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Risk for Depression and Anxiety in Youth: The Interaction between Negative Affectivity, Effortful Control, and Stressors

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Abstract

Theories of temperament suggest that individual differences in affective reactivity (e.g., negative affectivity) may confer risk for internalizing psychopathology in youth and that self-regulatory aspects of temperament (e.g., effortful control) may protect against the deleterious effects of high negative affective reactivity. However, no study to date has examined how the relationship between temperament and youth internalizing psychopathology may be moderated by stress. The current study used a prospective longitudinal design to test the interaction of temperament (e.g., negative affectivity and effortful control) and stressors as a predictor of youth (ages 7–16; 56% female; N = 576) depressive and anxious symptoms over a 3-month period. Findings show that at low levels of stress, high levels of effortful control protect against the development of depressive and anxious symptoms among youth with high levels of negative affectivity. However, at high levels of stress, this buffering effect is not observed. Gender and grade did not moderate this relationship. Overall, findings extend current understanding of how the interaction of individual psychosocial vulnerabilities and environmental factors may confer increased or decreased risk for depressive and anxious symptoms.

Keywords

temperament; stress; youth; depression; anxiety

Depression and anxiety are debilitating emotional disorders with significant implications for cognitive, interpersonal, and occupational functioning, as well as physical health (Bistricky, Ingram, & Atchley, 2011; Teubert & Pinquart, 2011). Although first onsets of depressive disorders have been identified in childhood, mid-to-late adolescence is a key developmental period during which rates of new cases of depression increase dramatically (from 3% to 15%), especially in girls (Hankin et al., 1998). In addition, anxiety has been shown to have a

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prevalence rate ranging between 10% to 15% in mid-to-late adolescence (for a review, see Teubert & Pinquart, 2011). Due to the striking prevalence of depression and anxiety in adolescence and their associated impairments (e.g., poor academic performance, troubles with peers), it is critical for research to elucidate the potential risk factors that lead to the development of these disorders.

Although many risk factors have been linked to depression and anxiety in youth, one factor that has received increasing attention in the field is temperament, a construct that has been linked to both externalizing problems and internalizing problems (see Nigg, 2006 for a review). Temperament refers to individual differences in affective reactivity (e.g., positive and negative affectivity) and self-regulation (e.g., effortful control) (Rothbart & Rueda, 2005). Negative affectivity (e.g., sadness, anger, frustration) is an aspect of reactive temperament that represents an ideal construct for the study of both depression and anxiety because it is related conceptually, as well as empirically, to hierarchical models of psychopathology, especially internalizing disorders (see Markon, Krueger, & Watson, 2005). Negative affectivity has been linked to internalizing symptoms in cross-sectional and longitudinal studies of adult clinical and community samples, as well as youth clinical and community samples (Dougherty, Klein, Durbin, Hayden, & Olino, 2010; Ormel et al., 2013). Fewer studies have investigated the relationship between both reactive and regulatory aspects of temperament and youth internalizing problems (for exception, see Vasey et al., 2013). Regulatory aspects of temperament, such as effortful control, may reduce risk for psychopathology by counteracting the deleterious effects of a highly reactive negative temperament (Muris & Ollendick, 2005), whereas individuals who do not possess high levels of this regulatory dimension but are still high on reactive temperament will not be able to mitigate their distress and will be more likely to develop internalizing problems (e.g., Muris, Meesters, & Blijlevens, 2007).

Despite well-established links between temperamental vulnerabilities (e.g., high negative affectivity and low effortful control) and youth internalizing symptoms, no study to date has examined how stressors may potentially moderate this relationship. Examining the interplay of temperament and stressors can extend current understanding of how individual psychosocial factors interact with the environment to contribute to internalizing problems in youth. In addition, no study to date has tested the unique associations among temperamental vulnerabilities, stressors, and depressive symptoms on the one hand, and anxious symptoms on the other hand. By distinguishing between these outcomes, the current study seeks to tease apart the well-established link between temperamental risk factors and broad internalizing problems as part of a transdiagnostic approach to studying risk for depression and anxiety (for a discussion, see McLaughlin & Nolen-Hoeksema, 2011). The goal of the current study therefore is to test the interaction of stress, negative affectivity, and effortful control as a prospective predictor of elevations in youths' depressive and anxious symptoms.

Temperament

Over the past few decades, several theoretical frameworks have been used to conceptualize temperament (e.g., Buss & Plomin, 1975; Thomas & Chess, 1977). Of these original accounts, Rothbart's temperament model has become among the most well-studied and

supported approaches to conceptualizing individual differences in youth temperament (Rothbart & Rueda, 2005). Rothbart defines temperament as individual differences in affective reactivity (e.g., positive and negative affectivity) and self-regulation (e.g., effortful control).

Affective reactivity refers to excitability, responsivity, or arousability of the behavioral and physiological systems of an organism in response to stress (Rothbart & Rueda, 2005). Highly reactive individuals exhibit a lower threshold of initial response, demonstrate a slower recovery to baseline, and show greater reactivation as a result of repeated exposure to stress compared to those who are not as reactive (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001). In Rothbart's model, affective reactivity is divided into two dimensions: positive affectivity (PA) and negative affectivity (NA). Positive affectivity (e.g., smiling/laughter, activeness, assertiveness) directs approach behavior towards reward, and overlaps with other well-established constructs, such as extraversion, surgency, and Gray's Behavioral Activation System (BAS) (Bijttebier, Beck, Claes, & Vandereycken, 2009). Negative affectivity (e.g., sadness, anger, frustration), on the other hand, mobilizes avoidance behavior away from non-reward or punishment, and is closely related to constructs such as neuroticism and Gray's Behavioral Inhibition System (BIS) (Bijttebier et al., 2009).

