderately stable and predict later depressive disorders and impairment (Keenan et al., 2008), it is likely that youth with riskier configurations of temperament may start to experience concurrently high levels of depressive symptoms during the end of middle childhood and may go on to experience increases in depressive symptoms into adolescence. Research from Dougherty et al. (2010) suggesting that dual reactivity risk exerts its influence on depression starting around the end of middle childhood provides further support for examining both concurrent and prospective associations between configurations of temperament and depressive outcomes starting from the end of middle childhood and into adolescence. Moreover, the risk or protection conferred by EC may depend on the developmental period. Among middle childhood and early adolescent youth, existing research suggests that both high and low levels of EC appear as suboptimal forms of self-regulation within the context of dual reactivity risk (i.e., over-controlled and triple risk combination). However, as youth transition to middle adolescence and early adulthood, high EC confers protection against increases in depressive symptoms whereas low EC continues to exacerbate dual reactivity risk. As neural regions associated with executive

functioning mature across adolescence and into young adulthood (Steinberg, 2005), high EC may start to characterize youth with a more flexible and adaptive repertoire of regulatory strategies.

Broadband vs. Fine-grained Approach to Temperament

While the literature on temperament-depression links has highlighted the importance of considering all three temperament factors, studies to date have primarily examined the three temperament factors at the broadband level. As a broadband approach to temperament involves averaging fine-grained dimensions to form composites, this approach is useful for summarizing a wide array of emotional and behavioral responses. Moreover, the broadband factors remain robust against normative variation in fine-grained dimensions across development as well as measurement differences across studies. One pitfall to this approach is the potential masking of any meaningful variation among the observable, fine-grained dimensions.

A fine-grained approach to temperament may reveal *which* dimensions drive the relative contribution of a factor's association with an outcome. Of the few studies that examined fine-grained dimensions of temperament, high EC has been found to be helpful in regulating submissive emotions (i.e., fear) rather than dominant emotions (i.e., anger/frustration) to reduce internalizing symptoms (Oldehinkel et al., 2007) and the affective dimension of PE (i.e., smiling/laughter) interacts with high NE to reduce the harmful effects of NE on depressive symptoms (Dougherty et al., 2010). Given these initial fine-grained results, it would be important for research to further discern whether the submissive emotions of NE (e.g., sadness, fear) relate more strongly to depression compared to dominant emotions (e.g., anger). Moreover, in addition to its affective dimension, it would be important to investigate whether the behavioral dimensions of PE (e.g., activity level, approach) play a role in depression risk. Taken together, a

fine-grained approach to temperament has significant merit for clarifying the relative contributions of *specific* emotions and behaviors in the development of adolescent depression.

Variable-centered vs. Person-centered Approach to Temperament

In addition to utilizing primarily a broadband approach, extant research on temperament-depression links has largely been conducted using variable-centered analyses (i.e., main effects, 2-way and 3-way interactions). Despite the longstanding history of a person-centered approach to temperament (e.g., Thomas & Chess, 1977; Kagan, 1997; Kagan et al., 1984; Kagan et al., 1987), variable-centered investigations have dominated the field of Developmental Psychopathology. Predicated on the assumption that the population is homogenous, a variable-centered approach to temperament is rooted in the idea that humans vary in degree on a set of affective-behavioral dispositions. Thus, variable-centered analyses have important utility in answering questions related to universal relations among variables (Laursen & Hoff, 2006), such as whether high or low levels of a temperament factor relate to differential levels of depression. The focus of a variable-centered approach is generally examining *linear* associations among a relatively limited number of variables (i.e., individual variables or the interactions among few variables) to describe and predict human behavior. Moreover, these studies require substantially large samples to ensure adequate statistical power for testing complex interactions. Aside from the study by Vasey, Harbaugh, Lonigan, et al. (2013) which examined 3-way interactions with a relatively large sample (N = 1,897), the majority of aforementioned studies on 3-way interactions are generally underpowered (N = 447 in Dinovo & Vasey, 2011; N = 211 in Van Beveren et al., 2019; N = 353 in Vasey et al., 2014). Given that there are likely *non-linear* associations among a larger set of fine-grained dimensions of temperament and the need to obtain large samples to

detect meaningful temperament combinations, there are statistical limits to variable-centered analyses.

On the contrary, a person-centered approach to temperament is rooted in the idea that *natural kinds* or typologies of individuals who inherently differ in temperament configuration exist within a heterogenous population (Bogat et al., 2016). The philosophy of natural kinds is influenced by essentialist thinking, such that natural kinds possess a richly organized "essence" or structure of underlying properties that allows them to be distinguished from one another (Haslam, 1998). Compared to a variable-centered approach, a person-centered approach to temperament offers a more robust statistical method of examining complex relations among temperament variables.

Person-centered analyses (e.g., latent profile analysis – LPA, latent class analysis - LCA) aim to statistically derive *profile* or *class* solutions from the data in order to group individuals who share similarities on a set of variables. These analyses allow researchers to examine non-linear "interactions" or patterns of associations among a number of temperament variables, such that the inclusion of more variables improves statistical power to detect meaningfully distinct groups (Tein et al., 2013). Thus, person-centered analyses have utility in the identification and characterization of distinct groups of youth based on their pattern of temperament (Laursen & Hoff, 2006).

Integrating Person-centered and Fine-grained Approaches

Despite a sizeable body of theoretical and empirical work examining temperament-depression links within the last several decades, the majority of this work has taken a broadband and variable-centered approach. It is notable that this cumulative research has solidified the importance of examining all three temperament factors to predict depression risk and resilience.

Notwithstanding these contributions in advancing the field, there is a clear dearth of research examining the interplay among these factors using a fine-grained and person-centered approach.

A fine-grained approach in person-centered analyses may reveal differences between groups of youth who initially appear similar on a broadband factor but display noteworthy differences on fine-grained dimensions. For example, among two children with high PE, a child with greater surgent behaviors (e.g., high impulsivity and activity level) differs from a child with higher levels of joy (e.g., high smiling/laughter). These youth qualitatively differ in their patterns of emotional displays and behaviors, which impact the responses they elicit from their respective environments and their subsequent adjustment. Moreover, research shows that fine-grained dimensions within broadband factors are only moderately correlated (Ahadi et al., 1993), suggesting that variation among fine-grained dimensions may ultimately explain why developmental outcomes differ for children with ostensibly similar temperament (Janson & Mathiesen, 2008).

In addition to a more accurate identification and characterization of groups of youth who differ in fine-grained temperament dimensions, an integration of fine-grained and person-centered approaches has valuable clinical implications. Specifically, this research may inform interventions and treatments to target specific emotions and behaviors for distinct groups of youth placed at risk for the development of adolescent depression. To this end, the first major aim of the current study is to build upon the existing literature on temperament-depression links by examining person-centered profiles of temperament based on fine-grained dimensions of temperament.

Person-centered Profiles of Temperament

Based on Rothbart and colleagues' measurement of temperament, a growing body of research has examined profiles of temperament from infancy to middle childhood (i.e., Beekman et al., 2015; Gartstein et al., 2017; Prokasky et al., 2017; Komsi et al., 2006; Scott et al., 2016). These studies have identified between 3 to 6 profiles of youth who differ in their temperament configurations. The variability in profile solutions may be attributable to differences in statistical analysis (e.g., LPA, LCA, cluster analysis), broadband versus fine-grained temperament variables, measurement (e.g., Infant Behavior Questionnaire – IBQ, Children's Behavior Questionnaire – CBQ), and the developmental demands and capacities associated with each developmental stage (e.g., motor development during infancy, behavioral regulation in various contexts starting in early childhood). While these findings may appear disparate at first, several consistent themes in temperament configurations have emerged throughout infancy to middle childhood based on shared broadband and similar fine-grained patterns.

Across studies from infancy to middle childhood that utilized fine-grained measures of temperament, a *Typical* group of youth consistently emerges, as they display average levels on the majority of temperament dimensions (Beekman et al., 2015; Gartstein et al., 2017; Prokasky et al., 2017; Scott et al., 2016). A *Positive/Well-regulated* group also emerges, notable for their high self-regulation and high positive affectivity (i.e., low NE, high PE, high EC; Beekman et al., 2015; Gartstein et al., 2017; Komsi et al., 2006; Prokasky et al., 2017; Scott et al., 2016). In middle childhood, these youth display high levels of affective PE (i.e., smiling/laughter) but very low levels of behavioral PE (i.e., activity level, impulsivity). They also display low levels of dominant emotions (i.e., anger) compared to moderate levels of submissive emotions (i.e., sadness, fear). Lastly, they exhibit high levels on all fine-grained dimensions of EC (i.e.,

attentional focusing, inhibitory control, low intensity pleasure; Scott et al., 2016). By early childhood and into middle childhood, a *Bold/Surgent* group emerges, notable for their high positive affectivity, low shyness and fear, and adequate ability to regulate their high activity and impulsivity levels (i.e., low NE, high PE, moderate EC; Prokasky et al., 2017; Scott et al., 2016).

From infancy to middle childhood, a *Negative/Dysregulated* group of youth consistently emerges, notable for their high negative affectivity and low self-regulation (i.e., high NE, low PE, low EC; Beekman et al., 2015; Gartstein et al., 2017; Scott et al., 2016). In middle childhood, these youth have high levels on all dimensions of NE and low levels on all dimensions of EC. They exhibit low levels of affective PE (i.e., low smiling/laughter, high shyness) relative to their mean levels of behavioral PE (i.e., moderate activity level, impulsivity, approach; Scott et al., 2016). Komsi et al. (2006) measured temperament during infancy and middle childhood and identified two groups of youth characterized as *Under-controlled* and *Over-controlled* using the broadband factors from the IBQ and CBQ. *Under-controlled* youth exhibited a pattern of high NE, high PE, and low EC and may characterize youth who are emotionally labile and have difficulties regulating high levels of activity, impulsivity, and approach behaviors. On the other hand, *over-controlled* youth exhibited a pattern of high NE, low PE, and high EC and may characterize youth with too much self-control (e.g., inhibition of emotion), high fearfulness, and socially reticent behavior (e.g., low approach; Komsi et al., 2006).

Research thus far on person-centered profiles of temperament has identified distinct groups of youth who differ from one another in their temperament configurations. Specifically, 1) *Typical*, 2) *Positive/Well-regulated*, and 3) *Negative/Dysregulated* groups consistently emerge across studies from infancy to middle childhood. By middle childhood, additional groups

identified as 4) *Bold/Surgent*, 5) *Under-controlled*, and 6) *Over-controlled* emerge as well. This small but growing body of research on person-centered profiles of temperament provides theoretical support that *natural kinds* or types of individuals who differ in temperament configuration may exist within our population. More importantly, these studies provide useful descriptions of groups of youth who differ in their affective and behavioral tendencies across development.

Although the majority of studies assessed fine-grained dimensions of temperament, many of these studies did not include all possible subscales, with only Gartstein et al. (2017) creating profiles based on all dimensions from the IBQ. It is notable that this body of work has yet to identify profiles in middle childhood using the full range of fine-grained dimensions from the CBQ. As middle childhood reflects a period of maturation of biological systems that undergird self-regulation relative to earlier developmental stages (Scott et al., 2016) and research suggests that temperament factors may not exert its effects on depression vulnerability until the end of middle childhood (Dougherty et al., 2010), temperament captured during this developmental period may be particularly important for assessing risk and resilience towards adolescent depression.

Furthermore, research on person-centered profiles of temperament has yet to extend beyond identification and into prediction. That is, it is unclear whether temperament profiles concurrently or prospectively predict depressive outcomes. Based on shared overlap between variable-centered temperament combinations and person-centered temperament profiles, it is likely that youth who belong to certain profiles experience differential levels of concurrent depressive symptoms in middle childhood and differential levels of risk towards or protection against developing depression in adolescence. Therefore, the second major aim of the study was

to examine associations between temperament profiles and depressive outcomes in middle childhood as well as adolescence.

Consideration of Sex Differences

Although rates of depression do not differ between boys and girls during childhood, by middle adolescence (13-15 years), girls report higher rates and are more likely to develop depression than boys (see Angold & Costello, 2001; Garber & Rao, 2014; Hankin et al., 1998). One potential explanation for this is that girls may be over-represented in riskier temperament profiles relative to boys, such as the *Negative/Dysregulated* and/or *Over-controlled* groups. Although studies to date have yet to examine sex differences in temperament profiles, it would be important to clarify whether these differences emerge within the current study.

It is also likely that sex and gender differences in the pattern of associations between temperament and depression may help to explain the greater prevalence of depression in girls versus boys (Hyde et al., 2008). For example, sex differences in biological processes (e.g., pubertal and hormonal changes; Hyde et al., 2008) and/or gender differences in culturally sanctioned gender roles (see gender intensification hypothesis; Hill & Lynch, 1983) that emerge starting in early adolescence may moderate temperament-depression links to increase risk for girls relative to boys. Extant research on 3-way temperament interactions have focused on sex as a control rather than a moderating variable, likely due to statistical limits. While they have found that temperament combinations are significantly related to depressive outcomes across males and females, it would be important to examine whether the degree of significance differs by sex. Taken together, the third major aim of the study was to clarify the role of sex in both profile membership as well as the link between temperament profiles and depression.

Factor Structure & Measurement Invariance

Prior to the creation of temperament profiles, it is imperative to 1) replicate the 15 fine-grained dimensions from the CBQ through factor analysis and to 2) test for measurement invariance to ensure that each fine-grained dimension does not evidence bias in measurement. It is notable that extant research replicating the factor structure of the CBQ (both standard and short form versions) focuses on replicating the broadband factors, thus conducting factor analyses using the mean scores of the 15 fine-grained dimensions (e.g., de la Osa et al., 2014; Leyfer et al., 2012; Roberts et al., 2014; Sleddens et al., 2011).

To date, there is only one study that has examined the item-level factor structure of the original CBQ-Standard Version (SV; Kotelnikova et al., 2016) and only one study that has examined the item-level factor structure of the CBQ-Short Form (SF; Barcenilla et al., 2021). Kotelnikova et al. (2016) tested the item-level structure of the CBQ-SV in a large community sample of children at ages 3 ($N = 994$) and 5/6 ($N = 853$) years. Initial confirmatory factor analyses revealed poor fit. Based on exploratory factor analyses, the authors found that fewer than half of the 15 fine-grained dimensions resembled the original scales. The authors concluded that a substantial number of CBQ-SV items do not load well onto the original fine-grained dimensions, suggesting the elimination of poorly functioning items and reconsidering the number of factors that represent temperament traits in early to middle childhood. Barcenilla et al. (2021) tested the Spanish version of the CBQ-SF in a group of Chilean youth aged 4 to 7 years ($N = 998$). Confirmatory factor analyses revealed that the 15 fine-grained dimensions did not fit the data well. Given unsatisfactory fit for the original model, the authors ran an exploratory factor analysis and identified a 7-factor model. However, this 7-factor model still showed unsatisfactory fit after confirming in a CFA analysis. The authors attribute the failed replication

of the factor structure to cultural differences, measurement, wording, and respondent's characteristics. Given these initial findings from measurement studies suggesting poor fit in the item-level factor structure of the CBQ, it would be important for the current study to confirm the factor structure of the CBQ-SF at the item-level to replicate each of the fine-grained dimensions in order to ensure that the fine-grained indicators used to create latent profiles are valid and interpretable.

