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Anxious and Depressive Symptomatology Among Male Youth: The Joint and Interactive Contribution of Temperament and Executive Functioning

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Abstract

Few studies have investigated the combined effects of temperament and executive functioning (EF) on anxious and depressive symptomatology in youth. The current study is the first to investigate the joint and interactive contribution of mother- and youth self-reported affective dimensions of temperament and EF to the explanation of anxious and depressive symptomatology. Participants included 174 adolescent males (M_{age} = 13.6 ± 1.35). Results confirmed the joint and interactive contribution of temperament in the explanation of anxious and depressive symptomatology. Further, EF contributed to the explanation of anxious/depressive symptomatology via interaction with youth-, but not mother-reported, temperament; it was not a unique predictor. Results support the need to consider *both* affective dimensions of temperament *and* EF in etiological models of anxious and depressive symptomatology, which has implications for identifying at-risk youth and developing early intervention and targeted problem-specific prevention programs.

Keywords

Anxiety; Depression; Youth; Tripartite model; Temperament; Executive functioning

Introduction

Anxiety and depression have a significant impact on a large number of youth: Approximately 10–20 % of youth experience anxiety and/or depression at some point during

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their development [1, 2]. Additionally, anxiety and depression are among the most common comorbid disorders in youth with estimated comorbidity rates ranging from 10 to 75 % depending on the age of onset and type of affective psychopathology studied (e.g., [2, 3]). Further, anxious and depressive symptomatology in youth has been found to represent an increased risk for the recurrence of anxiety or depression across the life span. Moreover, youth anxiety and depressive symptomatology prospectively predicted more severe forms of psychopathology in adulthood, including bipolar disorders [4], substance use disorders, and suicidal behaviors [1, 5]. Taken together, the empirical literature is unequivocal concerning the detrimental developmental, psychosocial, and psychopathological consequences of untreated anxious and depressive symptomatology in youth. Thus, understanding etiological mechanisms associated with this symptomatology in youth is critical for guiding research to the development of early intervention and targeted problem-specific prevention programs [1, 6].

Although rarely examined in concert, affective dimensions of temperament and executive functioning (EF) have both emerged as potential etiological mechanisms associated with anxious and depressive symptomatology. Specifically, with regard to temperament, the tripartite model reveals that the broad, higher order affective dimensions of negative and positive temperament (NT and PT, respectively) represent the core temperamental features underlying symptoms of anxiety and depression [7]. As described in more detail below, the tripartite model has considerable empirical support for anxious and depressive symptomatology. Additionally, a smaller nascent body of work has shown that impairments in EF are also associated with youth anxious and depressive symptomatology [8–11]. Surprisingly, however, few studies to date have investigated the combined effects of temperament and EF on anxious and depressive symptomatology. With the eventual goal of better understanding etiological mechanisms associated with the development of anxiety and depression, the current study examined the contribution of the two major dimensions of affective temperament and neuropsychological indicators of task-based EF, both jointly and interactively, in explaining symptoms of anxiety and depression among youth. Because the extant literature suggests there may be sex differences in the mechanisms associated with internalizing problems (e.g., [12]), sex-segregated studies are needed; therefore, we investigated only male youth.

Temperament and Anxious and Depressive Symptomatology

Temperament refers to individual differences in patterns of emotional and behavioral reactivity and self-regulation that emerge early in life and exhibit relative stability over time and situations. Temperament traits describe individual tendencies, dispositions, and capacities that influence individuals' adaptation or maladaptation to the environment throughout life [13–15]. As previously mentioned, two broad, higher-order dimensions of temperament, namely NT and PT, are fundamentally affective. NT refers to a tendency for negative emotional and behavioral reactivity, including fear, sadness, and anger, whereas PT refers to a propensity for positive affective experience, including joy, interest, and excitement, as well as reward sensitivity and sociability [13, 14].

The tripartite model asserts that both anxiety and depression are characterized by high levels of NT, whereas depression, but generally not anxiety, is associated also with low levels of PT [7]. Large bodies of cross-sectional and longitudinal studies of adults (e.g., [16]) and youth (e.g., [17–20]) have provided considerable empirical support for these distinct relations. Further, in a more recent study of inpatient youth with comorbid externalizing and anxiety or depression, NT evidenced significant associations with both depression and various anxiety disorders (e.g., general anxiety disorder [GAD], social anxiety disorder, panic disorder), whereas the combination of high NT and low PT was more consistently associated with depression [21]. Similarly, in a prospective study of community youth, Lonigan et al. [20] found that NT was associated with changes in symptoms of both depression and anxiety, whereas PT was more strongly associated with changes in symptoms of depression 7 years later. Collectively, the extant literature strongly supports the tripartite model across clinical and non-clinical samples of adults and youth in the explanation of anxious and depressive symptomatology.

Executive Functioning and Anxious and Depressive Symptomatology

Executive functioning reflects a set of higher order cognitive processes associated largely, although not entirely, with the prefrontal cortex, that control a wide range of neuropsychological and cognitive abilities, including decision making, planning, problem solving, attentional flexibility, inhibitory control, and working memory [22–24]. Most commonly, EF has been examined with regard to externalizing behaviors, with considerable research finding significant associations between executive dysfunction and the development and maintenance of a range of behavioral disorders including antisocial behaviors, substance use, and attention deficit/hyperactive disorder [25, 26].