Effortful control involves the recruitment of attentional and behavioral processes to modulate affective reactivity (Rothbart & Rueda, 2005). Broadly, these processes facilitate the ability to employ flexible, strategic, and ultimately, effective coping strategies to modulate high levels of negative emotion that stem from reactive temperament (Lengua & Long, 2002). Processes of effortful control include the ability to maintain or shift attentional focus, inhibit maladaptive behavioral responses, or activate appropriate responses in light of changing task demands (Eisenberg et al., 2005). Because these regulatory processes ultimately influence the level of emotional arousal experienced or expressed by an individual, effortful control has important implications for the study of depression and anxiety. For instance, individuals who are able to shift attention away from negative cognitions and focus on positive material may be able to reduce emotional distress (Eisenberg et al., 2009). High levels of effortful control might therefore serve as a protective factor to reduce risk for internalizing problems, even among individuals who are high on negative affectivity. Conversely, low levels of effortful control may increase risk for the development of internalizing problems, especially for those who are high on negative affectivity. Individuals who are low on effortful control may not be able to redirect attention, inhibit maladaptive responses, or activate approach responses. As a result, they may not be as successful at modulating their emotions and therefore may experience sustained levels of high negative affect, and consequently, internalizing problems. In light of robust findings linking negative affectivity and youth internalizing symptoms (e.g., Ormel et al., 2013), recent studies of temperamental vulnerability have integrated both reactive and regulatory aspects of temperament (e.g., effortful control) in order to better understand the link between temperament and youth internalizing symptoms (e.g., Dinovo & Vasey, 2011; Vasey et al., 2013). These studies have found that high levels of negative affectivity and low levels of effortful control are associated with internalizing symptoms (e.g., Eisenberg et al., 2001; Muris et al., 2007).

Stressors

Although research supports a direct association between individual differences in temperament (i.e., negative affectivity and effortful control) and youth internalizing symptoms, no study to date has examined whether stressors might moderate this relationship. It is important to consider how stressors might interact with temperament to influence youth internalizing symptoms because stressors are a well-established and robust predictor of psychopathology, especially depressive and anxious symptoms in childhood and adolescence (Hammen, 2005). For those with high levels of negative affectivity, it is hypothesized that stress will easily and quickly trigger physiological and emotional arousal, including high levels of sadness, anger, and frustration, which is associated with internalizing problems (Compas et al., 2001). For individuals with low levels of temperamental negative affectivity, however, stress will not trigger negative emotional arousal at a level that would confer risk for internalizing problems. Several studies have examined two-way interactions between negative affectivity and stress (e.g., Brown & Rosellini, 2011, Fox, Halpern, Ryan, & Lowe, 2010).

Synthesis of temperament dimensions and stress: Two alternative hypotheses

One hypothesis, based predominately on temperamental theories of risk, is that individuals with high levels of negative affectivity may be protected from the deleterious effects of stress if they are also high on effortful control. As discussed earlier, effortful control may facilitate the use of effective strategies to reduce sustained levels of negative affect triggered by stress. Lengua (2002) found a buffering effect for effortful control in youth ages 7 to 11 exposed to demographic (e.g., ethnic or racial minority status), psychosocial (e.g., maternal depression), and environmental (e.g., neighborhood crime) stress. Stress was less strongly related to adjustment problems for youth who were also high on inhibitory and attentional control, two lower-order dimensions of effortful control, compared to youth low on these dimensions. These results indicate that high effortful control protects against the negative impact of stress.

On the other hand, an alterative and competing hypothesis suggests that the heavy burden of stress may compromise effortful control processes, and as a result individuals may not be able to effectively use coping strategies to mitigate particularly high levels of negative affect as they typically and habitually can under low stress conditions. Research in animal models has demonstrated that exposure to stress is linked to behavioral deficits in effortful control. Experimental studies with rodents exposed to both acute (e.g., shock) and chronic (e.g., maternal separation) stress have shown impairments in the ability to maintain or shift attention, inhibit a response, or flexibly switch strategies in the context of changing task demands (Holmes & Wellman, 2009). Research with humans demonstrates a link between acute and chronic stress and behavioral deficits in effortful control. Young adults exhibited poorer performance on a cognitive control task (e.g., color-word Stroop task) following an intervening uncontrollable noise stressor compared to young adults that did not experience this uncontrollable stressor (Henderson, Snyder, Gupta, & Banich, 2012). Similarly, graduate students demonstrated greater response costs on a cognitive control task when they

were tested 1 month before an upcoming exam compared to after the exam (Liston, McEwen, & Casey, 2009). Taken together, these studies in humans show that acute laboratory stressors (e.g., uncontrollable noise), as well as more chronic naturalistic stressors (e.g., an upcoming exam), are associated with diminished abilities to perform experimental tasks that require effortful control. It is also possible that stress may undermine coping strategies that are supported by effortful control, such as redirecting attention away from negative material, inhibiting maladaptive responses, or activating appropriate approach responses. As such, high stress may diminish the protective effects of effortful control on the relationship between high levels of temperamental negative reactivity, and later psychopathology.

The Present Study

The current study sought to address several important gaps in knowledge in order to extend understanding of temperamental risk for youth depressive and anxious symptoms in the context of stress. First, the current study tested two competing hypotheses regarding the role of effortful control in the association between negative affectivity, stress, and youth internalizing symptoms. Consistent with prior research, high levels of stressors will serve as a trigger for emotional distress among individuals who are also high on negative affectivity. Conversely, high levels of stress will not trigger emotional distress for individuals low on negative affectivity. The first hypothesis, based predominately on the temperament literature, posits that those who are also typically high on temperamental effortful control will be able to regulate their emotional distress, and will therefore be buffered against increases in internalizing symptoms. Conversely, those who are typically low on temperamental effortful control will not be able to regulate their distress, and will demonstrate increases in internalizing symptoms. The second alternative and competing hypothesis, which is based on the cognitive neuroscience literature, posits that high levels of stress will compromise the ability to implement coping strategies supported by effortful control. Individuals who are typically high on effortful control will be unable to regulate emotional distress triggered by high levels of stress, and thus will be at increased risk for developing internalizing symptoms. Therefore, in the context of high levels of stress, there will be no difference in the relationship between negative affectivity and internalizing symptoms among youth who are typically low versus typically high on effortful control.