Bias in measurement, or measurement non-invariance, would mean that, despite boys and girls having an equal mean on a fine-grained dimension, girls score systematically higher on specific items relative to boys – or vice versa. That is, if parents interpret and respond to CBQ items in dissimilar ways for boys and girls, these biased items have the potential to introduce sex differences in the means of fine-grained dimensions, and ultimately temperament profiles, where none truly exist. Although one study found that the CBQ broadband factors of PE and EC were invariant while NE was non-invariant across boys and girls (Clark et al., 2016), research to date has yet to examine measurement invariance across sex for fine-grained dimensions (i.e., using individual items as the indicators). Therefore, in order to determine whether fine-grained dimensions of the CBQ function similarly across boys and girls and to establish temperament scores that are comparable across groups, tests of measurement invariance will be conducted between boys and girls for all 15 fine-grained CBQ dimensions for the current study.

Goals & Hypotheses

Extant research has primarily focused on broadband and variable-centered approaches to examine the significance of temperament in the etiology of adolescent depression. An important way to move the field forward is to contribute to the smaller but growing body of research on fine-grained and person-centered approaches to temperament. Thus, the first goal of the current

study is to examine latent profiles of temperament based on the 15 fine-grained dimensions of the CBQ. Based on consistent profiles that have emerged within the person-centered literature, the following profiles are predicted to emerge within the current sample: 1) *Typical*, 2) *Negative/Dysregulated*, 3) *Positive/Well-regulated*, 4) *Over-controlled*, 5) *Under-controlled*, and/or 6) *Bold/Surgent*.

The largest group of youth is predicted to fall into a *Typical* profile with average levels on the majority of fine-grained temperament dimensions. The next largest group is predicted to fall into the *Positive/Well-regulated* group, displaying low NE, high PE, and high EC at the broadband level and specifically high affective PE (i.e., smiling/laughter) and low behavioral PE (i.e., activity, impulsivity) at the fine-grained level. The *Bold/Surgent* group is predicted to display high PE, low NE, and moderate EC at the broadband level, specifically high behavioral PE (i.e., activity, impulsivity) and low submissive NE (i.e., fear).

The smallest groups of youth are predicted to fall into the *Negative/Dysregulated*, *Over-controlled*, and *Under-controlled* profiles. The *Negative/Dysregulated* youth are predicted to display high NE, low PE, and low EC at the broadband level, specifically low affective PE (i.e., smiling/laughter) and moderate behavioral PE (i.e., activity, impulsivity, approach) at the fine-grained level. The *Over-controlled* youth are predicted to display high NE, low PE, and high EC across broadband and fine-grained levels. Lastly, the *Under-controlled* youth are predicted to display high NE, high PE, and low EC with noteworthy levels of dominant NE (i.e., anger/frustration) and behavioral PE (i.e., activity, approach).

Based on notable profiles that emerge within the data, certain youth may be at increased risk for or protection against the development of depression based on their configuration of temperament dimensions. However, existing research has yet to examine the concurrent as well

as predictive links between latent profiles of temperament and depression. Thus, the second goal of the study is to examine the associations between profile membership and depressive symptoms, specifically whether 1) profile membership relates to depressive symptoms at 10 years of age and whether 2) profile membership predicts differential levels of depressive symptoms in adolescence at 15 years of age, accounting for earlier levels of symptoms. *A priori* hypotheses related to relative risk and resilience of certain profiles to depression outcomes are drawn from the shared overlap at the broadband and fine-grained levels between variable-centered temperament combinations and person-centered temperament profiles.

Given the overlap between the triple-risk combination and the *Negative/Dysregulated* profile as well as the over-controlled combination and the *Over-controlled* profile, groups that emerge resembling *Negative/Dysregulated* and *Over-controlled* profiles may concurrently and prospectively predict the greatest increase in depressive symptoms. Given the overlap with the under-controlled combination, a group that emerges resembling the *Under-controlled* profile may concurrently and prospectively predict the next greatest increase in depressive symptoms. Given its overlap with the triple-risk protection combination, a group that emerges resembling the *Positive/Well-regulated* profile may be concurrently and prospectively associated with protection against increases in depressive symptoms.

Lastly, the third goal of the study is to clarify the role of sex differences in both profile membership and in the link between temperament profiles and depressive symptoms. It is hypothesized that girls may be more likely than boys to belong to certain temperament profiles that may elevate their risk for depression, notably the *Negative/Dysregulated* and/or *Over-controlled* groups. It is also hypothesized that sex may moderate the relation between profiles

and depressive symptoms at 15 years of age, such that associations between profiles and depressive symptoms are stronger for girls than for boys.

CHAPTER II: METHODOLOGY

Participants

The current study utilized data from three cohorts of children who are part of an ongoing longitudinal study of social and emotional development. The goal for recruitment was to obtain a sample of children who were at risk for developing future externalizing behavior problems and who were representative of the surrounding community in terms of race and socioeconomic status (SES). All cohorts were recruited through child day care centers, the County Health Department, and the local Women, Infants, and Children (WIC) program. Potential participants for cohorts 1 and 2 were recruited at 2-years of age (cohort 1: 1994-1996 and cohort 2: 2000-2001) and screened using maternal report of the Child Behavior Checklist (CBCL 2-3; Achenbach, 1992) to over-sample for externalizing behavior problems. Children were identified as being at risk for future externalizing behaviors if they received an externalizing T-score of 60 or above. Efforts were made to obtain approximately equal numbers of males and females. This recruitment effort resulted in a total of 307 children. Cohort 3 was initially recruited when infants were 6 months of age (in 1998) for their level of frustration, based on laboratory observation and parent report, and were followed through the toddler period (see Calkins et al., 2002 for more information). Children from Cohort 3 whose mothers completed the CBCL at two-years of age ($N = 140$) were then included in the larger study. Of the entire sample ($N = 447$), 37% of children were identified as being at risk for future externalizing problems. There were no significant demographic differences between cohorts with regard to sex, $\chi^2\ (2, N = 447) = .63, p = .73$, race, $\chi^2\ (2, N = 447) = 1.13, p = .57$, or two-year SES, $F(2, 444) = .53, p = .59$.

Of the 447 originally selected participants, six were dropped because they did not participate in any data collection at 2 years old. An additional 12 families participated at

recruitment, did not participate at two-year, but did participate at later years. At age 10, 357 families participated, including 31 families that did not participate in the 7-year assessment. No significant differences were noted between families who did and did not participate in the 10-year assessment in terms of child sex, χ^2 (1, N = 447) = 3.31, p = .07; race, χ^2 (3, N = 447) = 3.12, p = .08; 2-year SES, t(432) = .02, p = .98; or 2-year externalizing T score, t(445) = -.11, p = .91. At age 15, 327 families participated, including 27 families that did not participate in the 10-year assessment. Again, there were no significant differences between families who did and did not participate in the 15-year assessment in terms of race, χ^2 (3, N = 447) = 3.96, p = .27; 2-year SES, t(432) = -.56, p = .58; or 2-year externalizing T score, t(445) = .24, p = .81. Boys were less likely to participate in the 15-year assessment, χ^2 (1, N = 447) = 9.31, p = .002.

Participants in the current sample include 319 mother-child dyads (175 girls, 144 boys; 65.5% White, 27.6% Black, 4.1% Mixed, 1.9% Other) and the current study will use data from 10-year (M_{age} = 10.67 years) and 15-year (M_{age} = 15.63 years) assessments. Data collection for age 10 took place from 2005-2009 and data collection for age 15 took place from 2010-2014. There was no significant relation between sex and race in this sample, such that sex was independent from race in this sample, χ^2 (3, N = 319) = .761, p = .859. Families were economically diverse based on Hollingshead (1975) scores at the 10-year assessment (Min-Max = 12-66, M = 44.21, SD = 12.25) and 15-year assessment (Min-Max = 9-66, M = 44.04, SD = 13.71), thus representing families from each level of social strata typically captured by this scale. Hollingshead scores ranging from 40 to 54 reflect minor professional and technical occupations considered to be representative of middle class.

Although the original study over-sampled for youth with externalizing behavior problems at 2 years of age, it is important to note the normative decline in externalizing behavior problems

across time within the sample. Specifically, maternal reports of youth's externalizing behavior problems on the CBCL at 10 years old (M = 48.62, SD = 10.27, Min – Max = 32 – 77, Skew = .338, Kurtosis = -.443) and 15 years old (M = 47.85, SD = 10.75, Min – Max = 34 – 81, Skew = .513, Kurtosis = -.280) show a normal distribution of scores and these scores are similar to those found in other community samples (Bornstein et al., 2013; Göbel et al., 2016).

Procedure

Children and their mothers participated in an ongoing longitudinal study beginning at 2 years of age. When youth were 10 years old, they came into the laboratory with their mothers. As part of this visit, mothers completed a paper-pencil measure of temperament and youth completed a self-report measure of depressive symptoms. When youth were 15 years old, they again came into the laboratory with their mothers. As part of this visit, youth completed the same paper-pencil self-report measure of depressive symptoms. Only the measures that are relevant to the current study are reported here.

Measures

Temperament

When youth were 10 years of age, participant mothers completed the Children's Behavior Questionnaire – Short Form, a 94-item measure developed to assess temperamental differences in youth (CBQ-SF; Putnam & Rothbart, 2006). The parent read items about their child's reaction to various situations and decided to what extent each item was true or untrue of their child, using the past 6 months as a reference point. Each item was rated on a scale from 1 (*Extremely Untrue*) to 7 (*Extremely True*), with the additional option of selecting "N/A." The CBQ-SF yields 15 subscales or fine-grained dimensions.

Approach measures the amount of excitement and positive anticipation for expected pleasurable activities ($N = 6$; $\alpha = .624$; $M = 4.805$, $SD = .869$; Min-Max = 2.33 – 7). Example items are "My child gets so worked up before an exciting event that s/he has trouble sitting still" and "My child gets very enthusiastic about the things s/he does." *Activity Level* measures gross motor activity including rate and extent of locomotion ($N = 7$; $\alpha = .716$; $M = 4.135$, $SD = 1.048$; Min-Max = 1.57 – 7). Example items are "My child seems always in a big hurry to get from one place to another" and "My child tends to run rather than walk from room to room." *High Intensity Pleasure* measures the amount of pleasure or enjoyment related to situations involving high stimulus intensity, rate, complexity, novelty, and incongruity ($N = 6$; $\alpha = .747$; $M = 4.472$, $SD = 1.164$; Min-Max = 1.17 – 7). Example items are "My child likes going down high slides or other adventurous activities" and "My child likes to play so wild and recklessly that s/he might get hurt." *Impulsivity* measures the speed at which a response is initiated ($N = 6$; $\alpha = .584$; $M = 4.257$, $SD = .948$; Min-Max = 1.67 – 7). Example items are "My child usually rushes into an activity without thinking about it" and "My child often rushes into new situations." *Shyness* measures the extent to which a slow or inhibited approach occurs in situations involving novelty or uncertainty ($N = 6$; $\alpha = .842$; $M = 3.266$, $SD = 1.272$; Min-Max = 1 – 7). Example items are "My child is sometimes shy even around people s/he has known a long time" and "My child sometimes seems nervous when talking to adults s/he has just met." *Smiling & Laughter* measures the amount of positive affect in response to changes in stimulus intensity, rate, complexity, and incongruity ($N = 6$; $\alpha = .713$; $M = 5.877$, $SD = .791$; Min-Max = 1.83 – 7). Example items are "My child smiles a lot at people s/he likes" and "My child often laughs out loud in play with other children."

Anger/Frustration measures the amount of negative affect related to interruption of ongoing tasks or goal blocking ($N = 6$; $\alpha = .838$; $M = 3.616$, $SD = 1.330$; Min-Max = 1 – 7). Example items are "My child gets angry when told s/he has to go to bed" and "My child gets quite frustrated when prevented from doing something s/he wants to do." *Fear* measures the amount of negative affect related to anticipated pain, distress, or potentially threatening situations ($N = 6$; $\alpha = .683$; $M = 3.412$, $SD = 1.176$; Min-Max = 1 – 6.5). Example items are "My child is afraid of burglars or the 'boogie man'" and "My child is afraid of loud noises." *Sadness* measures the amount of negative affect and lowered mood and energy related to exposure to suffering, disappointment, and object loss ($N = 7$; $\alpha = .546$; $M = 4.098$, $SD = .890$; Min-Max = 1.75 – 6.43). Example items are "My child cries sadly when a favorite toy gets lost or broken" and "My child tends to become sad if the family's plans don't work out." *Discomfort* measures the amount of negative affect related to sensory qualities of stimulation ($N = 6$; $\alpha = .735$; $M = 3.868$, $SD = 1.196$; Min-Max = 1.17 – 7). Example items are "My child becomes quite uncomfortable when cold and/or wet" and "My child is quite upset by a little cut or bruise." *Soothability* measures the rate of recovery from peak distress, excitement, or general arousal ($N = 6$; $\alpha = .734$; $M = 4.850$, $SD = .984$; Min-Max = 2 – 7). Example items are "My child, if upset, cheers up quickly when s/he thinks about something else" and "My child is easy to soothe when s/he is upset."

Attentional Focusing measures the tendency to maintain attentional focus during tasks ($N = 6$; $\alpha = .681$; $M = 4.752$, $SD = 1.034$; Min-Max = 2 – 7). Example items are "My child shows strong concentration when drawing or coloring in a book" and "My child, when building or putting something together, becomes very involved in what s/he is doing, and works for long periods." *Inhibitory Control* measures the capacity to plan and to suppress inappropriate

approach responses under instructions or in novel or uncertain situations ($N = 6$; $\alpha = .653$; $M = 5.222$, $SD = .981$; Min-Max = 1.67 – 7). Example items are "My child can wait before entering into new activities if s/he is asked to" and "My child can easily stop an activity when s/he is told 'no'." *Low Intensity Pleasure* measures the amount of pleasure or enjoyment involved in situations with low stimulus intensity, rate, complexity, novelty, and incongruity ($N = 8$; $\alpha = .728$; $M = 5.232$, $SD = .889$; Min-Max = 1.5 – 7). Example items are "My child enjoys taking warm baths" and "My child enjoys "snuggling up" next to a parent or babysitter. *Perceptual Sensitivity* measures the extent to which slight, low intensity stimuli from the external environment can be detected ($N = 6$; $\alpha = .667$; $M = 5.655$, $SD = .864$; Min-Max = 1 – 7). Example items are "My child notices the smoothness or roughness of objects s/he touches" and "My child notices it when parents are wearing new clothing."

Depressive Symptoms

When participant youth were 10 and 15 years of age, they completed the Children's Depressive Inventory (CDI; Kovacs, 1992), a 27-item questionnaire designed to measure levels of depressive symptoms in youth aged 7 and 17 years. Youth are asked to select 1 of 3 sentences that best represents the way they have been feeling for the past 2 weeks. A score of 0 indicates *absence of symptoms*, a score of 1 indicates *mild symptoms*, and a score of 2 indicates *severe symptoms*. The CDI consists of 5 subscales which yields a composite Total Score. The *Negative Mood* subscale measures the extent to which the child feels sad, feels like crying, worries about "bad things," is bothered or upset by things, and is unable to make up his or her mind ($M = 3.616$, $SD = 1.330$). The *Interpersonal Problems* subscale measures the extent to which the child has problems with difficulties in interactions with people, including trouble getting along with people, social avoidance, and social isolation. The *Ineffectiveness* subscale measures the extent

to which the child negatively evaluates his or her ability and school performance. The *Anhedonia* subscale measures "endogenous depression," including impaired ability to experience pleasure, loss of energy, problems with sleep and appetite, and a sense of isolation. The *Negative Self-Esteem* subscale measures the extent to which the child has low self-esteem, dislikes him or herself, feels unloved, and tends to have thoughts of suicide. For the current study, the summed Total Score will be used to capture overall depressive symptomatology, with higher scores reflecting greater symptoms (10-year: $\alpha = .894$, $M = 5.828$, $SD = 6.511$; 15-year: $\alpha = .862$; $M = 6.583$, $SD = 6.078$).