Second, the current study utilized longitudinal methods to determine whether the interaction of temperamental vulnerabilities (i.e., negative affectivity and effortful control) and stressors predicts increases in internalizing symptoms over time. The majority of research to date has used cross-sectional methodology to examine relationships among temperamental vulnerabilities and internalizing symptoms. Although informative, these designs are limited in their ability to determine whether these temperamental factors are correlates of internalizing symptoms, or whether they represent risk factors that contribute to the development and maintenance of internalizing symptoms. Therefore, the current study used a two time-point prospective longitudinal design to determine whether negative affectivity and effortful control assessed at baseline interact with high levels of stressors to predict increases in internalizing symptoms over a 3-month period.

Third, the current study assessed temperamental vulnerabilities as part of a transdiagnostic approach to studying risk for depressive and anxious symptoms (see McLaughlin & Nolen-Hoeksema, 2011). Depression and anxiety are moderately to highly correlated. A majority of the aforementioned studies of temperamental vulnerability used broad-based measures, like the Achenbach Child Behavioral Checklist (CBCL), to assess youth general internalizing problems (e.g., Eisenberg et al., 2001; Lengua & Long, 2002). Few studies, however, have assessed whether temperamental vulnerabilities (e.g., negative affectivity and effortful control) represent transdiagnostic factors that contribute equally to the development of both depressive and anxious symptoms in youth, or whether they might differentially predict these symptoms (for an exception, see Verstraeten, Bijttebier, Vasey, & Raes, 2011). Therefore, a third goal of the current study was to utilize separate measures of depressive and anxious symptoms to determine the specific outcomes predicted by the interplay of temperamental vulnerabilities and stressors. We hypothesized that temperamental vulnerabilities (e.g., negative affectivity and effortful control) in conjunction with high stress would predict both depressive symptoms and anxious symptoms over a 3-month period[1].

Finally, the current study tested for the moderating effects of grade and gender. As mentioned previously, rates of depression and anxiety increase dramatically from childhood to mid-to-late adolescence, with females experiencing these problems at twice the rate of males (Hankin et al., 1998). In addition to main effects of age and gender on symptoms, there is also evidence for moderating effects on other variables linked to depression and anxiety (e.g., stress: Rudolph & Hammen, 1999; coping strategies: Agoston & Rudolph, 2011). Therefore, the fourth goal of the current study was to explore whether grade and gender moderate the associations among temperamental vulnerabilities, stressors, and depressive and anxious symptoms.

Method

Participants

Participants were 576 parents (85% mothers) of children and adolescents recruited from school districts in metropolitan Denver, Colorado and central New Jersey. Youth had to currently be enrolled in third (age 7–9 years old), sixth (age 10–12 years old), or ninth (age 13–16 years old) grade. The sample of youth was approximately evenly divided by sex (males: 44%, females: 56%), grade (third grade: 31%, sixth grade: 37%, ninth grade: 32%) and by ethnic origin (Caucasian: 62%, African American: 10%, Latino: 22%, Asian/Pacific Islander: 10%, Other/Mixed Race: 10%). Youth ranged in age from 7 to 16 years old (mean age 12 years old, SD 2.4).

[1]Our decision to not include positive affectivity was motivated by our theoretical model of how affective reactivity, regulation, and stress work together to confer risk for depression and anxiety. In our model, stressors trigger negative emotional distress among individuals who are high on temperamental negative affectivity. Positive affectivity, on the other hand, does not reflect a tendency to experience negative emotional distress in the face of stress (for a discussion, see Brown & Rosellini, 2011). Therefore, although positive affectivity is a temperamental trait unique to depression, and not anxiety, we ultimately decided to omit it from the current study because it was inconsistent with the particular theoretical model we were testing.

Procedures

Parents visited the laboratory for the baseline assessment and provided informed written consent for participation. Adolescents provided informed written assent. Parents completed questionnaires assessing their child's negative affectivity, effortful control, depressive symptoms, and anxious symptoms at baseline assessment (T1). Follow-up assessment evaluating parent-reported depressive and anxious symptoms for their child occurred 3 months after the baseline visit (T2). The Institutional Review Board approved all procedures. Parents were reimbursed for their participation.

Measures

Negative Affectivity—The Positive and Negative Affect Schedule for Children – Parent Version (PANAS-C-P: Ebesutani, Okamura, Higa-McMillan, & Chorpita, 2011) is a widely used measure of the two dimensions of trait temperamental reactivity: positive and negative affectivity (e.g., Dinovo & Vasey, 2011; Lonigan & Vasey, 2009; Vasey et al., 2013). The PANAS-C-P contains 27 items consisting of emotions (e.g., "interested" or "sad") and participants rate the extent to which their child has experienced each particular emotion on a five-point Likert scale ranging from *Very slightly or not at all* (1) to *Extremely* (5) during the past few weeks. There are two 10-item scales, one for positive affectivity and one for negative affectivity. The data utilized for this study focus on ratings from the negative affectivity (NA) scale only. The PANAS-C-P has good reliability and validity for measuring affectivity (Ebesutani et al., 2011). In the current study, internal consistency (α) was .89 for negative affectivity.