Analytic Strategy

All analyses were conducted using Mplus 8 (Muthén & Muthén, 1998-2017). Missing data were handled by Full Information Maximum Likelihood (FIML) to preserve power and minimize bias in the model estimates. FIML is a method of generating parameter estimates using all available data to handle variable-level missingness under the assumption that the data are missing at random. Robust Maximum-Likelihood (MLR) was used in MPLUS as the estimator to generate parameter estimates and standard errors that are robust to non-normality.

Confirmatory and Exploratory Factor Analysis

First, a confirmatory factor analysis (CFA) including all 15 dimensions was conducted in order to replicate the factor structure of Rothbart's 15 fine-grained dimensions, where all items for each fine-grained dimension were constrained to their respective factor. Due to an MPLUS warning suggesting that too many factors were extracted, the fine-grained dimensions were split into 3 separate CFA models and were evaluated within their respective higher-order construct of NE, PE, and EC. However, CFA analyses revealed poor fit of the hypothesized fine-grained dimensions with the data, suggesting an alternative factor structure. Exploratory factor analyses

(EFA) were conducted within 3 separate models to explore the item level factor structure. While *a priori* specifications on the factor structure are made when running a CFA, EFA is a data-driven approach with no specifications made on the numbers of factors or the pattern of relationships between factors and items, which allows researchers to uncover underlying factors within the data (Brown, 2015).

EFAs were conducted using the geomin (oblique) rotation, which is recommended to use for interrelated factors (Brown, 2015). The number of factors to extract was guided by examining the eigenvalues (>1.0 rule), scree plot, and substantive considerations (e.g., prior theory; Brown, 2015). A scree plot displays the number of factors on the horizontal axis and the eigenvalues on the vertical axis. The graph is inspected to determine the point at which the plotted eigenvalues levels off or flattens (Brown, 2015). Individual items were also evaluated for low factor loadings (<.40 rule) as well as cross-loadings on more than one factor. CFAs were then conducted using the same sample to evaluate model fit and were respecified based on following guidelines.

Several model fit indices were used to evaluate the adequacy of the models, including the chi-square test of model fit (p-value > .05 = good fit), Comparative Fit Index (CFI; ≥.90 good, ≥.95 excellent), Root Mean Square Error of Approximation (RMSEA; ≤.06 good fit, ≤.08 acceptable), and Standardized Root Mean Square Residual (SRMR; ≤ 0.08 good fit). As the chi-square statistic is sensitive to sample size, researchers recommend assessing model fit using multiple fit indices for a more holistic view of goodness of fit (Kline, 2005). In addition to chi-square difference ($\Delta\chi^2$) tests, change in CFI (ΔCFI) was used for comparisons between models. A non-significant $\Delta\chi^2$ and ΔCFI no greater than .01 have been proposed as markers to suggest negligible differences between models (Chen, 2007; Cheung and Rensvold, 2002). As the MLR estimator was used for all analyses, the Satorra-Bentler scaled chi-square difference test was

used to calculate if the differences between nested models were significant (Satorra & Bentler, 2010). For factor analyses, model re-specification such as removing or correlating items were guided by modification indices, low standardized factor loadings (< .40 rule), and low communality (< .20 rule).

Measurement Invariance

Second, tests of measurement invariance were conducted between boys and girls for the fine-grained dimensions via nested multi-group confirmatory analyses. Three levels of measurement invariance were evaluated: configural, metric (i.e., weak), and scalar (i.e., strong) invariance. Configural invariance refers to the extent to which the basic factor structure (i.e., each fine-grained dimension) is equivalent across groups. Metric invariance refers to whether factor loadings are equivalent across groups. Scalar invariance refers to whether both factor loadings and factor indicator intercepts are equivalent across groups and is generally required to compare factor means across groups (Brown, 2015; Millsap & Olivera-Aguilar, 2012). That is, if factor loadings and intercepts are not equal, true mean-level differences between boys and girls would be contaminated by differences due to artifacts in measurement. When full scalar invariance was not achieved, we tested for partial scalar invariance by freeing the most non-invariant item intercept until the partial scalar and metric model did not significantly differ (Dimitrov, 2010). Many researchers consider partial scalar invariance acceptable for making mean-level group comparisons, particularly when the proportion of noninvariant parameters to all parameters is small (Dimitrov, 2010; Millsap & Olivera-Alguilar, 2012; Muthén & Asparouhov, 2002; Sass, 2011). The aforementioned fit indices and difference tests were used to compare models at progressively more restrictive levels of invariance.

After completing measurement invariance testing, factor scores were saved out and standardized to ensure that all dimensions were on a similar metric and could be more easily compared. Factor scores create an approximation of each person's score on a latent variable, thereby reflecting the weighted scores for the fine-grained dimensions.

Latent Profile Analysis

Third, latent profile analyses (LPA) with one to five profiles were conducted to identify the number of profiles that best fit the data. The following fit indices were used to compare and identify the best fitting model: Akaike Information Criteria (AIC), Bayesian Information Criteria (BIC), and Sample Size Adjusted Bayesian Information Criteria (SSABIC), with lower values indicating better model fit. An elbow plot of these fit indices was used as one method to identify the number of profiles at which the fit indices flatten out (Morin, 2016). Model entropy (> .80 as a measure of good classification quality) and adjusted Lo-Mendell-Rubin likelihood ratio test (*p*-value < .05 as indicating that a solution with *k* number of classes fits better than a solution with *k*-1 number of classes) were also used to consider the best fitting profile solution. In order to interpret the profiles and compare with *a priori* profile characterizations, the indicator variables were plotted using standardized estimates.

Latent Profile Analysis Predicting Depressive Outcomes

After selecting the optimal profile solution based on fit indices and consistent with theory, the manual BCH procedure (Bakk & Vermunt, 2014) was used to examine 1) profile differences in depressive symptoms at age 15, controlling for depressive symptoms at age 10, 2) profiles differences in concurrent depressive symptoms at age 10, and 3) sex as a moderator in the link between profile membership for concurrent and prospective depressive symptoms. The BCH procedure for mixture modeling is the preferred method for examining continuous distal

outcomes based on posterior probabilities as well as control for covariates. Specifically, this method allows for the estimation of covariates and distal outcomes without altering individuals' membership in profiles and accommodates unequal variances in outcomes across profiles (Asparouhov & Muthén, 2020).

Multinomial Logistic Regression Predicting Profile Membership

A multinomial logistic regression analysis was conducted to determine whether profile membership differed based on sex in order to provide descriptive information about the composition of sex across profiles. This analysis was conducted using the R3STEP command in Mplus 8. In determining statistical significance for these logistic regression estimates, Muthén (2020) recommends relying on 95% confidence intervals rather than p-values; for this reason, Mplus no longer provides p-values when conducting these tests in the context of LPA.

CHAPTER III: RESULTS

Confirmatory Factor Analysis (CFA)

Results from CFAs for the hypothesized NE, PE, and EC fine-grained dimensions revealed poor fit to the data even after model re-specification (see Table 1).

Table 1. Fit Indices for CFA Models for PE, NE, and EC Fine-grained Factors

Model	N	χ^2	*df*	*p*	RMSEA [90% CI]	SRMR	CFI	Hypothesized Factors
PE factors	319	3186.300	614	<.001	0.115 [0.111 0.119]	0.116	0.670	6
NE factors	319	1525.623	424	<.001	0.090 [0.085 0.095]	0.073	0.833	5
EC factors	319	1070.854	293	<.001	0.091 [0.085 0.097]	0.078	0.837	4

Exploratory Factor Analysis (EFA)

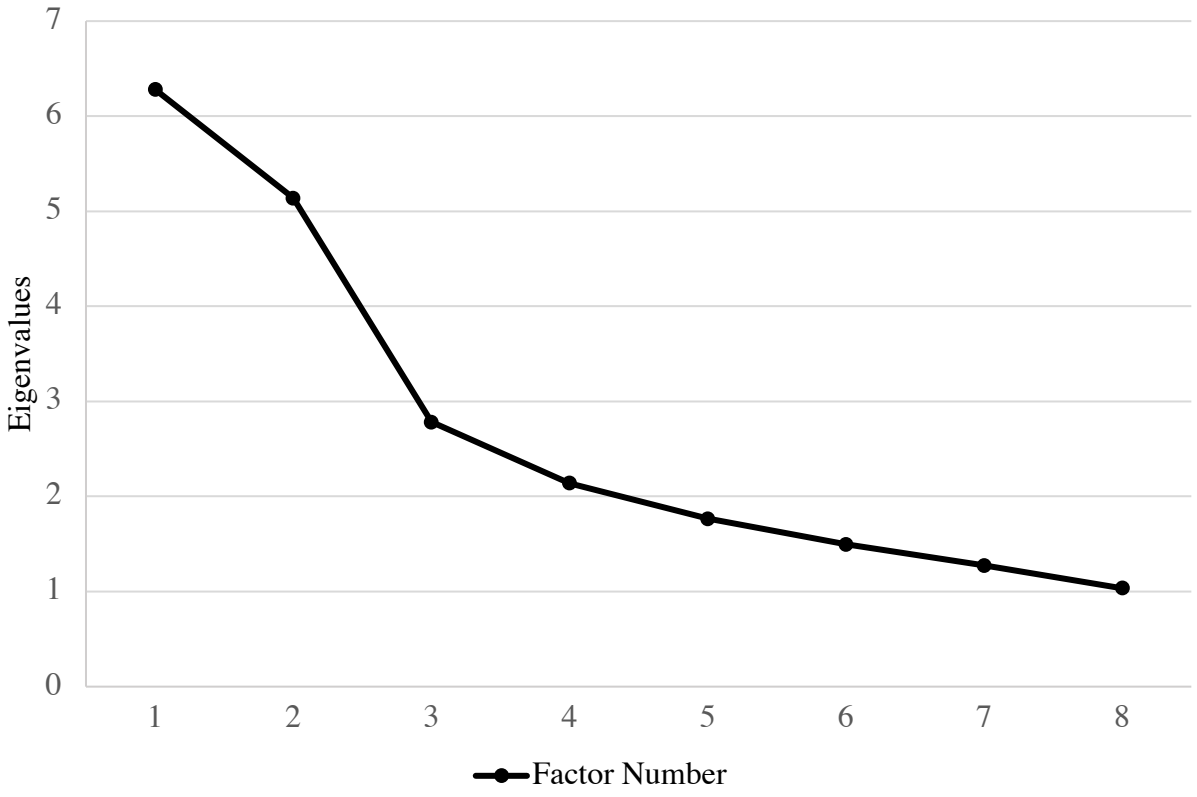
EFA for PE Fine-grained Factors

When an exploratory factor analysis of the items that were hypothesized to load onto PE factors was conducted, results indicated that there were 8 factors with eigenvalues greater than 1. Fit indices for the 2-factor through 8-factor models for PE dimensions are displayed in Table 2 and a scree plot of eigenvalues for the factor models are displayed in Figure 1. Although fit indices suggest that the 8-factor model is the best fitting solution, the scree plot suggested extracting the 3 or 4 factor solution, and the interpretability was best for the 3-factor solution. Taking this balance of factors into account, the 3-factor solution was selected based on substantive considerations as well as low factor determinacy for the 4-factor solution when examining factor loadings. See Table B1 in Appendix B for EFA factor loadings for each item for the 3-factor solution.

Table 2. Fit Indices for EFA Models for PE Fine-grained Factors

Model	N	χ^2	*df*	*p*	RMSEA [90% CI]	SRMR	CFI	ΔCFI	Comparison
2-factor	319	1830.872	593	<.001	0.081 [0.077 0.085]	0.084	0.640	-	-
3-factor	**319**	**1460.288**	**558**	**<.001**	**0.071 [0.067 0.076]**	**0.064**	**0.738**	**0.098**	**2-factor**
4-factor	319	1227.835	524	<.001	0.065 [0.060 0.070]	0.052	0.795	0.057	3-factor
5-factor	319	1063.629	491	<.001	0.060 [0.055 0.065]	0.043	0.833	0.038	4-factor
6-factor	319	783.221	459	<.001	0.047 [0.041 0.053]	0.035	0.906	0.073	5-factor
7-factor	319	727.381	428	<.001	0.047 [0.041 0.053]	0.030	0.913	0.007	6-factor
8-factor	319	592.494	398	<.001	0.039 [0.032 0.046]	0.027	0.943	0.030	7-factor

Figure 1. Scree Plot for PE EFA Factor Solutions



This 3-factor solution was confirmed using the same sample in a CFA analysis which yielded adequate fit (χ^2 (296) = 691.549, p < .001, RMSEA = .065, CFI = .836, SRMR = .076). See Table B2 in Appendix B for CFA factor loadings for the 3-factor solution. The originally hypothesized 6 PE factors (i.e., Activity Level, High Intensity Pleasure, Impulsivity, Approach,

Shyness, Smiling) collapsed into 3 theoretically coherent factors based on factor analysis of the data:

1) Under-control (UC) factor: A total of 12 items loaded onto this factor, including 5 Activity Level items, 3 High-Intensity Pleasure items, 3 impulsivity items, and 1 Approach item. These items collectively reflect a general "under-control" disposition, specifically high levels of activity level, impulsivity, and approach behaviors. It is notable that 5 out of 6 Approach items, 3 out of 6 High Intensity Pleasure items, 2 out of 7 Activity Level items, and 1 out of 6 Impulsivity items were dropped due to low factor loadings on all factors.
2) Shyness (SHY) factor: A total of 8 items loaded onto this factor, including all 6 Shyness items and 2 reverse coded Impulsivity items (i.e., "Takes a long time in approaching new situations" and "Is among the last children to try out a new activity").
3) Smiling (SMI) factor: All original 6 items were retained for this factor.

EFA for NE Fine-grained Factors

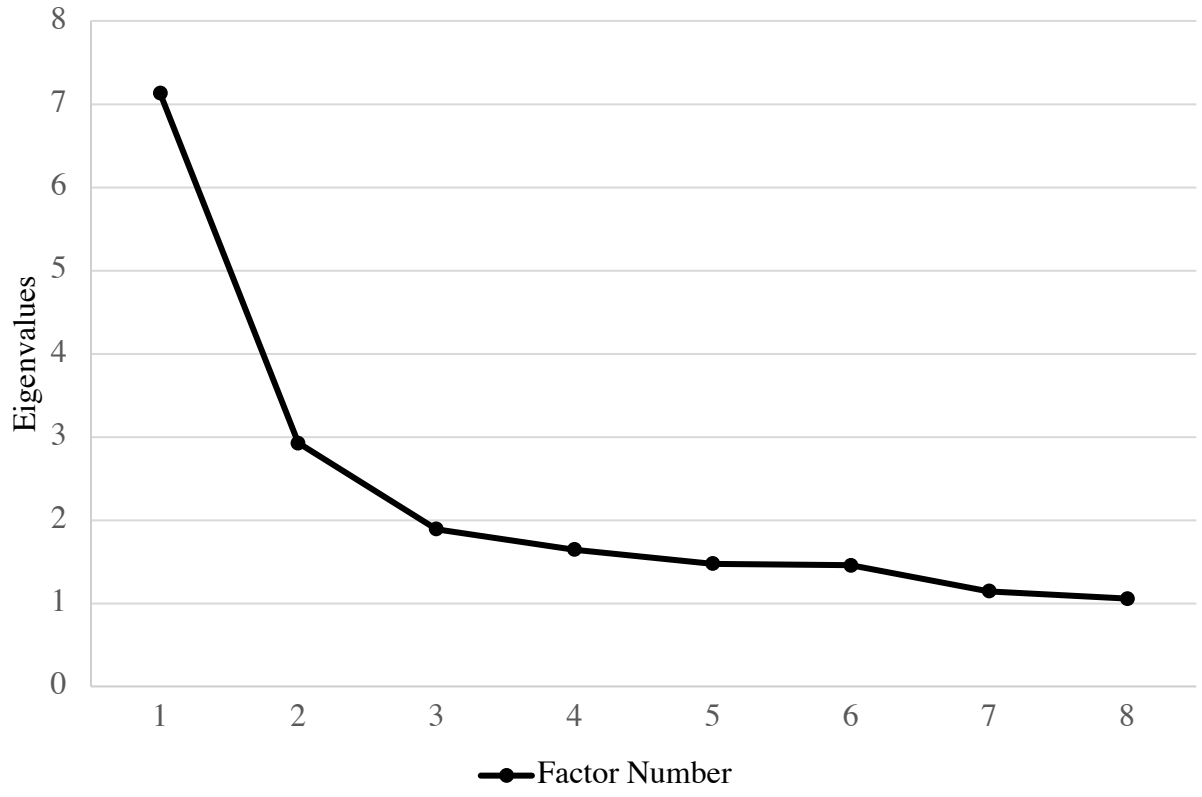
When an exploratory factor analysis of the items that were hypothesized to load onto NE factors was conducted, results indicated that there were 8 factors with eigenvalues greater than 1. Fit indices for the 2-factor through 8-factor models for NE dimensions are displayed in Table 3 and a scree plot of eigenvalues for the factor models are displayed in Figure 2. Although fit indices suggest that the 8-factor model is the best fitting solution, the scree plot suggested extracting the 3 or 4 factor solution, and the interpretability was best for the 4-factor solution. Taking this balance of factors into account, the 4-factor solution was selected as the best fitting solution based on substantive considerations as well as low factor determinacy for the 3-factor

solution when examining factor loadings. See Table C1 in Appendix C for EFA factor loadings for each item for the 4-factor solution.

Table 3. Fit Indices for EFA Models for NE Fine-grained Factors

Model	N	χ^2	*df*	*p*	RMSEA [90% CI]	SRMR	CFI	ΔCFI	Comparison
2-factor	319	1179.491	404	<.001	0.078 [0.072 0.083]	0.071	0.709	-	-
3-factor	319	968.136	375	<.001	0.070 [0.065 0.076]	0.061	0.778	0.069	2-factor
4-factor	**319**	**761.546**	**347**	**<.001**	**0.061 [0.055 0.067]**	**0.050**	**0.845**	**0.067**	**3-factor**
5-factor	319	626.237	320	<.001	0.055 [0.048 0.061]	0.042	0.885	0.040	4-factor
6-factor	319	515.802	294	<.001	0.049 [0.042 0.056]	0.034	0.917	0.032	5-factor
7-factor	319	409.760	269	<.001	0.041 [0.032 0.048]	0.031	0.947	0.030	6-factor
8-factor	319	357.622	245	<.001	0.038 [0.029 0.046]	0.027	0.958	0.011	7-factor

Figure 2. Scree Plot for NE EFA Factor Solutions



This 4-factor solution was confirmed using the same sample in a CFA analysis which yielded adequate fit (χ^2 (224) = 488.989, p < .001, RMSEA = .061, CFI = .879, SRMR = .074). See Table C2 in Appendix C for CFA factor loadings for the 4-factor solution. The originally

hypothesized 5 NE factors (i.e., Anger, Discomfort, Fear, Sadness, Soothability) collapsed into 4 theoretically coherent factors based on factor analysis of the data:

1) Frustration-Disappointment (FD) factor: A total of 9 items loaded onto this factor, including all 6 Anger items, 2 Sadness items (i.e., "Tends to become sad if the family's plans don't work out" and "Seems to feel depressed when unable to accomplish some task), and 1 reversed Soothability item (i.e., "Has a hard time settling down after an exciting activity"). These items collectively reflect a general proclivity towards frustration and disappointment towards failed goals or expectations. It is notable that 4 out of 7 Sadness items were dropped due to low factor loadings on all factors.
2) Discomfort (DIS) factor: A total of 5 items loaded onto this factor, including 4 Discomfort items and 1 Sadness item (i.e., "Cries sadly when a favorite toy gets lost or broken). Two Discomfort items were dropped due to low factor loadings.
3) Fear (FEA) factor: A total of 5 out of 6 Fear items loaded onto this factor. One Fear item was dropped due to its low factor loading.
4) Soothability (SOO) factor: A total of 4 Soothability items loaded onto this factor. One Soothability item was dropped due to its low factor loading.

EFA for EC Fine-grained Factors

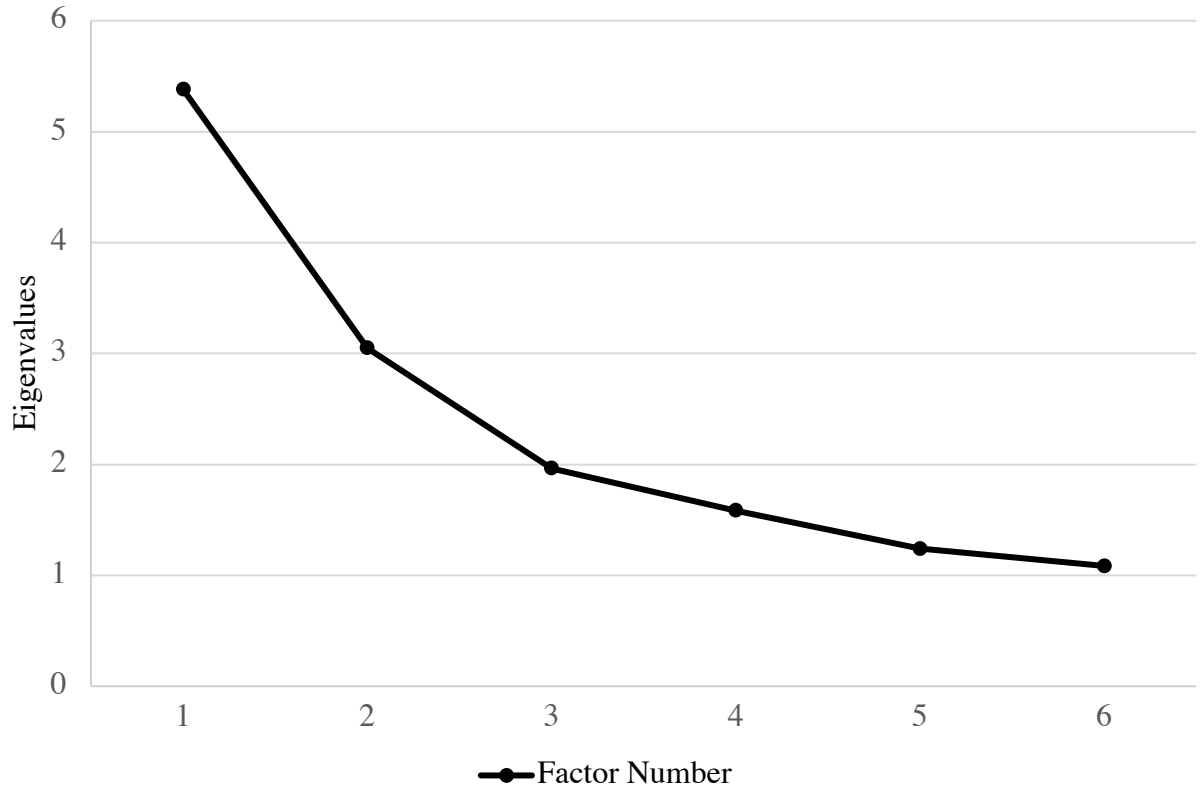
When an exploratory factor analysis of the items that were hypothesized to load onto EC factors was conducted, results indicated that there were 7 factors with eigenvalues greater than 1. As the 7-factor solution did not converge, the 2-factor through 6-factor solutions are displayed in Table 4 and a scree plot of eigenvalues for the factor models are displayed in Figure 3. Although fit indices suggest that the 6-factor model is the best fitting solution, the scree plot suggested

extracting the 3 or 4 factor solution, and the interpretability was best for the 3-factor solution. Taking this balance of factors into account, the 3-factor solution was selected as the best fitting solution based on substantive considerations as well as low factor determinacy for the 4-factor solution when examining factor loadings. See Table D1 in Appendix D for EFA factor loadings for each item for the 3-factor solution.

Table 4. Fit Indices for EFA Models for EC Fine-grained Factors

Model	N	χ^2	*df*	*p*	RMSEA [90% CI]	SRMR	CFI	ΔCFI	Comparison
2-factor	319	860.488	274	<.001	0.082 [0.076 0.088]	0.074	0.680	-	-
3-factor	**319**	**559.940**	**250**	**<.001**	**0.062 [0.055 0.069]**	**0.053**	**0.831**	**0.151**	**2-factor**
4-factor	319	411.957	227	<.001	0.051 [0.043 0.058]	0.041	0.899	0.068	3-factor
5-factor	319	366.556	205	<.001	0.050 [0.041 0.058]	0.036	0.912	0.013	4-factor
6-factor	319	305.276	184	<.001	0.045 [0.036 0.054]	0.033	0.934	0.022	5-factor

Figure 3. Scree Plot for EC EFA Factor Solutions



This 3-factor solution was confirmed using the same sample in a CFA analysis which yielded adequate fit (χ^2 (116) = 260.426, $p < .001$, RMSEA = .062, CFI = .890, SRMR = .067). See Table D2 in Appendix D for CFA factor loadings for the 3-factor solution. The originally hypothesized 4 EC factors (i.e., Attentional Focusing, Inhibitory Control, Low Intensity Pleasure, Perceptual Sensitivity) collapsed into 3 theoretically coherent factors based on factor analysis of the data:

1) Focus-Control (FC) factor: A total of 7 items loaded onto this factor, including 3 Attentional Focusing items and 4 Inhibitory Control items. These items collectively reflect a general proclivity towards executive control. It is notable that 3 out of 6 Attentional Focusing items and 2 out of 6 Inhibitory Control items were dropped due to low factor loadings on all factors.
2) Low Intensity Pleasure (LIP) factor: A total of 7 Low Intensity Pleasure items loaded onto this factor. One Low Intensity Pleasure item was dropped from due to its low factor loading.
3) Perceptual Sensitivity (PER) factor: A total of 3 Perceptual Sensitivity items loaded onto this factor. The other 3 Perceptual Sensitivity items were dropped due to low factor loadings.

Measurement Invariance

Measurement Invariance for PE Fine-grained Factors

Measurement invariance testing was completed for the PE fine-grained factors (i.e., Under-control, Smiling, and Shyness) between boys ($N = 144$) and girls ($N = 175$). The initial configural model revealed inadequate fit (χ^2 (592) = 1113.089, $p < .001$, RMSEA = .074, CFI = .803, SRMR = .087), therefore modification indices were examined. Modification indices

revealed that removing one item from the Under-control factor (i.e., "Prefers quiet activities to active games") and correlating two items in the Shyness factor (those from the original Impulsivity factor) would optimize model fit. After respecifying the model by removing item R50 and correlating items R82 and R36, configural model reached adequate fit (χ^2 (542) =924.015, $p < .001$, RMSEA = .066, CFI = .847, SRMR = .079), suggesting that the structure of the model fits both boys and girls adequately.

Metric invariance was achieved as this model did not fit significantly worse than the configural model ($\Delta\chi^2$ (22) = 19.14, $p = .637$, ΔCFI = -.005), suggesting equivalent factor loadings across groups. However, full scalar invariance was not achieved as the scalar model fit worse than the metric model based on a significant chi-square difference test and change in CFI greater than 0.01 ($\Delta\chi^2$ (22) = 69.96, $p < .001$, ΔCFI = .017). We tested for partial scalar invariance by freeing the most non-invariant item intercepts. After freeing two items from the Under-control factor (i.e., "Enjoys riding a tricycle or bicycle fast and recklessly" and "Likes to play so wild and recklessly that s/he might get hurt") and two items from the Smiling factor (i.e., "Smiles a lot at people s/he likes" and "Rarely laughs aloud while watching TV or movie comedies"), partial scalar invariance was achieved ($\Delta\chi^2$ (18) = 25.77, $p = .105$, ΔCFI = .003). See Table 5 for comparison of measurement models. The final model for PE factors consisted of the Under-control (UC) factor with a total of 11 items, Shyness (SHY) factor with a total of 8 items and Smiling (SMI) factor with a total of 6 items.

Table 5. Comparison of PE Measurement Models

	Configural	Metric	Scalar	Partial Scalar[b]
N	319	319	319	319
Parameters	158	136	114	118
χ^2	924.015	934.575	1000.010	960.727
df	542	564	586	582
p	<.001	<.001	<.001	<.001
RMSEA [90% CI]	0.066 [0.059 0.074]	0.064 [0.057 0.071]	0.067 [0.059 0.074]	0.064 [0.057 0.071]
SRMR	0.079	0.085	0.089	0.086
CFI	0.847	0.852	0.835	0.849
Comparison	-	Configural	Metric	Metric
$\Delta\chi^{2\,a}$	-	19.137	69.964	25.777
Δ *df*	-	22	22	18
$\Delta\chi^2$ *p*	-	0.637	<.001	0.105
ΔCFI	-	-.005	0.017	.003

[a] Satorra-Bentler $\Delta\chi^2$.

[b] Four item intercepts freed in partial scalar model. Two items (items 88 and 10) were specific to the Under-control factor and two items were specific to the Smiling Factor (items 77 and R80).

Measurement Invariance for NE Fine-grained Factors

Measurement invariance testing was completed for the NE fine-grained factors (i.e., Frustration-Disappointment, Discomfort, Fear, Soothability) between boys (N = 144) and girls (N = 175). The initial configural model revealed inadequate fit (χ^2 (448) = 739.691, p < .001, RMSEA = .064, CFI = .869, SRMR = .085), therefore modification indices were examined. Modification indices revealed that removing one item from the Discomfort factor (i.e., "Cries sadly when a favorite toy gets lost or broken") and correlating two items in the Frustration-Disappointment factor ("Gets angry when told s/he has to go to bed" and "Rarely gets upset when told s/he has to go to bed") would optimize model fit. After respecifying the model by removing item 8 and correlating items R61 and 2, configural model reached good fit (χ^2 (404) = 612.333, p < .001, RMSEA = .057, CFI = .902, SRMR = .078), suggesting that the structure of the model fits both boys and girls well.