Effortful Control—The Early Adolescent Temperament Questionnaire – Revised Parent Report (EATQ–R-P; Ellis & Rothbart, 2001) is a measure of temperament in children and adolescents that was administered to parents at baseline assessment. The data that will be presented focus on the 18 items assessing the higher order construct of effortful control, which includes the three subscales of activation control, attention, and inhibitory control. Each item is rated on a five-point scale ranging from *Almost always untrue* (1) to *Almost always true* (5). Temperament trait scores are computed by summing ratings across relevant items. Internal consistency (α) for the 18-item effortful control (EC) scale of the EATQ-R-P in the current study was .87.

Depressive Symptoms—The parent version of the Children's Depression Inventory (CDI: Kovacs, 1992; CDI-P; Cole, Hoffman, Tram, & Maxwell, 2000) is a widely used measure of depressive symptoms in children and adolescents that was administered to parents at baseline and 3-month assessments. The CDI includes 27 items consisting of three statements (e.g., "My child is sad once in a while", "My child is sad many times", "My child is sad all the time"), which are rated on a 0 to 2 Likert scale. A total score, ranging from 0 to 54, is generated by summing all items, with a higher score indicating higher levels of depressive symptoms. The parent version of the CDI has sound psychometric properties, including test-retest reliability ($r = 0.74$, $p < .05$; Cole et al., 2000). Internal consistency (α) for the current study was above .80 for both time points.

Anxious Symptoms—The parent version of the Multidimensional Anxiety Scale for Children (MASC: March, Parker, Sullivan, Stallings, & Conners, 1997; MASC-P: Baldwin & Dadds, 2007) is a widely used measure of anxious symptoms in children and adolescents that was administered to parents at baseline and 3-month assessments. The MASC contains 39 items that assesses physical symptoms of anxiety, harm avoidance, social anxiety, and separation anxiety. Each item presents a symptom of anxiety (e.g., "Gets scared when parents go away" or "Worries about getting called on in class), and participants indicate how true each item is for their child on a four-point Likert scale ranging from *Never true* (0) to *Very true* (3). A total score, ranging from 0 to 117, is generated by summing all items, with a higher score indicating higher levels of anxious symptoms. The parent version of the MASC has high test-retest reliability ($r = 0.70$, $p < .05$, Baldwin & Dadds, 2007). Internal consistency (α) was above .80 for both time points.

Stressors—The Adolescent Life Events Questionnaire (ALEQ; Hankin & Abramson, 2002) assesses a broad range of negative events that typically occur among children and adolescents, including school/achievement problems (e.g., "Got a bad grade on an exam, project, or paper in class"), friendship (e.g., "Friend is criticizing you behind your back") and romantic difficulties (e.g., "Arguments or problems with boyfriends or girlfriends"), and family problems (e.g., "Getting punished by your parents"). The ALEQ was administered to parent participants at baseline. The ALEQ contains 37 negative events, and participants indicate how often each item occurred over the past 3 months on a five-point Likert scale ranging from *Never* (0) to *Always* (4). These rating were then dichotomized (0 = event not experienced and 1 = event occurred) and the dichotomized items were used to assess a count of stressors, with higher scores indicating more exposure to negative life events. Negative life events were coded into independent and dependent types of events based on previous research (e.g. Hankin, Stone, and Wright 2010). Independent events are those that befall an individual and are not related to the individual's characteristics or behaviors (e.g. "death of a relative"), whereas dependent events are due to the individual's characteristics or behaviors that might contribute to the negative event (e.g. "fighting or problems with a friend"). The ALEQ has been found to have good validity (e.g., Hankin, 2008).

Results

Data Analytic Strategy

Means, standard deviations, and inter-correlations for all variables are shown in Table 1. Hierarchical multiple regressions were conducted to examine whether negative affectivity, effortful control, and stressors interacted to predict prospective change in depressive symptoms and anxious symptoms over a 3-month period. The first hypothesized model tested if the proposed risk factors (e.g., negative affectivity at T1, effortful control at T1, and stressors at T1) predicted depressive symptoms at T2. Predictor variables were centered to minimize multicollinearity, and interaction terms were formed as the product of the centered predictors (Aiken & West, 1991). Depressive symptoms at T1 were entered in Step 1 to enable prediction of residual change in depressive symptoms over time (from T1 to T2). Negative affectivity, effortful control, and stressors at T1 were entered in Step 2 to determine main effects of risk factors. Cross-product terms for all pairs of risk factors were

entered in Step 3 to examine two-way interactions between risk factors. Finally, the cross-product term for all three risk factors was entered in Step 4 to determine the three-way interaction between risk factors. The second hypothesized model tested if the proposed risk factors predicted anxious symptoms. To analyze this model, the same steps were used as in the first model; however, the regressions included anxious symptoms at T1 and T2 instead of depressive symptoms.

We also tested whether gender moderated the associations among temperament stress, and symptoms in both hypothesized models and then separately tested whether grade also moderated the associations in both models. Main effects for either gender or grade were entered in Step 2, cross-product terms for all pairs of risk factors and either gender or grade were entered into Step 3, cross-product terms for all triples of risk factors and either gender or grade were entered into Step 4, and the cross-product term for all four risk factors were entered in Step 5 to determine the four-way interaction between risk factors and either gender or grade.