Metric invariance was achieved as this model did not fit significantly worse than the configural model ($\Delta\chi^2(18) = 21.94, p = .235, \Delta CFI = .001$), suggesting equivalent factor loadings across groups. However, full scalar invariance was not achieved as the scalar model fit worse than the metric model based on a significant chi-square difference test ($\Delta\chi^2(18) = 34.15, p = 0.012$), albeit the change in CFI suggested negligible differences between models ($\Delta CFI = .008$). We tested for partial scalar invariance by freeing the most non-invariant item intercepts. After freeing two items from the Discomfort factor (i.e., "Is likely to cry when even a little bit hurt" and "Hardly ever complains when ill with a cold"), partial scalar invariance was achieved ($\Delta\chi^2(16) = 24.34, p = .082, \Delta CFI = .004$). See Table 6 for comparison of measurement models. The final model for NE factors used for subsequent analyses consisted of the Frustration-Disappointment (FD) factor with a total of 9 items, Discomfort (DIS) factor with a total of 4 items, Fear (FEA) factor with a total of 5 items, and Soothability (SOO) factor with a total of 4 items.

Table 6. Comparison of NE Measurement Models

	Configural	Metric	Scalar	Partial Scalar[b]
N	319	319	319	319
Parameters	146	128	110	112
χ^2	612.333	634.247	667.933	658.566
df	404	422	440	438
p	<.001	<.001	<.001	<.001
RMSEA [90% CI]	0.057 [0.048 0.066]	0.056 [0.047 0.065]	0.057 [0.048 0.066]	0.056 [0.047 0.065]
SRMR	0.078	0.086	0.088	0.088
CFI	0.902	0.901	0.893	0.897
Comparison	-	Configural	Metric	Metric
$\Delta\chi^{2\,a}$	-	21.936	34.152	24.340
Δ *df*	-	18	18	16
$\Delta\chi^2$ *p*	-	0.235	0.012	0.082
ΔCFI	-	0.001	0.008	0.004

[a] Satorra-Bentler $\Delta\chi^2$.

[b] Two item intercepts freed in partial scalar model. Two items were specific to the Discomfort factor (items 64 and 91).

Measurement Invariance for EC Fine-grained Factors

Measurement invariance testing was completed for the EC fine-grained factors (i.e., Focus-Control, Low Intensity Pleasure, Perceptual Sensitivity) between boys (N = 144) and girls (N = 175). The initial configural model revealed adequate fit (χ^2 (232) = 380.265, p < .001, RMSEA = .063, CFI = .885, SRMR = .077). Although metric invariance was also achieved, full scalar invariance was not achieved as the scalar model fit worse than the metric model based on a significant chi-square difference test ($\Delta\chi^2$ (18) = 34.15, p = .012, ΔCFI = .008). Upon testing for partial scalar invariance, the two most non-invariant item intercepts were under the Perceptual Sensitivity factor (i.e., "Notices it when parents are wearing new clothing" and "Comments when a parent has changed his/her appearance"). It is recommended that at least two factor loadings and intercepts are invariant (i.e., equal) across groups in order to make valid inferences about the differences between latent factor means (Byrne et al., 1989). Given that two out of three total items within this factor were non-invariant, we decided to remove the Perceptual Sensitivity factor for subsequent analyses. Therefore, the decision to retain and analyze mean differences of Perceptual Sensitivity between boys and girls would be contraindicated as the construct is not being measured similarly in both groups.

We re-tested configural invariance without Perceptual Sensitivity (i.e., dropped all items on this factor) and the initial configural model revealed inadequate fit (χ^2 (178) = 335.711, p < .001, RMSEA = .075, CFI = .846, SRMR = .080), therefore modification indices were examined. Modification indices revealed that correlating two items in the Low Intensity Pleasure factor ("Enjoys sitting on parent's lap" and "Enjoys "snuggling up" next to a parent or babysitter") would optimize model fit. After respecifying the model by correlating items 86 and 39, the configural model reached adequate fit (χ^2 (176) = 294.821, p < .001, RMSEA = .065, CFI =

.884, SRMR = .078), suggesting that the structure of the model fits both boys and girls adequately.

Metric invariance was achieved as this model did not fit significantly worse than the configural model ($\Delta\chi^2(13) = 8.33, p = .822, \Delta CFI = -.012$), suggesting equivalent factor loadings across groups. However, full scalar invariance was not achieved as the scalar model fit worse than the metric model based on a significant chi-square difference test and change in CFI greater than 0.01 ($\Delta\chi^2(13) = 34.74, p = .001, \Delta CFI = .021$). We tested for partial scalar invariance by freeing the most non-invariant item intercepts. After freeing one item from the Focus-Control factor (i.e., "Prepares for trips and outings by planning things s/he will need"), partial scalar invariance was achieved ($\Delta\chi^2(12) = 19.43, p = .079, \Delta CFI = .007$). See Table 7 for comparison of measurement models without Perceptual Sensitivity. The final model for EC factors consisted of the Focus-Control (FC) factor with a total of 7 items and Low Intensity Pleasure (LIP) factor with a total of 7 items.

Table 7. Comparison of EC Measurement Models

	Configural	Metric	Scalar	Partial Scalar[b]
N	319	319	319	319
Parameters	94	81	68	69
χ^2	294.821	295.218	329.241	314.624
df	176	189	202	201
p	<.001	<.001	<.001	<.001
RMSEA [90% CI]	0.065 [0.052 0.078]	0.059 [0.046 0.072]	0.063 [0.050 0.075]	0.060 [0.047 0.072]
SRMR	0.078	0.084	0.091	0.089
CFI	0.884	0.896	0.875	0.889
Comparison	-	Configural	Metric	Metric
$\Delta\chi^{2\,a}$	-	8.325	34.741	19.432
Δ *df*	-	13	13	12
$\Delta\chi^2$ *p*	-	0.822	0.001	0.079
ΔCFI	-	-0.012	0.021	0.007

[a] Satorra-Bentler $\Delta\chi^2$.

[b] One item intercept freed in partial scalar model. The one item was specific to the Focus-Control factor (item 45).

Latent Profile Analysis

Profile Enumeration

All 9 factors from the aforementioned final models (i.e., Under-control, Shyness, Smiling, Frustration-Disappointment, Discomfort, Fear, Soothability, Focus-Control, Low Intensity Pleasure) were saved out as factor scores and standardized to ensure that all dimensions were on a similar metric and could be more easily compared. Latent profile analyses were run and the fit indices for the one to five profile solutions are presented below in Table 8.

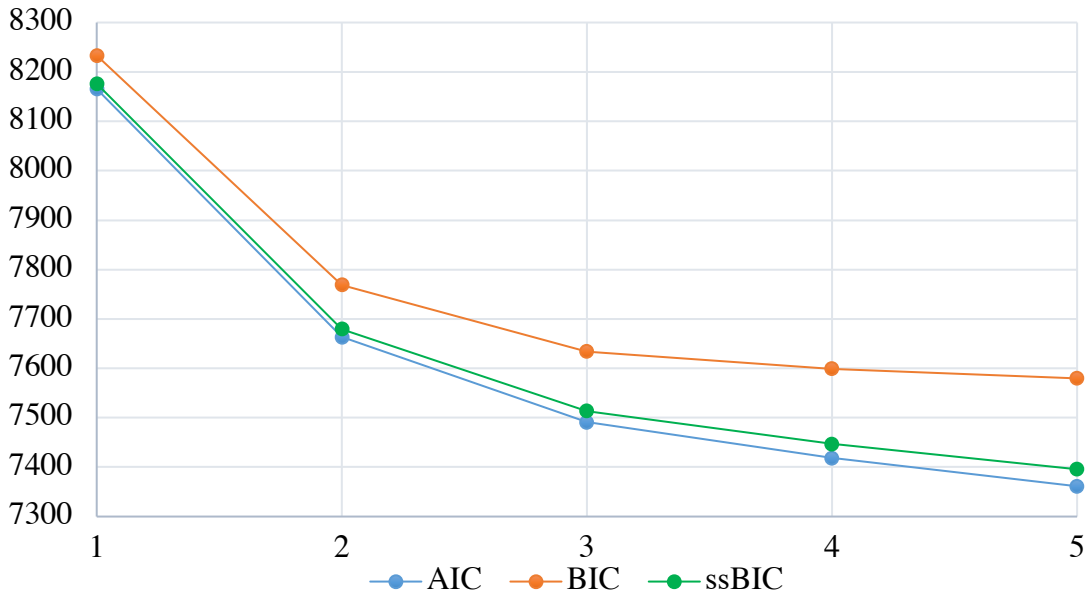
Table 8. Fit Indices for Profile Enumeration

Model	LL	Parameters	AIC	BIC	ssBIC	Entropy	a-LMR	Smallest Class %
1 Profile	-	18	8165.488	8233.262	8176.169	-	-	-
2 Profiles	-3803.573	28	7663.147	7768.572	7679.761	0.828	<.001	3.7%
3 Profiles	**-3707.614**	**38**	**7491.228**	**7634.305**	**7513.777**	**0.830**	**<.001**	**23.68%**
4 Profiles	-3661.123	48	7418.245	7598.974	7446.728	0.869	0.2816	0.94%
5 Profiles	-3622.654	58	7361.308	7579.690	7395.725	0.840	0.4923	0.94%

Note. LL: Log likelihood; AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion; ssBIC: Sample-size Adjusted BIC; a-LMR: Adjusted Lo-Mendell-Rubin Likelihood Ratio Test.

The 3-profile solution was selected as the best fitting solution based on the following considerations: 1) the elbow plot of fit indices flattened out around three profiles (see Figure 4), 2) the adjusted Lo-Mendell-Rubin likelihood ratio tests indicated that the 3-profile solution fits better than the 2-profile solution and that the 4-profile solution did not fit significantly better, and 3) the 3-profile solution was theoretically meaningful.

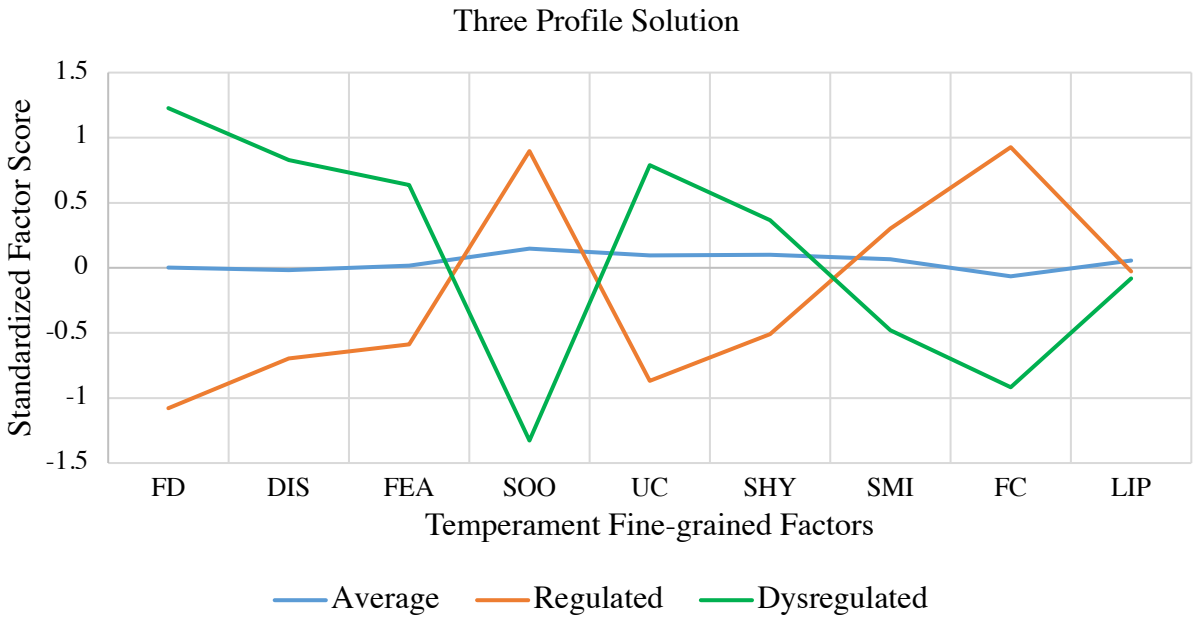
Figure 4. Plot of Fit Indices for Profiles



Note. AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion; ssBIC: sample-size adjusted BIC.

The 3-profile solution yielded three meaningfully distinct profiles of youth (see Figure 5). The majority of youth fell into an *Average* profile (49.3%; blue line) characterized by mean levels on all fine-grained indicators. The next largest group of youth fell into a *Regulated* profile (27%; orange line) characterized by lower levels of Frustration-Disappointment, Discomfort, Fear, Under-Control, and Shyness as well as higher levels of Soothability, Smiling, and Focus-Control. The smallest group of youth fell into a *Dysregulated* profile (23.7%; green line) characterized by higher levels of Frustration-Disappointment, Discomfort, Fear, Under-control, and Shyness as well as lower levels of Soothability, Smiling, and Focus-Control.

Figure 5. Three Profile Solution



Note. FD = Frustration-Disappointment. DIS = Discomfort. FEA = Fear. SOO = Soothability. UC = Under-control. SHY = Shyness. SMI = Smiling. FC = Focus-Control. LIP = Low Intensity Pleasure. Standardized factor scores have a mean of 0 and standard deviation of 1.

Latent Profile Analysis Predicting Depression

The manual BCH procedure (Bakk & Vermunt, 2014) was used to examine whether 1) profile membership predicted depressive symptoms at 15 years of age, controlling for depressive symptoms at 10 years of age 2) whether profile membership was concurrently associated with depressive symptoms at 10 years of age and 3) whether sex moderated the link between profile membership for concurrent and prospective depressive symptoms. Unfortunately, these analyses yielded null results (see Appendix E).

Multinomial Logistic Regression Predicting Profile Membership

Lastly, a multinomial logistic regression was conducted to determine whether profile membership was significantly related to sex (see Table 9). The analysis revealed that sex did not

predict profile membership as indicated by confidence intervals that include or cross the value of 1. This finding suggests that the profile groups are not significantly different by sex and that neither boys or girls are more likely than the other to belong to any of the three profiles.

Table 9. Multinomial Logistic Regression Models

	Reference: Average				*Reference: Regulated*	
	Regulated		Dysregulated		Dysregulated	
Variable	Odds Ratio	95% CI	Odds Ratio	95% CI	Odds Ratio	95% CI
Sex[a]	0.861	0.461-1.611	0.741	0.402-1.367	0.861	0.441-1.679

[a] Sex coded as 0 = Boys and 1 = Girls.

CHAPTER IV: DISCUSSION

Summary

Depression is one of the most prevailing and impairing mental health disorders among youth. The developmental period of adolescence is a window of heightened risk to the onset of depression, as the point prevalence of depression increases two-fold from childhood to adolescence (Costello et al., 2002). Given the significant morbidity and mortality associated with this pervasive disorder, researchers within the field of developmental psychopathology have contributed to an increasing body of theoretical and empirical research to uncover the developmental pathways to adolescent depression (Abela & Hankin, 2008; Cicchetti & Toth, 2009). The purpose of the current study was to elucidate the antecedent factors that contribute to the development of adolescent depression to inform clinical prevention and intervention efforts. As individual differences in temperament serve as one potential source of vulnerability in the development of this disorder, the current study employed a person-centered approach to identify profiles or groups of youth who differ in their temperament configuration. The study focused on Rothbart and colleagues' conceptualization and measurement of temperament, namely the 15 fine-grained dimensions from the Children's Behavior Questionnaire – Short Form (CBQ-SF; Putnam & Rothbart, 2006). Study goals and interpretation of results are discussed below.

Factor Structure of Temperament

Prior to generating profiles of temperament, it was crucial to confirm the factor structure of the CBQ fine-grained dimensions. Confirmatory factor analyses revealed poor fit of the hypothesized fine-grained dimensions with the data and instead exploratory factor analyses revealed an alternative factor structure. A total of 10 fine-grained dimensions emerged from the data. While many hypothesized fine-grained constructs were retained (i.e., Shyness, Soothability,

Smiling/Laughter, Discomfort, Fear, Low Intensity Pleasure, Perceptual Sensitivity), alternative fine-grained constructs emerged, including those labeled as Frustration-Disappointment, Under-control, and Focus-Control dimensions. There may be a few explanations for why we did not replicate the original 15 fine-grained dimensions.

First, there are notable differences between sample characteristics from the current study compared to samples used by Rothbart and colleagues to validate the CBQ. Rothbart and colleagues tested the factor structure of the CBQ using a predominantly White, middle to upper-middle class sample drawn from Midwest and Northwest regions of the United States during 1997 and 2000. Although the current study sample was also predominantly White, the sample was more economically diverse and drawn from a Southern state during 2005-2009. Sample cohort effects may have also impacted parents' perceptions and reporting of their children's emotions and behaviors. For example, national safety and security concerns (e.g., post September 11 attacks, Hurricane Katrina, Virginia Tech shooting) were likely more salient in the current sample cohort relative to the original sample cohort. These cultural events may shape the experiences of youth (e.g., socialization opportunities, limits to trips or going outside) as well as parental expectations and beliefs around the expression and regulation of certain emotions and behaviors. Taken together, variations found between geographic regions, socioeconomic status, and shared life experiences among cohorts during a given time period have the potential to impact parental responses to items on the CBQ and may ultimately account for differences in the factor structure of the CBQ.

Second, the CBQ was validated using samples of youth in their early childhood years (3 to 8 years of age), whereas the current sample included youth in their middle childhood years (10 years of age). Factor structure differences between these samples may suggest the presence of

developmental shifts and may reflect the emotional and behavioral traits that are the most salient for the respective developmental periods. Although temperament is conceptualized as relatively stable, researchers agree that temperamental functioning is also influenced by maturation and experience (Rothbart et al., 2001; Rothbart & Bates, 1998) and research supports heterotypic continuity for certain fine-grained dimensions across infancy to early childhood (Komsi et al., 2006; Putnam et al., 2008). For example, the Frustration-Disappointment dimension was comprised of mainly items from the original Anger subscale with a few items from Sadness and Soothability. These items collectively reflect a propensity to experience frustration and disappointment in the face of unmet goals or expectations during a developmental period when youth have greater self-awareness, desire, and agency in setting their own goals and expectations (Massey et al., 2008; Steinberg & Morris, 2001).

The Under-control dimension was comprised of items from the original Activity Level, High-intensity Pleasure, Impulsivity, and Approach dimensions. These items collectively reflect a propensity towards behavioral under-control, characterizing youth who display hyperactive and impulsive tendencies. During early childhood, most children are actively exploring their environments and are met with fewer expectations around behavioral regulation and control relative to middle childhood. Therefore, parents can readily observe and report on a multitude of behaviors that can be further distinguished as high levels of energy and movement, enjoyment in high intensity activities, reckless and impulsive behaviors, and positive anticipation towards enjoyable activities. By middle childhood, youth are met with greater demands and expectations for behavioral regulation in various settings (e.g., sitting still in class or at the dinner table, walking instead of running, playing quietly instead of recklessly) along with greater maturation of regulatory processes within the brain relative to early childhood. Therefore, parents during

this developmental stage may readily observe a general propensity towards global under-control, characterizing those youth who continue to experience high levels of activity and impulsivity beyond developmentally appropriate expectations.

Lastly, the Focus-Control dimension reflects a general proclivity towards both attentional and behavioral control. Whereas the original Attentional Focusing and Inhibitory Control dimensions may be better distinguished in early childhood as neural processes that undergird attentional regulation develop earlier than those for behavioral regulation (e.g., motor control; Calkins, 2007), the cognitive and behavioral features of global executive control may be less differentiated in middle childhood as youth are expected to demonstrate both forms of regulation simultaneously across developmentally appropriate contexts (e.g., staying seated while listening to teacher). In summary, while the current study did not replicate the original 15 fine-grained dimensions of the CBQ, perhaps due to differences in sample characteristics (e.g., regions, SES, cohorts, developmental period), the alternative factor structure of the CBQ among the current sample of 10-year-old youth provides a useful understanding of temperamental functioning during middle childhood and suggests that temperament may function differently across development. It is also important to caveat that the current study sample is not nationally representative and represents a cohort of youth captured within a specific period of time.

Measurement Invariance

After confirming the alternative factor structure of the CBQ for the current data, tests of measurement invariance revealed that the majority of fine-grained dimensions reached partial scalar invariance for boys and girls, which allows for valid mean-level comparisons of fine-grained dimensions across sex and ultimately valid indicators for examining latent profiles of temperament. The only dimension that did not reach partial scalar invariance was Perceptual

Sensitivity. Perceptual Sensitivity refers to the detection of slight, low intensity environmental stimuli and is related to attentional systems of orienting (Rothbart et al., 2001). Scalar non-invariance for this dimension suggests that parents may be interpreting and responding to these items differently for boys and girls. As mean-level comparisons for this construct are difficult to interpret, Perceptual Sensitivity was excluded as an indicator for the examination of latent profiles of temperament.

Study Goal 1

The first goal of the current study was to contribute to the smaller but growing body of research on fine-grained and person-centered approaches to temperament by examining latent profiles of temperament using fine-grained dimensions of the CBQ. Based on existing person-centered research on temperament profiles, the following profiles were predicted to emerge within the current sample: 1) *Typical*, 2) *Negative/Dysregulated*, 3) *Positive/Well-regulated*, 4) *Over-controlled*, 5) *Under-controlled*, and/or 6) *Bold/Surgent*.

Using the alternative fine-grained dimensions that emerged from factor analyses and reached partial scalar invariance during measurement invariance testing, the latent profile analysis revealed 3 distinct groups of youth. Specifically, the first 3 out of 6 hypothesized profiles were supported. The largest group of youth fell into an Average profile (49.3%), characterized by mean levels on all fine-grained dimensions. The emergence of an *Average* profile is consistent with prior studies that found an Average profile to reflect the largest profile group (*Typical* in Beekman et al., 2015; *Average Approach/Vocal Reactivity* in Garstein et al., 2017; *Average* in Prokasky et al., 2017; *Regulated/Typical Reactive* in Scott et al., 2016).

The next largest group of youth fell into a *Regulated* profile (27%) and this profile was consistent with the hypothesized broadband (i.e., low NE, high PE, high EC) and fine-grained

pattern (i.e., high affective PE, low behavioral PE). Specifically, this profile was characterized overall by lower levels of Frustration-Disappointment, Discomfort, Fear, Under-Control, and Shyness as well as higher levels of Soothability, Smiling, and Focus-Control. Moreover, *Regulated* youth had markedly low levels of Frustration-Disappointment and Under-Control as well as markedly high levels of Soothability and Focus-Control. This profile is consistent with those identified in other studies (*Positive Reactive* in Beekman et al., 2015; *High Positive/Regulated* in Gartstein et al., 2017; *Resilient* in Komsi et al., 2006; *Well-regulated/Positive Reactive* in Scott et al., 2016).

Lastly, the smallest group of youth fell into a *Dysregulated* profile (23.7%) and this profile was similar to the hypothesized broadband (i.e., high NE, low PE, low EC) and fine-grained pattern (i.e., low affective PE, moderate behavioral PE), although behavioral PE for this profile was high rather than moderate. Specifically, this profile was characterized overall by higher levels of Frustration-Disappointment, Discomfort, Fear, and Under-control as well as lower levels of Soothability, Smiling, and Focus-Control. Moreover, *Dysregulated* youth had markedly high levels of Frustration-Disappointment and Under-Control as well as markedly low levels of Soothability and Focus-Control. This profile is consistent with those identified in other studies (*Negative Reactive* in Beekman et al., 2015; *Frustrated/Difficult to Calm* in Gartstein et al., 2017; *Dysregulated/Negative Reactive* in Scott et al., 2016).

It is notable that the fine-grained dimensions of Frustration-Disappointment, Soothability, Under-control, and Focus-Control appear to best differentiate those who were classified as *Regulated* vs. *Dysregulated* at 10-years old. Specifically, the *Regulated* profile reflects a group of youth who tend to experience lower levels of frustration and feelings of disappointment, are less active and impulsive, are easily soothed, and can readily regulate their attention and

behaviors. The *Dysregulated* profile characterizes youth who tend to experience higher levels of frustration and feelings of disappointment, are more active and impulsive, are not easily soothed, and have difficulty regulating their attention and behaviors. These specific fine-grained dimensions may reflect developmentally salient temperament traits for middle childhood youth. During a developmental period where youth are gaining greater independence, responsibilities, social expectations from others, and navigating peer and parental conflict (Steinberg & Morris, 2001), tendencies towards or away from frustration and disappointment, soothability, under-control, and executive control may be the most observable and important for youth's functioning in multiple settings.

Study Goal 2

The second goal of the study was to examine the concurrent and prospective associations between profile membership and depressive symptoms, specifically whether 1) profile membership related to depressive symptoms at 10 years of age and whether 2) profile membership predicted differential levels of depressive symptoms in adolescence at 15 years of age, accounting for earlier levels of symptoms. It was originally hypothesized that groups resembling *Negative/Dysregulated* and *Over-controlled* profiles from the literature would be concurrently and prospectively linked to the greatest level/increase in depressive symptoms. A group resembling the *Under-controlled* profile was hypothesized to be concurrently and prospectively associated with the next greatest level/increase in depressive symptoms. Lastly, a group resembling the *Positive/Well-regulated* profile was hypothesized to be concurrently and prospectively associated with the lowest level/increase in depressive symptoms.

Analyses revealed null results, suggesting that there were no associations between profile membership (i.e., *Average, Regulated, Dysregulated*) and levels of depressive symptoms at 10

and 15 years of age. There may be a few reasons why we did not find significant results. First, the study sample was a community sample of youth with both low values and variability for depressive symptoms on the CDI at the 10-year time point ($M_{\text{TotalSum}} = 5.8$, $SD = 6.51$, Min–Max = 0 – 47) and 15-year time point ($M_{\text{TotalSum}} = 6.58$, $SD = 6.08$, Min–Max = 0 – 34). CDI scores from the current sample fall on the lower end of the spectrum relative to the range of scores from other community samples within the literature (range from 5.30 to 17.40; Bang et al., 2015; Figueras Masip et al. 2010; Koizumi, 1991; Rotundo & Hensley, 1985). Second, a lower study sample size yielded relatively small groups of youth who belonged to *Dysregulated* ($N = \sim 76$) and *Regulated* ($N = \sim 86$) profiles. Associations between profiles and depressive outcomes may be best captured within larger samples with greater variability in scores for depressive outcomes.

Study Goal 3

The third goal of the study was to examine the role of sex differences in both profile membership and in the link between temperament profiles and depressive symptoms. It was hypothesized that girls may be more likely than boys to belong to *Negative/Dysregulated* and/or *Over-controlled* groups as girls are disproportionately at greater risk for developing adolescent depression relative to boys (Angold & Costello, 2001). Analyses revealed that sex was not significantly related to profile membership, suggesting that neither boys or girls were more likely than the other to belong to any of the three profiles including the *Dysregulated* profile. This finding may indicate that temperament profiles do not inherently differ by sex as theoretically suggested by other researchers (e.g., Komsi et al., 2006). Rather, other processes such as those related to sex and/or gender may serve to increase risk for girls in the development of depression. Therefore, it was also hypothesized that sex may moderate the relation between profiles and depressive symptoms at 15 years of age, such that the association between profiles and

depressive symptoms are stronger for girls than for boys. However, analyses did not reveal a moderation of sex. In addition to a low range of scores for depressive symptoms in our sample of boys and girls, the current study may be limited in power to detect potential sex differences.

Strengths

The current study has several notable strengths. To our knowledge, this is the second study after Barcenilla et al. (2021) to test the item-level factor structure of the CBQ-SF and the first study to do so with a sample of 10-year-old youth. As the majority of research examining the factor structure of the CBQ standard and short form versions have focused on replicating the 3 broadband factors, the current study contributes to the field of measurement research on temperament through its focus on item-level factor analysis. Similar to Barcenilla et al. (2021) for the CBQ-SF and Kotelnikova et al. (2016) for the CBQ-SV, the current study did not replicate all of the original 15 fine-grained dimensions. While many of the fine-grained dimensions were retained from the original CBQ, factor analyses found support for alternative dimensions, including Frustration-Disappointment, Under-control, and Focus-Control. The retention of dimensions from the CBQ as well as the discovery of alternative dimensions contributes to the extant temperament literature. The alternative factor structure of the CBQ among 10-year-old youth provides theoretical support for the idea that temperamental functioning shifts across development through maturation and experience. That is, the behaviors and emotions indicative of a given temperament trait during one developmental stage may not measure the same trait at other developmental stages. During middle childhood, behaviors and emotions that map onto the original fine-grained dimensions (i.e., Shyness, Soothability, Smiling/Laughter, Discomfort, Fear, Low Intensity Pleasure, Perceptual Sensitivity) as well as alternative dimensions of Frustration-Disappointment, Under-control, and Focus-Control may

collectively reflect temperament traits that are the most developmentally salient and informative for functioning across settings.

This study is also the first to our knowledge to test measurement invariance for fine-grained dimensions of the CBQ between boys and girls. The current study supports that the majority of identified fine-grained dimensions, not including Perceptual Sensitivity, are partially invariant across boys and girls. These findings suggest that mean-level comparisons across boys and girls for the fine-grained dimensions as well as the indicators used to create temperament profiles are valid for the current study. However, due to differences in sample characteristics and measurement across studies, it is still important for future research to conduct measurement invariance across groups (e.g., age, sex, gender, informants, race/ethnic group) to ensure that any group comparisons regarding temperament are free from measurement bias.

Given the privileged position of a broadband and variable-centered approach to examining temperament-depression links within Developmental Psychopathology, the current study contributes to the growing body of person-centered research on temperament profiles by examining profiles in middle childhood using fine-grained dimensions of the CBQ. The current study found 3 distinct groups of youth who differed in their temperament configuration consistent with profiles found in prior research. Although a relatively small body of research has examined profiles of temperament thus far, the identification of similar profiles across studies throughout infancy to middle childhood provides theoretical support that *natural kinds* or types of individuals who differ in temperament configuration exist within our population. More importantly, these studies provide useful descriptions of groups of youth who differ in their affective and behavioral tendencies across development.

Although variable-centered research has identified broadband temperament combinations that confer risk and resilience towards depression, the current study's fine-grained approach in identifying person-centered profiles of temperament revealed variation of fine-grained dimensions *within* broadband factors. For example, while the *Regulated* profile appears consistent with the variable-centered "triple protection combination" (i.e., low NE, high PE, and high EC) and the *Dysregulated* profile appears consistent with the variable-centered "triple risk combination (i.e., high NE, low PE, and low EC), *Regulated* vs. *Dysregulated* youth had opposite levels of behavioral PE (i.e., Under-control) and affective PE (i.e., Smiling). A broadband approach to taking the mean of these PE fine-grained dimensions would have masked this meaningful variation that ultimately helped to differentiate these two profiles.