Depression

To test the negative affectivity x effortful control x stress interaction as a predictor of prospective changes in depressive symptoms, we first included both grade and gender as possible moderators of the three-way interaction. Neither grade nor gender moderated this three-way interaction, so these higher order interactions were removed. Analyses (Table 2) revealed the predicted significant negative affectivity x effortful control x stress interaction. The three-way interaction was interpreted in post-hoc analysis by examining simple slopes describing negative affectivity's association with depressive symptoms at the four combinations of high and low levels of effortful control and stress (±1 SD). Following the Bonferroni procedure, alpha was set at .0125 for these four tests. The predicted lines are shown in Figure 1 along with estimates of the simple slopes. The pattern of the three-way interaction was such that at low levels of stress, negative affectivity was not related to significant changes in depressive symptoms at T2 for those who were either low or high on effortful control. At high levels of stress, negative affectivity was also not linked to significant changes in symptoms for those who were low on effortful control. However, at high levels of stress, negative affectivity was related to a significant increase in symptoms for those who were high on effortful control. Taken together, these results suggest that effortful control does not buffer against the synergistic effect of both high negative affectivity and high levels of stress on depressive symptoms.

We further tested this model by replacing overall stress with dichotomized dependent and independent stress items of the ALEQ, respectively. The negative affectivity x effortful control x dependent stress interaction as a predictor of prospective changes in depressive symptoms was not significant. Analyses (Online Resource 1) showed that the negative affectivity x effortful control x independent stress interaction was significant. The three-way interaction was interpreted in post-hoc analysis by examining simple slopes describing negative affectivity's association with depressive symptoms as described above with overall stress. The predicted lines are shown in Online Resource 1 along with estimates of the

simple slopes. The pattern of results for independent stress was consistent with the pattern of results for overall stress described above.

Anxiety

As with the first model, we tested the negative affectivity x effortful control x stress interaction as a predictor of prospective changes anxious symptoms. Neither grade nor gender moderated the three-way interaction, so the higher order interactions were removed. Analyses (Table 3) revealed that the negative affectivity x effortful control x stress interaction was significant. The three-way interaction was interpreted in post-hoc analysis by examining simple slopes describing negative affectivity's association with anxious symptoms. The predicted lines are shown in Figure 2 along with estimates of the simple slopes. The pattern of the three-way interaction showed some similarities to that of depressive symptoms, but also some differences. At low levels of stress, negative affectivity was related to a significant increase in anxious symptoms at T2 for those who were low on effortful control. In contrast, negative affectivity was not related to a significant change in symptoms for those who were high on effortful control. At high levels of stress, negative affectivity was not linked to changes in symptoms for those who were low on effortful control. However, at high levels of stress, negative affectivity was related to a significant increase in symptoms for those who were high on effortful control. Post-hoc probing revealed that the difference between low and high effortful control groups at high levels of negative affectivity and high levels of stress was not significant. These results suggest that youth who are high on negative affectivity experience some buffering effects against the development of anxious symptoms at low levels of stress if they are also high on effortful control. However, as in the previous model predicting depressive symptoms, at high levels of stress, effortful control does not buffer against the synergistic effect of high negative affectivity and high levels of stress on anxious symptoms.

We further tested this model by replacing overall stress with dichotomized dependent and independent stress items of the ALEQ, respectively. As with depressive symptoms, the negative affectivity x effortful control x dependent stress interaction as a predictor of prospective changes in anxious symptoms was not significant. Analyses (Online Resource 1) showed that the negative affectivity x effortful control x independent stress interaction was significant. The three-way interaction was interpreted in post-hoc analysis by examining simple slopes describing negative affectivity's association with anxious symptoms. The predicted lines are shown in Online Resource 1 along with estimates of the simple slopes. The pattern of results for independent stress was consistent with the pattern of results for overall stress described above.

Discussion

Rothbart's theory of temperament (Rothbart & Rueda, 2005) proposes that individual differences in affective reactivity (e.g., negative affectivity) and self-regulation (e.g., effortful control) are related to internalizing psychopathology in youth, however no study has examined how stressful life events may moderate this relationship. Investigating the role of stress in the relationship between temperament and internalizing symptoms makes a key

contribution to extant understanding of how individual vulnerabilities operate in the context of the environment to increase risk for psychopathology in youth. The current study found that for youth with high levels of negative affectivity experiencing low levels of stress, effortful control served as a protective factor against elevations in internalizing symptoms. Yet, at high levels of stress, effortful control did not suffice as a protective factor for youth who were also high on temperamental negative affectivity.

The current study is the first to provide evidence showing that the relationship between negative affectivity and effortful control differs at low and high levels of stress. These findings highlight the importance of integrating both reactive and regulatory dimensions of youth temperament in elucidating the link between stress and youth psychopathology. Specifically, at low levels of stress, negative affectivity was linked to a significant increase in anxious, but not depressive symptoms, for those who were low on effortful control. It seems logical that youth with low levels of effortful control would not be able regulate enhanced negative affectivity and would experience helplessness and uncertainty, two key cognitive components linked to anxious distress (Mineka, Watson, & Clark, 1998). However, it is less likely that low levels of stress would be sufficient to trigger the development of hopelessness and negative outcome expectancies, which are unique characteristics of depression (Mineka et al., 1998). Negative affectivity was not related to significant changes in depressive and anxious symptoms for those who were also high on effortful control, which suggests a buffering effect against elevations in internalizing psychopathology, at least at lower stress levels.

At high levels of stress, negative affectivity was related to a significant increase in both depressive and anxious symptoms for youth who were typically high on effortful control. The finding that typically high levels of effortful control did not buffer the relationship between high levels of negative affectivity and internalizing symptoms at high levels of stress may seem counterintuitive given the temperament literature, however we believe that it is consistent with the cognitive neuroscience literature and also with a separate body of research on ego depletion from social psychology (e.g., Baumeister, Vohs, & Tice, 2007). In other words, youth with typically high levels of effortful control are accustomed to employing effective coping strategies to regulate their emotional distress. High levels of stress may undermine typically high levels of effortful control. At high levels of stress, these youth may therefore be at a particular disadvantage when effortful control is disrupted and they can no longer effectively cope. Without the ability to employ their usual and habitual coping strategies, these youth are at an increased risk for the development of depressive and anxious symptoms. Thus, integrating together our findings at low and high levels of stress, whereas youth with typically high effortful control are able to protect themselves from developing internalizing symptoms at low levels of stress, they are precluded from doing so at high levels of stress.