Lastly, the current study moved beyond identification of profiles and into prediction by testing cross-sectional and longitudinal associations between temperament profiles and depressive outcomes, albeit null findings. Continued research examining associations between profile membership and outcomes towards adjustment vs. maladjustment has important clinical implications. For example, this line of research can elucidate *which* youth are placed at increased risk for psychopathology and inform prevention and intervention efforts for at-risk groups of youth. Prevention and intervention efforts can include the provision of psychoeducational materials to caregivers and educators to increase awareness and understanding of temperamental differences in children, potential risks and benefits associated with these temperamental differences, behavioral management strategies to respond to youths' specific emotional and behavioral displays, and the provision of strategies to enhance skills development (e.g., emotion and behavior regulation). Research also investigating outcomes related to adjustment, such as social competence, academic functioning, and coping styles, can further elucidate the traits that

allow youth to function adaptively in multiple settings and instill those traits through skills development across youth.

The identification of temperament profiles associated with psychopathology can also inform targeted, personalized treatments in clinical settings. This idea of personalized treatments is not a new endeavor, as researchers in the field of psychotherapy acknowledged early on the importance of identifying "what treatment, by whom, is most effective for this individual with that specific problem and under which set of circumstances" (Paul, 1967, p. 111). Given that treatment is often time-limited, selecting the most effective treatments or techniques based on the characteristics of an individual is likely to be more cost-effective and result in better treatment outcomes (Zilcha-Mano, 2021). In line with the movement towards personalized psychotherapy (see Cuijpers et al., 2016), clinical practitioners can provide targeted skills that may promote resilience for an individual's temperamental profile. For example, *Dysregulated* youth in middle childhood present with relatively high levels of Frustration-Disappointment and Under-Control as well as low levels of Soothability and Focus-Control. Clinical treatment may focus on strategies to cope with feelings of frustration and disappointment within the context of youth's goals or practicing strategies to improve both attentional focus and behavioral regulation.

Limitations

Despite these empirical and theoretical strengths, there are several limitations to this study. First, the study is limited in its mono-method (i.e., paper-pencil questionnaire) approach to measure all constructs. Future studies would benefit from examining profiles of temperament using a multi-method (e.g., home observations, lab tasks, fine-grained questionnaires) and multi-informant approach (e.g., additional caregivers, teachers) in order to reduce shared method variance and informant biases. While the majority of extant research on temperament profiles

have utilized data from parent questionnaires, a growing body of research is starting to utilize observational data (e.g., Dollar et al., 2017; Hawes et al. 2022; Planalp & Goldsmith, 2020).

Second, the current sample consists of majority White, albeit an economically diverse sample of youth and parents. The current sample is also a community sample, where most youth did not endorse elevated levels of depressive symptoms or reach threshold for clinical depression. It is imperative for future research to include more diverse samples, such as at-risk and currently depressed youth, non-White racial/ethnic youth, economically disadvantaged youth, cross-cultural youth, as well as non-neurotypical youth (e.g., those with neurodevelopmental differences), in order to increase generalizability of profiles across development, test for potential group differences in temperament-depression links, and promote inclusivity of under-studied populations in the field of Developmental Psychopathology.

Third, the current sample was limited in sample size which likely contributed to various statistical limitations. For example, a smaller sample size has the potential to limit the number of meaningful profiles generated within the data, whereas a larger sample size may detect additional groups with smaller group membership, such as *Over-controlled*, *Under-controlled*, or *Bold/Surgent* groups that have emerged in other studies. Moreover, difficulties running a CFA using all fine-grained dimensions may have been due to the smaller sample size (Wurpts & Geiser, 2014). As the fine-grained dimensions were split into 3 separate CFA models and were evaluated within their respective higher-order construct of NE, PE, and EC, the current study was unable to evaluate items that may have cross-loaded onto other dimensions outside of their respective broadband factor. The current study also did not utilize holdout samples (i.e., splitting the data into subsamples data) to test EFA and CFA analyses, as holdout samples need to be large enough to provide reliable parameter estimates for testing models. Lastly, the smaller

sample size likely contributed to null findings for moderation of sex differences and predictions for depressive symptoms.

Future Directions

Results from the current study inform a myriad of future directions. Researchers who study temperament using the CBQ may benefit greatly from examining the factor structure of this measure at the item level. A dearth of research conducting item-level factor analyses to replicate Rothbart and colleagues' 15 fine-grained dimensions as well as the current study's findings of an alternative factor structure highlight the importance of measurement investigations. The CBQ has been codified as one of the hallmark measures of temperament and both the broadband factors and fine-grained dimensions from the CBQ have informed decades of temperament research. At the same time, future measurement investigations that replicate and/or modify existing temperament constructs across a variety of samples serve to strengthen and advance the current field of temperament research. As Rothbart and colleagues agree that temperament can be shaped by maturation and experience (Rothbart et al., 2001; Rothbart & Bates, 1998), these future investigations can shed light onto both homotypic and heterotypic continuity of temperament across development. Moreover, it would be important to replicate the alternative dimensions that emerged from the current study (i.e., Frustration-Disappointment, Under-Control, Focus-Control) to confirm whether these dimensions reliably reflect developmentally salient temperament traits during middle childhood and to inform clinical implications. For example, tendencies towards frustration and feelings of disappointment in the face of unmet goals and expectations during middle childhood, rather than general tendencies towards sadness or anger, may serve as a more specific predictor of depressive outcomes in adolescents.

Although the current study examined the predictive link between temperament profiles and depressive outcomes in adolescence, future research may benefit from examining associations between profiles and other forms of adolescent psychopathology. For example, *Dysregulated* and *Under-controlled* profiles from the literature may be associated with greater externalizing disorders in adolescence, such as problems with inattention, hyperactivity, disruptive, and risk-taking behaviors (see Oldehinkel et al., 2004). *Over-controlled* youth may develop comorbid depression and anxiety, as their proclivity towards rigid and constrained self-regulation may result in greater sustained attention towards and difficulties disengaging from negative stimuli as well as inhibited, avoidant behavior. As attentional bias and avoidant coping styles are notable risk factors for anxiety disorders (Perez-Edgar & Fox, 2005), it is worth examining whether these youth have a greater likelihood of being placed on a comorbid internalizing pathway.

As girls are more likely to develop internalizing disorders and boys more likely to develop externalizing disorders during adolescence (Merikangas et al., 2010), processes related to sex and gender likely impact pathways of temperament profiles towards psychopathology. Despite null findings of sex differences in the current study, greater investigations are needed to examine the role of sex and gender in both profile membership and associations between profiles and psychopathology. It is important to highlight that the current study assessed sex differences based on parent report of biological sex. While it is important to determine whether differences exist between males and females, it is more informative to explore why these differences may emerge. That is, differential patterns of associations between temperament profiles and outcomes of psychopathology among males and females may reflect inherent biological differences, socialization differences, or an interaction of both. In order to accurately answer this question,

future researchers need to measure the underlying mechanisms, namely biological markers (e.g., genetic, neural, hormonal, physiological indices) to capture sex differences or measures of gender socialization and attitudes to capture gender differences. For example, sex-specific biological processes (e.g., pubertal timing, pubertal hormones) and gender-specific socialization processes (e.g., intensification of gender roles) that arise starting from the end of middle childhood and into early adolescence may influence the associations between temperament profiles and psychopathology and may partly account for the disproportionate rates of internalizing disorders among females and externalizing disorders among males.

Within the framework of risk and resilience, membership in risk profiles reflects a diathesis or vulnerability to depression. However, a stressor is necessary for the disorder to manifest. As youth are embedded in dynamic environments, environmental and interpersonal stressors such as stressful life events (e.g., death of a loved one, admission to a hospital, parental separation; Fox et al., 2010), family and parenting processes (e.g., parental rejection; Yap et al., 2007) as well as peer processes (e.g., peer rejection, peer victimization; Brendgen et al., 2005) serve as potential moderators that may influence the onset of depression among youth with risky profiles. Parenting processes may be particularly influential during the transition from end of middle childhood to adolescence. This period is marked by various developmental demands and challenges, including changes to the parent-child dynamic. While youth continue to rely on parents as their primary source of support during this period (Blyth et al., 1982), they also experience increased conflict, rule-setting, and monitoring due to their increasing desire for autonomy (Steinberg, 1990). Therefore, the quality of parenting and nature of the parent-child dynamic during this period may serve to either exacerbate or attenuate youths' temperamental risk towards depression. For example, negative parenting behaviors (i.e., parental overprotection,

lack of emotional warmth) exacerbated the link between high NE and depressive symptoms (Oldehinkel et al., 2006) and parental rejection exacerbated the link between low PE and depressive symptoms (Lengua et al., 2000) in middle childhood and early adolescent samples. In this way, future research may explore the moderating role of parenting factors in the link between temperament profiles and depression outcomes.

Lastly, future research utilizing person-centered analyses (e.g., CA, LCA, LPA) can continue to inform the identification and classification of temperament profiles across development. It would be important for future research to identify profiles that did not emerge within the current study, including *Under-controlled*, *Over-controlled*, and *Bold/Surgent* profiles. Future researchers may also conduct latent transition analyses (Lanza, Bray, & Collins, 2013) to examine stability and change in profile membership across time. Variable-centered analyses can then be applied to examine relations between longitudinal profile trajectories and adjustment outcomes. Rather than an individual's profile membership at one time point in development, one's stability in a particular profile or transition in and out of profiles may closely relate to depression outcomes. For example, stability of membership in a *Dysregulated* profile across infancy to middle childhood may confer risk for an early onset, chronic form of depression. Taken together, an integration of person-centered and variable-centered approaches can advance existing research on temperament-depression links through investigations examining temperament profiles at multiple developmental stages, temperament profile stability vs. fluidity across stages, and their associations with outcomes of depression.

Conclusion

There is an enduring effort within the field of Developmental Psychopathology to identify risk and resilience processes that impact the onset of adolescent depression.

Temperament, or an individual's affective-behavioral ways of reacting and responding to their environment, serves as one intrapersonal factor that contributes to depression vulnerability. The current study examined profiles of temperament based on fine-grained dimensions from the Children's Behavior Questionnaire (CBQ). Using an alternative factor structure of the CBQ during middle childhood, three profiles labeled *Average*, *Dysregulated*, and *Regulated* emerged from the current data. These findings shed light onto the presence of developmental shifts in temperamental functioning and that youth who differ in their configuration of temperament traits exist within our population. Although the current study did not find support for associations between profile membership and adolescent depression, it is likely that *Dysregulated* youth are placed at increased risk for depression and other forms of psychopathology. Further research should continue to identify and characterize *which* youth go on to develop depression. At the same time, it is imperative for research to focus on factors or conditions that promote resilience among these at-risk youth. The real-world applications of this line of research are significant. My ultimate hope for this research is to support and better equip youth to weather through this period of "storm and stress," so that they may experience the joys, accomplishments, and growth that also serve as hallmarks of adolescence.

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APPENDIX A: TEMPERAMENT MEASURE

Table A1. Broadband and Fine-grained Subscales of Temperament Measure

Children's Behavior Questionnaire (CBQ)
NE Subscales
1. **Sadness**: Amount of negative affect and lowered mood and energy related to exposure to suffering, disappointment, and object loss.
2. **Fear**: Amount of negative affect, including unease, worry or nervousness related to anticipated pain or distress and/or potentially threatening situations.
3. **Anger/frustration**: Amount of negative affect related to interruption of ongoing tasks or goal blocking.
4. **Discomfort**: Amount of negative affect related to sensory qualities of stimulation, including intensity, rate or complexity of light, movement, sound, and texture.
5. **Falling Reactivity & Soothability**: Rate of recovery from peak distress, excitement, or general arousal.
PE Subscales
1. **Approach**: Amount of excitement and positive anticipation for expected pleasurable activities.
2. **Activity Level**: Level of gross motor activity including rate and extent of locomotion.
3. **High Intensity Pleasure**: Amount of pleasure or enjoyment related to situations involving high stimulus intensity, rate, complexity, novelty, and incongruity.
4. **Smiling & Laughter**: Amount of positive affect in response to changes in stimulus intensity, rate, complexity, and incongruity.
5. **Impulsivity**: Speed of response initiation.
6. **Shyness**: Slow or inhibited approach in situations involving novelty or uncertainty.
EC Subscales
1. **Low Intensity Pleasure**: Amount of pleasure or enjoyment related to situations involving low stimulus intensity, rate, complexity, novelty, and incongruity.
2. **Attentional Focusing**: Tendency to maintain attentional focus upon task-related channels.
3. **Inhibitory Control**: The capacity to plan and to suppress inappropriate approach responses under instructions or in novel or uncertain situations.
4. **Perceptual Sensitivity**: Amount of detection of slight, low intensity stimuli from the external environment.

APPENDIX B: TABLES FOR PE FINE-GRAINED FACTORS

Table B1. Exploratory Factor Analysis Factor Loadings for PE Fine-grained Factors

Original Factor	Item #	Item	Factor 1 (UC)	Factor 2 (SHY)	Factor 3 (SMI)
Activity Level	1	Seems always in a big hurry to get from one place to another	**0.530**	0.076	-0.026
	12	Tends to run rather than walk from room to room	**0.661**	0.000	-0.067
	18	When outside, often sits quietly*	0.154	-0.279	0.186
	22	Moves about actively (runs, climbs, jumps) when playing in the house	**0.604**	0.062	0.109
	50	Prefers quiet activities to active games*	**0.429**	-0.271	0.206
	85	Is full of energy, even in the evening	**0.576**	-0.023	0.208
	93	Likes to sit quietly and watch people do things*	0.259	-0.376	0.012
High Intensity Pleasure	4	Likes going down high slides or other adventurous activities	0.303	-0.179	0.266
	10	Likes to play so wild and recklessly that s/he might get hurt	**0.742**	-0.145	-0.106
	33	Enjoys activities such as being chased, spun around by the arms, etc.	**0.466**	0.064	0.327
	69	Likes to go high and fast when pushed on a swing	0.343	-0.010	0.330
	78	Dislikes rough and rowdy games*	0.317	-0.319	-0.024
	88	Enjoys riding a tricycle or bicycle fast and recklessly	**0.650**	-0.118	0.043
Impulsivity	7	Usually rushes into an activity without thinking about it	**0.737**	0.014	-0.108
	28	Often rushes into new situations	**0.741**	-0.063	-0.002
	36	Takes a long time in approaching new situations*	-0.022	**-0.670**	0.065
	43	Is slow and unhurried in deciding what to do next*	0.095	-0.335	0.057
	51	Tends to say the first thing that comes to mind, without stopping to think about it	**0.509**	0.016	-0.136
	82	Is among the last children to try out a new activity*	0.091	**-0.522**	0.259
Approach	6	Gets so worked up before an exciting event that s/he has trouble sitting still	**0.637**	0.096	-0.020
	15	Gets very enthusiastic about the things s/he does	0.189	-0.037	0.261
	46	Becomes very excited while planning for trips	0.114	0.177	0.295
	58	Becomes very excited before an outing (e.g., picnic party)	0.289	0.113	0.264
	90	Remains pretty calm about upcoming desserts or ice cream*	0.230	0.052	0.075
	92	Looks forward to family outings, but does not get too excited about them*	0.196	-0.105	0.120
Shyness	11	Seems to be at ease with almost any person*	0.001	**0.544**	-0.037
	37	Is sometimes shy even around people s/he has known a long time	0.083	**0.732**	-0.020
	42	Sometimes seems nervous when talking to adults s/he has just met	-0.01	**0.785**	0.216
	52	Acts shy around new people	-0.01	**0.845**	0.157
	60	Is comfortable asking other children to play*	0.030	**0.412**	-0.127
	70	Sometimes turns away shyly from new acquaintances	0.080	**0.823**	0.164
Smiling & Laughter	19	Enjoys funny stories but usually doesn't laugh at them*	-0.105	-0.143	**0.485**
	48	Hardly ever laughs out loud during play with other children*	-0.042	-0.048	**0.652**
	55	Sometimes smiles or giggles playing by her/himself	-0.017	0.100	**0.534**
	77	Smiles a lot at people s/he likes	-0.108	-0.038	**0.421**
	79	Often laughs out loud in play with other children	0.054	0.047	**0.632**
	80	Rarely laughs aloud while watching TV or movie comedies*	-0.016	-0.139	**0.480**

Note. Asterisked items indicate reverse coded items. Bold factor loadings indicate items retained from the CFA. UC = Under-control. SHY = Shyness. SMI = Smiling/Laughter.

Table B2. Confirmatory Factor Analysis Factor Loadings for PE 3-factor Solution

Factor	Item	Factor Loading	Original Factor
Under-control	Seems always in a big hurry to get from one place to another	0.537	ACT
	Tends to run rather than walk from room to room	0.661	ACT
	Moves about actively (runs, climbs, jumps) when playing in the house	0.598	ACT
	Prefers quiet activities to active games*	0.411	ACT
	Is full of energy, even in the evening	0.566	ACT
	Likes to play so wild and recklessly that s/he might get hurt	0.728	HIP
	Enjoys activities such as being chased, spun around by the arms, etc.	0.442	HIP
	Enjoys riding a tricycle or bicycle fast and recklessly	0.640	HIP
	Usually rushes into an activity without thinking about it	0.755	IMP
	Often rushes into new situations	0.766	IMP
	Tends to say the first thing that comes to mind, without stopping to think about it	0.518	IMP
	Gets so worked up before an exciting event that s/he has trouble sitting still	0.626	APP
Shyness	Takes a long time in approaching new situations	0.673	IMP
	Is among the last children to try out a new activity	0.570	IMP
	Seems to be at ease with almost any person*	0.584	SHY
	Is sometimes shy even around people s/he has known a long time	0.741	SHY
	Sometimes seems nervous when talking to adults s/he has just met	0.718	SHY
	Acts shy around new people	0.820	SHY
	Is comfortable asking other children to play*	0.455	SHY
	Sometimes turns away shyly from new acquaintances	0.775	SHY
Smiling	Enjoys funny stories but usually doesn't laugh at them*	0.574	SMI
	Hardly ever laughs out loud during play with other children*	0.744	SMI
	Sometimes smiles or giggles playing by her/himself	0.507	SMI
	Smiles a lot at people s/he likes	0.448	SMI
	Often laughs out loud in play with other children	0.640	SMI
	Rarely laughs aloud while watching TV or movie comedies*	0.582	SMI

Note. Standardized factor loadings from the CFA are displayed. Asterisked items indicate reverse coded items. ACT = Activity Level. HIP = High Intensity Pleasure. IMP = Impulsivity. APP = Approach. SHY = Shyness. SMI = Smiling & Laughter.

APPENDIX C: TABLES FOR NE FINE-GRAINED FACTORS

Table C1. Exploratory Factor Analysis Factor Loadings for NE Fine-grained Factors

Original Factor	Item #	Item	Factor 1 (FD)	Factor 2 (DIS)	Factor 3 (FEA)	Factor 4 (SOO)
Anger	2	Gets angry when told s/he has to go to bed	**0.682**	-0.109	0.031	-0.002
	14	Has temper tantrums when s/he doesn't get what s/he wants	**0.703**	0.030	-0.025	0.013
	30	Gets quite frustrated when prevented from doing something s/he wants to do	**0.786**	-0.009	-0.036	-0.019
	40	Gets angry when s/he can't find something s/he wants to play with	**0.683**	0.008	-0.007	-0.08
	61	Rarely gets upset when told s/he has to go to bed*	**0.442**	-0.028	0.13	-0.087
	87	Gets angry when called in from play before s/he is ready to quit	**0.719**	-0.072	0.005	-0.014
Discomfort	3	Is not very bothered by pain*	-0.196	0.388	0.014	-0.062
	9	Becomes quite uncomfortable when cold and/or wet	0.268	0.150	0.074	-0.016
	29	Is quite upset by a little cut or bruise	0.126	**0.801**	0.006	0.011
	49	Is not very upset at minor cuts or bruises*	-0.205	**0.801**	-0.014	-0.024
	64	Is likely to cry when even a little bit hurt	0.036	**0.772**	0.032	-0.037
	91	Hardly ever complains when ill with a cold *	0.013	**0.412**	-0.028	-0.050
Fear	17	Is afraid of burglars or the "boogie man"	0.163	0.204	**0.377**	0.109
	23	Is afraid of loud noises	0.164	0.223	**0.265**	0.006
	35	Is not afraid of the dark*	-0.122	-0.051	**0.740**	-0.05
	41	Is afraid of fire	0.013	0.256	0.052	0.021
	63	Is afraid of the dark	0.039	0.022	**0.798**	-0.063
	68	Is rarely frightened by "monsters" seen on TV or at movies*	-0.003	0.097	**0.408**	-0.022
Sadness	8	Cries sadly when a favorite toy gets lost or broken	0.295	**0.279**	0.062	0.033
	20	Tends to become sad if the family's plans don't work out	**0.457**	0.142	-0.039	0.011
	27	Seems to feel depressed when unable to accomplish some task	**0.421**	0.109	0.032	-0.034
	31	Becomes upset when loved relatives or friends are getting ready to leave following a visit	0.275	0.139	0.176	0.119
	54	Rarely cries when s/he hears a sad story*	-0.208	0.202	0.104	0.165
	56	Rarely becomes upset when watching a sad event in a TV show*	-0.163	0.109	0.187	0.090
	74	Rarely becomes discouraged when s/he has trouble making something work*	0.291	0.041	0.100	-0.096
Soothability	24	Has a hard time settling down after an exciting activity *	**-0.630**	-0.009	-0.021	-0.015
	34	When angry about something, s/he tends to stay upset for ten minutes or longer*	-0.446	-0.161	0.172	**0.345**
	44	Changes from being upset to feeling much better within a few minutes	0.195	0.026	0.002	0.595
	59	If upset, cheers up quickly when s/he thinks about something else	0.006	-0.026	0.014	**0.698**
	66	Is easy to soothe when s/he is upset	-0.261	0.028	-0.065	**0.651**
	75	Is very difficult to soothe when s/he has become upset*	-0.316	-0.056	-0.110	**0.501**

Note. Asterisked items indicate reverse coded items. Bold factor loadings indicate items retained from the CFA. FD = Frustration-Disappointment. DIS = Discomfort. FEA = Fear. SOO = Soothability.

Table C2. Confirmatory Factor Analysis Factor Loadings for NE 4-factor Solution

Factor	Item	Factor Loading	Original Factor
Frustration-Disappointment	Gets quite frustrated when prevented from doing something s/he wants to do	0.774	ANG
	Gets angry when told s/he has to go to bed	0.643	ANG
	Has temper tantrums when s/he doesn't get what s/he wants	0.716	ANG
	Gets angry when s/he can't find something s/he wants to play with	0.717	ANG
	Rarely gets upset when told s/he has to go to bed*	0.517	ANG
	Gets angry when called in from play before s/he is ready to quit	0.715	ANG
	Tends to become sad if the family's plans don't work out	0.496	SAD
	Seems to feel depressed when unable to accomplish some task	0.459	SAD
	Has a hard time settling down after an exciting activity	0.617	SOO
Discomfort	Is quite upset by a little cut or bruise	0.867	DIS
	Cries sadly when a favorite toy gets lost or broken	0.418	SAD
	Is not very upset at minor cuts or bruises*	0.678	DIS
	Is likely to cry when even a little bit hurt	0.825	DIS
	Hardly ever complains when ill with a cold *	0.394	DIS
Fear	Is afraid of burglars or the "boogie man"	0.483	FEA
	Is afraid of loud noises	0.416	FEA
	Is not afraid of the dark*	0.649	FEA
	Is afraid of the dark	0.866	FEA
	Is rarely frightened by "monsters" seen on TV or at movies*	0.420	FEA
Soothability	If upset, cheers up quickly when s/he thinks about something else	0.543	SOO
	When angry about something, s/he tends to stay upset for ten minutes or longer*	0.601	SOO
	Is easy to soothe when s/he is upset	0.802	SOO
	Is very difficult to soothe when s/he has become upset*	0.790	SOO

Note. Standardized factor loadings from the CFA are displayed. Asterisked items indicate reverse coded items. ANG = Anger. SAD = Sadness. DIS = Discomfort. FEA = Fear. SOO = Soothability.

APPENDIX D: TABLES FOR EC FINE-GRAINED FACTORS

Table D1. Exploratory Factor Analysis Factor Loadings for EC Fine-grained Factors

Original Factor	Item #	Item	Factor 1 (FC)	Factor 2 (LIP)	Factor 3 (PER)
Attentional Focusing	16	When practicing an activity, has a hard time keeping her/his mind on it*	**0.781**	0.003	-0.032
	21	Will move from one task to another without completing any of them*	**0.791**	-0.014	-0.114
	62	Shows strong concentration when drawing or coloring in a book	0.285	0.331	0.005
	71	When building or putting something together, becomes very involved in what s/he is doing, and works for long periods	0.328	0.225	-0.040
	84	Is easily distracted when listening to a story*	**0.643**	0.02	-0.013
	89	Sometimes becomes absorbed in a picture book and looks at it for a long time	-0.045	**0.515**	-0.186
Inhibitory Control	38	Can wait before entering into new activities if s/he is asked to	0.283	0.253	0.094
	45	Prepares for trips and outings by planning things s/he will need	**0.382**	0.186	0.212
	53	Has trouble sitting still when s/he is told to (at movies, church, etc.)*	**0.632**	-0.096	0.096
	67	Is good at following instructions	**0.646**	0.151	0.026
	73	Approaches places s/he has been told are dangerous slowly and cautiously	0.164	0.239	-0.072
	81	Can easily stop an activity when s/he is told "no"	**0.537**	0.201	-0.024
Low Intensity Pleasure	26	Enjoys taking warm baths	-0.102	**0.436**	0.101
	39	Enjoys "snuggling up" next to a parent or babysitter	0.094	**0.482**	0.033
	57	Enjoys just being talked to	0.232	0.250	0.067
	65	Enjoys looking at picture books	-0.027	**0.457**	0.006
	72	Likes being sung to	0.018	**0.629**	-0.022
	76	Likes the sound of words, such as nursery rhymes	0.011	**0.539**	-0.041
	86	Enjoys sitting on parent's lap	0.033	**0.549**	-0.013
	94	Enjoys gentle rhythmic activities, such as rocking or swaying	-0.077	**0.495**	0.016
Perceptual Sensitivity	5	Notices the smoothness or roughness of objects s/he touches	-0.068	0.244	0.207
	13	Notices it when parents are wearing new clothing	-0.009	-0.008	**0.801**
	24	Seems to listen, even to quiet sounds	0.066	0.435	0.163
	32	Comments when a parent has changed his/her appearance	-0.003	0.013	**0.825**
	47	Is quickly aware of some new item in the living room	0.002	0.021	**0.794**
	83	Doesn't usually notice odors such as perfume, smoke, cooking, etc.*	0.199	-0.076	0.255

Note. Asterisked items indicate reverse coded items. Bold factor loadings indicate items retained from the CFA. FC = Focus-Control. LIP = Low Intensity Pleasure. PER = Perceptual Sensitivity.

Table D2. Confirmatory Factor Analysis Factor Loadings for EC 3-factor Solution

Factor	Item	Factor Loading	Original Factor
Focus-Control	When practicing an activity, has a hard time keeping her/his mind on it*	0.764	ATT
	Will move from one task to another without completing any of them*	0.762	ATT
	Is easily distracted when listening to a story*	0.629	ATT
	Prepares for trips and outings by planning things s/he will need	0.452	INB
	Has trouble sitting still when s/he is told to (at movies, church, etc.)*	0.619	INB
	Is good at following instructions	0.700	INB
	Can easily stop an activity when s/he is told "no"	0.582	INB
Low Intensity Pleasure	Enjoys taking warm baths	0.641	LIP
	Enjoys "snuggling up" next to a parent or babysitter	0.450	LIP
	Enjoys looking at picture books	0.647	LIP
	Likes being sung to	0.379	LIP
	Likes the sound of words, such as nursery rhymes	0.419	LIP
	Enjoys sitting on parent's lap	0.674	LIP
	Enjoys gentle rhythmic activities, such as rocking or swaying	0.446	LIP
Perceptual Sensitivity	Notices it when parents are wearing new clothing	0.831	PER
	Comments when a parent has changed his/her appearance	0.802	PER
	Is quickly aware of some new item in the living room	0.803	PER

Note. Standardized factor loadings from the CFA are displayed. Asterisked items indicate reverse coded items. ATT = Attentional Focusing. INB = Inhibitory Control. LIP = Low Intensity Pleasure. PER = Perceptual Sensitivity.

APPENDIX E: TABLES WITH DEPRESSION

Table E1. Latent Profile Analysis Predicting Depression

	Wald Test	*Regulated*	*Dysregulated*	*Average*
10-year CDI	χ^2 (2) = 2.769, p = 0.250	6.214	3.172	6.105
15-year CDI, controlling for 10-year CDI	χ^2 (2) = 2.618, p = 0.2701	5.627	3.990	4.090
15-year CDI, moderated by sex and controlling for 10-year CDI	χ^2 (2) = 2.784, p = 0.2486	4.030	4.443	3.382

Note. Means of distal outcome variable are presented using BCH approach. Based on Wald tests, means between profiles were not statistically different for each analysis. CDI = Children's Depression Inventory.

Table E2. Effect Size Statistics for Depression Means

	Regulated vs. Dysregulated	*Regulated vs. Average*	*Average vs. Dysregulated*
10-year CDI	0.173	0.006	0.201
15-year CDI, controlling for 10-year CDI	0.099	0.105	0.008
15-year CDI, moderated by sex and controlling for 10-year CDI	0.022	0.037	0.068

Note. Cohen's *d* estimates are provided between the means of distal outcome variable across profiles.

Table E3. Correlations Between Latent Fine-Grained Dimensions and Depression

	10-year CDI	15-year CDI
Frustration-Disappointment	.183**	.189**
Discomfort	.168**	.021
Fear	.072	.047
Soothability	-.187**	-.098
Under-control	.199**	.148*
Shyness	.083	.035
Smiling	-.122*	-.187**
Focus-Control	-.295**	-.192**
Low Intensity Pleasure	-.066	.079
Perceptual Sensitivity	-.110	-.033

Note. ** $p < 0.01$. * $p < 0.05$. CDI = Children's Depression Inventory.