We also found that at high levels of stress, negative affectivity was not related to changes in depressive and anxious symptoms among youth who were already typically low on effortful control. This finding was unexpected and inconsistent with our second hypothesis. We had posited that in the context of high levels of stress, there would be no difference in the relationship between negative affectivity and internalizing symptoms among youth who are

typically low versus typically high on effortful control. Instead, we found no relationship between negative affectivity and internalizing symptoms for youth who are already typically low on effortful control. We reasoned that youth with typically low effortful control have very few effective coping strategies to regulate their emotional distress. Unlike youth with typically high levels of effortful control, those with low effortful are therefore not any worse off at high levels of stress. That being said, youth with low effortful control would not be able to regulate emotional distress, regardless of levels of negative affectivity. Future studies should further investigate the relationship among negative affectivity and low effortful control in the context of high levels of stress.

Findings are consistent with a body of literature that includes both animal and human subjects demonstrating the deleterious effect of stress on effortful control via neurobiological mechanisms (Holmes & Wellman, 2009; Lupien, McEwen, Gunnar, & Heim, 2009). Prolonged exposure to stress leads to structural changes in neurons within the prefrontal cortex (Lupien et al., 2009), as well as functional changes (Liston et al., 2009). This has important implications for effortful control, as the prefrontal cortex plays an integral role in effortful control processes (Holmes & Wellman, 2009). For example, morphological changes in the prefrontal cortex as a result of stress are associated with behavioral deficits in cognitive control, including impaired ability to sustain or switch attention, inhibit prepotent responses, and update the contents of working memory (Holmes & Wellman, 2009). It can be inferred that morphological changes in the prefrontal cortex as a result of stress may make it more difficult for individuals to engage in cognitive control process. In the context of the current study, youth who are typically high on effortful control may be unable to employ these processes to regulate the physiological and emotional arousal triggered by high levels of stress, and therefore experience increases in depressive and anxious symptoms over time. Unlike high levels of stress, low levels of stress, however, may not lead to structural and functional changes in the prefrontal cortex, and so effortful control abilities are maintained. As such, youth with high levels of negative affectivity and high effortful control will be able to utilize coping strategies supported by effortful control to mitigate their physiological and emotional arousal, and consequently will be protected against increases in depressive and anxious symptoms over time.

In addition, the current study found that the interaction of negative affectivity and effortful control was significantly moderated by both overall stress and independent stress, but not dependent stress (Online Resource 1). The particular finding that independent stress moderated the association between temperament and youth psychopathology is consistent with other findings in the cognitive neuroscience literature (e.g., Henderson et al., 2012), which found that uncontrollable (i.e., independent) noise stressors compromised performance on a cognitive control task. In a similar manner, independent stressors (i.e., stressors that are out of an individual's control) might compromise effortful control and therefore affect the ability to utilize effective coping strategies in the face of these independent stressors.

The current study has a number of methodological strengths that help to advance knowledge of the interplay between temperament and stressful life events and associations with internalizing psychopathology. Using a two time-point prospective longitudinal design lends

support to the notion that certain characteristics of temperament (e.g., high negative affectivity and low effortful control) may act as risk factors that interact with stress to predict increases in internalizing symptoms over time. Furthermore, the use of a two time-point prospective design eliminated the concern that associations between negative affective reactivity and internalizing symptoms were confounded by item-content overlap, as baseline symptoms were controlled for in the analysis. In addition, prior studies have only examined the link between temperament and internalizing symptoms broadly defined, without distinguishing between two types of internalizing symptoms (i.e., depression and anxiety). The use of separate questionnaires to distinguish between changes in depressive versus anxious symptoms contributes to a growing area of research focusing on a transdiagnostic approach to studying risk for psychopathology (see McLaughlin & Nolen-Hoeksema, 2011). Finally, the association between temperament, stress, and internalizing symptoms was found in a large, ethnically diverse community sample of youth across two separate sites. The findings are likely generalizable to a variety of youth populations, as results did not differ by grade and gender.

One limitation of the current study is the use of parent-report questionnaires for all variables. It is possible that the associations among temperament, stress, and internalizing symptoms are inflated by shared informant and method variance. Future studies would benefit from the use of multiple reporters, including child self-report, as well as parent and teacher report (see Eisenberg et al., 2001 for an example), as research has shown that different informants do not always agree (De Los Reyes & Kazdin, 2005). In order to address the issue of method variance, future studies would benefit from the use of observational measures or experimental tasks to assess affective reactivity and self-regulation in conjunction with questionnaire methods (e.g., Hayden, Klein, & Durbin, 2005). Additionally, future studies could incorporate more objective measures of stress (e.g., Hammen, Henry, & Daley, 2000).

The findings of the current study extend extant understanding of the interplay between reactive and regulatory dimensions of temperament, however gaps in knowledge remain. A key area for future investigation is identifying mediating mechanisms (e.g., maladaptive emotion regulation strategies) linking temperamental vulnerabilities and stress to internalizing psychopathology. For instance, rumination mediated the link between high levels of negative affectivity and depressive symptoms, and this relationship was stronger among individuals with low levels of effortful control (Verstraeten, Vasey, Raes, and Bijttebier, 2009).

In conclusion, the current study extends the literature surrounding temperamental vulnerabilities and youth internalizing symptoms by demonstrating the important differential effects that occur in the context of high versus low stress. More specifically, self-regulatory aspects of temperament protect against increases in both depressive and anxious symptoms for youth with high levels of negative affectivity, but only in the context of low levels of stress. In the context of high levels of stress, effortful control does not serve as a buffer for the relationship, and youth with high levels of negative affectivity are likely to experience high levels of depressive and anxious symptoms even if they are typically high on effortful control.

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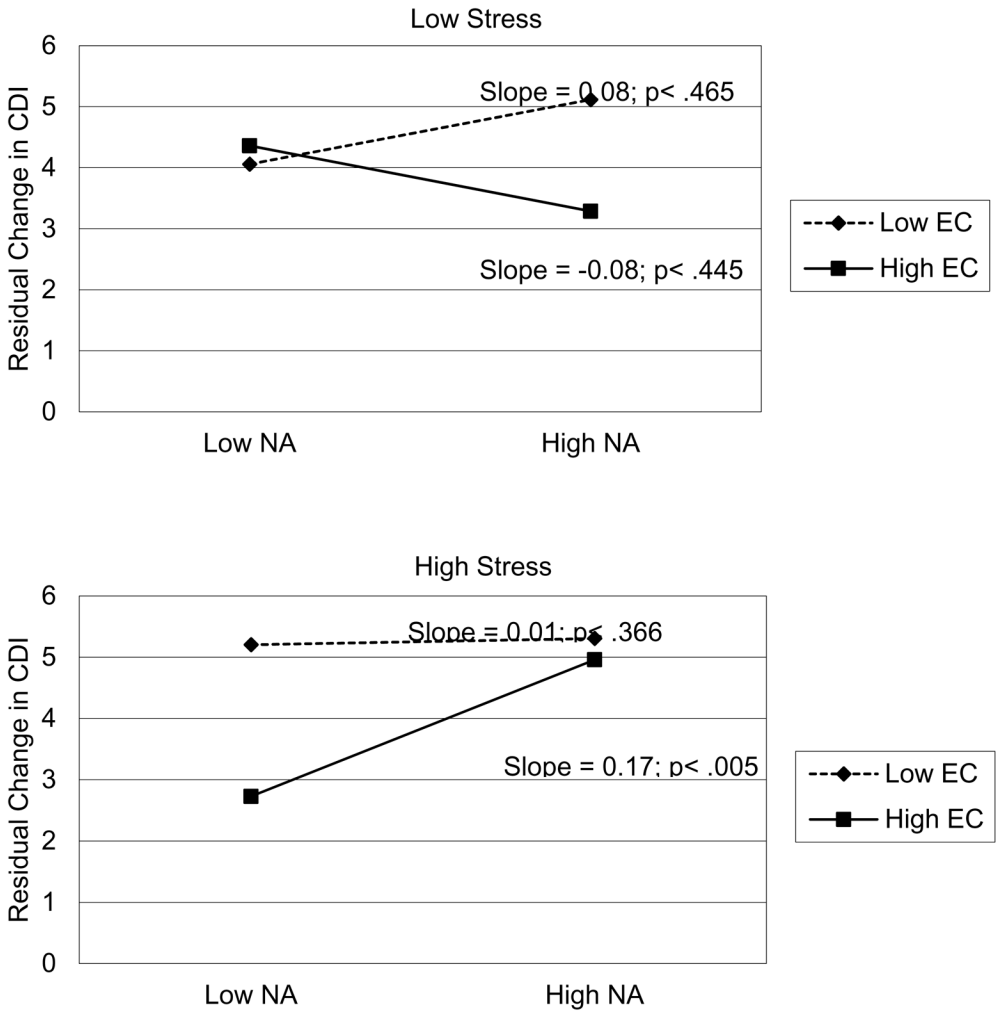

Figure 1.

NA x EC interaction predicting residual changes in depressive symptoms at T2 at low and high levels of overall stress

Figure 1. NE and EC interact with Stress to predict changes in depressive symptoms at T2. CDI Children's Depression Inventory; NA Negative Affectivity from the Positive and Negative Affect Schedule-Child Version; EC Effortful Control from the Early Adolescent Temperament Questionnaire; STRESS; Number of Stressors endorsed on the Adolescent Life Events Questionnaire;

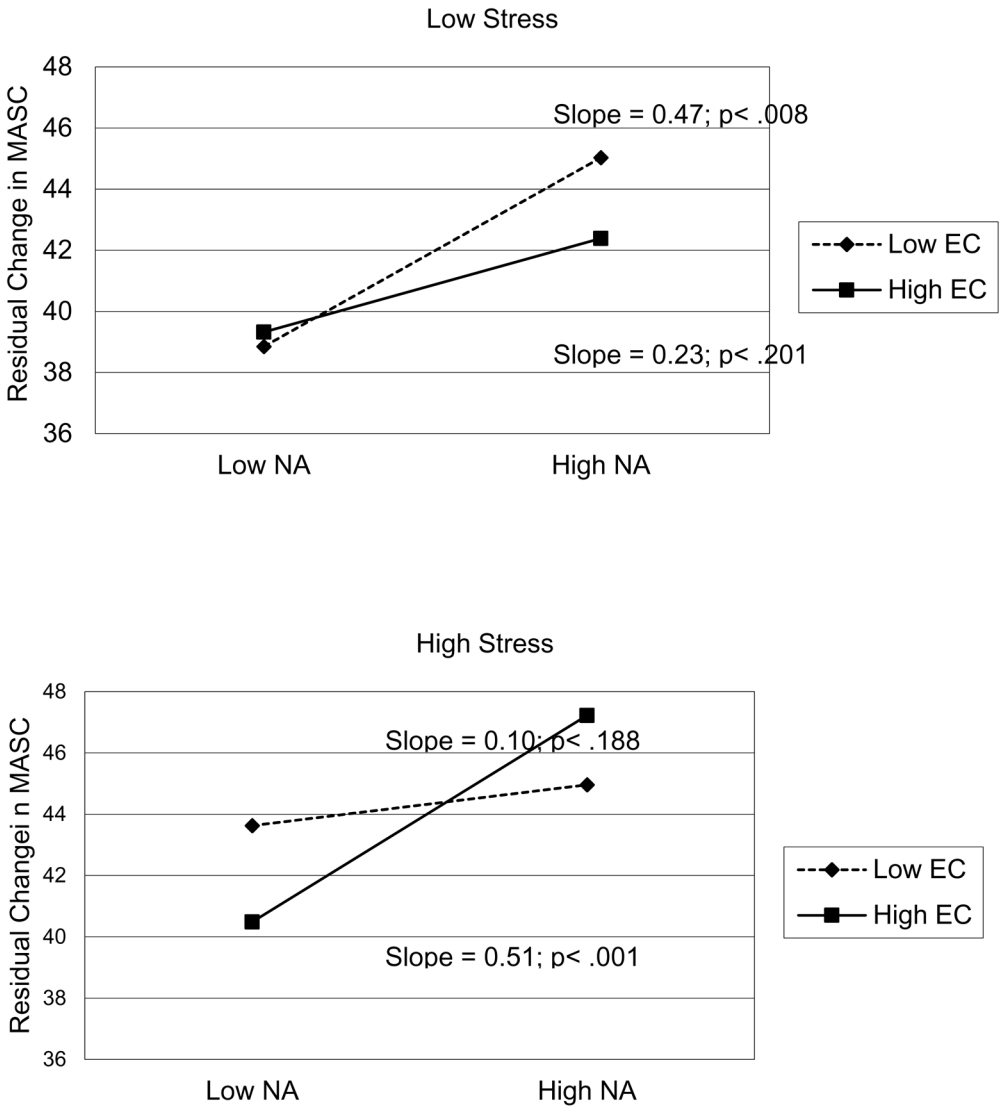

Figure 2.

NA x EC interaction predicting residual changes in anxious symptoms at T2 at low and high levels of overall stress

Figure 2. NE and EC interact with Stress to predict changes in anxious symptoms at T2. MASC Multidimensional Anxiety Scale for Children; NA Negative Affectivity from the Positive and Negative Affect Schedule-Child Version; EC Effortful Control from the Early Adolescent Temperament Questionnaire; STRESS; Number of Stressors endorsed on the Adolescent Life Events Questionnaire

Table 1

Means, standard deviations, and inter-correlations between all variables

	1	2	3	4	5	6	7	8	9
1. CDI_T1	-								
2. MASC_T1	.348**	-							
3. NA	.505**	.330**	-						
4. EC	−.498**	−.202**	−.317**	-					
5. STRESS	.355**	.277**	.355**	−.371**	-				
6. CDI_T2	.577**	.228**	.342**	−.350**	.263**	-			
7. MASC_T2	.290**	.598**	.330**	−.207**	.301**	.378**	-		
8. GRADE	−.018	−.174**	−.144**	.100**	.194**	.044	−.181**	-	
9. GENDER	−.058	.097*	.054	.189**	.084*	−.033	.115**	.026	-
Mean	4.89	41.01	20.80	59.83	14.92	4.47	42.85	6.07	1.56
SD	5.25	13.21	6.58	10.89	7.43	4.78	15.30	2.39	.497

** Correlation is significant at the .01 level (2-tailed)

* Correlation is significant at the .05 level (2-tailed)

CDI Children's Depression Inventory; MASC Multidimensional Anxiety Scale for Children; NA Negative Affectivity from the Positive and Negative Affect Schedule-Child Version; EC Effortful Control from the Early Adolescent Temperament Questionnaire; STRESS; Number of Stressors endorsed on the Adolescent Life Events Questionnaire; GRADE Children's grade; GENDER; Children's gender (1=Boy; 2=Girl)

Table 2

Depression regression analysis with overall stress

Model	R^2	ΔR^2	Unstandardized B at Final Step	Standardized B at Final Step	SE at Final Step
Step 1	.321				
Constant			4.378***		.177
CDI_T1			.439***	.477***	.041
Step 2	.331	.010			
NA			.044	.061	.032
EC			−.050**	−.117**	.018
Stress			.023	.036	.025
Step 3	.335	.004			
NA x EC			.000	.007	.002
NA x Stress			.006	.071	.004
EC x Stress			−.002	−.035	.02
Step 4	.340	.005			
NA x EC x Stress			.001*	.097*	.000

*** p < .001,

** p < .01,

* p < .05

CDI Children's Depression Inventory; NA Negative Affectivity from the Positive and Negative Affect Schedule-Child Version; EC Effortful Control from the Early Adolescent Temperament Questionnaire; STRESS; Number of Stressors endorsed on the Adolescent Life Events Questionnaire

Table 3

Anxiety regression analysis with overall stress

Model	R^2	ΔR^2	Unstandardized B at Final Step	Standardized B at Final Step	SE at Final Step
Step 1	.363				
Constant			42.737***		.480
MASC_T1			.528***	.525***	.036
Step 2	.388	.025			
NA			.329***	.160***	.086
EC			−.035	−.029	.046
Stress			.180*	.099*	.069
Step 3	.393	.005			
NA x EC			.004	.022	.007
NA x Stress			−.003	−.010	.010
EC x Stress			.002	.012	.006
Step 4	.397	.004			
NA x EC x Stress			.002*	.089*	.001

*** p < .001,

** p < .01,

* p < .05

MASC Multidimensional Anxiety Scale for Children; NA Negative Affectivity from the Positive and Negative Affect Schedule-Child Version; EC Effortful Control from the Early Adolescent Temperament Questionnaire; STRESS; Number of Stressors endorsed on the Adolescent Life Events Questionnaire;