In recent years, a growing body of neuropsychological research has also found EF deficits to be associated with anxiety and depression. For example, both individual studies [27, 28] and a recent meta-analysis [29] have demonstrated positive associations between adult depression and impairments in various abilities subsumed under the EF umbrella. Many fewer studies have investigated associations between EF and depression among youth. Among those that have, similar conclusions regarding the importance of considering EF in investigations of depression have emerged. For example, youth with (vs. without) depression evidence difficulties with task initiation, attentional deficits, and slower response time when performing various neuropsychological tasks [8], as well as significant deficits in working memory, cognitive inhibition, and processing speed (for a comprehensive review, see [10]). Thus, a converging literature in both adult and youth samples suggests negative associations between EF and depressive symptoms.

With regard to anxiety, as compared to the literature on depression, many fewer studies have examined associations with EF. Among those that have, results are equivocal, perhaps as a result of foci on various specific forms of anxiety-related psychopathology [e.g., panic disorder, obsessive–compulsive disorder (OCD)]. For example, across a range of *DSM-IV* anxiety disorders, Airaksinen et al. [30] found that whereas adults meeting diagnostic criteria for panic disorder and OCD exhibited significantly lower attentional capabilities than

did healthy controls, those diagnosed with GAD and specific phobia did not exhibit EF deficits.

Although similarly limited, studies among youth also collectively suggest negative associations between EF and anxiety. For example, Günther and colleagues [31] found that, compared to healthy controls, youth diagnosed with GAD, separation anxiety disorder, and social phobia exhibited poor verbal working memory and difficulty sustaining attention, two indicators of EF. Further, youth diagnosed with (vs. without) OCD were found to perform more poorly on tests of cognitive flexibility, verbal comprehension, and visuospatial abilities [32]. Thus, although the adult literature is largely equivocal, as noted above, the few studies that have examined associations between EF and anxiety in youth generally converge on negative associations.

Temperament and EF

Whereas converging research has confirmed the role of temperament and EF in relation to anxiety and depression, relations between EF and affective dimensions of temperament are more equivocal, particularly with regard to NT. PT-related dimensions have been found to be positively associated with verbal fluency [33], verbal working memory, problem-solving [34, 35], and cognitive flexibility, as well as with increased distractibility [36]. However, with regard to NT-related dimensions, the few studies have found consistent associations with EF, with the exception of a positive association with visual spatial memory [37, 38].

As noted earlier, only a single study to date has examined the role of child temperament and EF on child anxiety: parent-reported shifting, a single dimension subsumed under executive functioning, mediated the effect of parent-reported fear temperament, a NT-related dimension, on anxiety among 7-to-10-year-old children [39]. To date, research has yet to consider task-based neuropsychological assessments in such investigations. Given the relative lack of research concerning associations among neuropsychological indicators of EF and affective dimensions of temperament, consideration of the extant literature that has examined associations between temperamental traits (i.e., NT and PT), and effortful control (EC), which overlaps with EF both conceptually and empirically [40–42], may help to explicate a pattern of associations.

Effortful control refers to the ability to inhibit a dominant, prepotent response to perform a subdominant, less salient response and to detect errors [43] and, as noted above, is thought to share common features, such as attentional focus and inhibitory control, with broad, higher order cognitive processes of EF [44, 45]. The tripartite model underscores the importance of considering the way in which associations between temperament dimensions and anxious and depressive symptomatology may be moderated by a third variable [7, 46–48]. Consistent with this view, the extant literature that investigated two-way interactions between affective dimensions of temperament and EC has found that EC moderates the effect of both NT and PT in relation to anxiety and depression (e.g., [49–53]), indicating the potential moderating role of EF in the association between temperament and anxious and depressive symptomatology.

Taken together, the extant literature highlights the importance of investigating the joint and interactive contribution of the core underlying processes of EF and affective dimensions of temperament in service of advancing our understanding of etiological mechanisms associated with anxiety and depression. Knowledge of how EF moderates the interplay between NT and PT, both with established links to symptoms of anxiety and depression, will contribute to a better understanding of risk factors associated with anxiety and depression.

Current Study

In the present study, we report the results of the first investigation to date of triangular relations among task-based neuropsychological indicators of EF, two affective dimensions of temperament, and anxiety and depressive symptoms within a community sample of adolescent males. Given the relative lack of task-based measures of EF used in previous research, a clear strength of the current study is our use of a widely used task-based neuropsychological assessment tapping a range of EF subdimensions. Consistent with the tripartite model [7], it was expected that NT would be positively associated with both anxiety and depressive symptoms, whereas PT would be negatively correlated with depression. We further expected that PT would moderate the effect of NT on depressive symptoms. That is, it was expected that the individuals with both higher levels of NT and lower levels of PT would show increased depressive symptoms above and beyond the additive effects of the temperament dimensions. Additionally, consistent with the literature reviewed, it was hypothesized that anxiety and depressive symptoms would be negatively associated with EF.

In a more exploratory set of analyses, we investigated the interactive relations of EF and affective dimensions of temperament with anxiety and depressive symptoms. Given the dearth of research examining three-way interactions among EF, NT, and PT in the explanation of anxiety and depression, our a priori hypotheses were tentative. Nonetheless, drawing from literature examining two-way interactions between EC and NT or PT in association with anxiety and depression (e.g., [49–53]), we hypothesized that PT and EF together would explain associations between NT and anxiety and depressive symptoms above and beyond their additive effects.

Methods

Participants

Participants were a community sample of 174male youths and their mothers who participated in the Iowa Youth Development Project (I-YDP), a larger study of developmental factors associated with social behaviors in male adolescents. Three youth did not complete all of the measures, resulting in a final sample of 171 for youth-reported data. Participants were predominantly White adolescent males aged 11–16 years (M_{age} = 13.6 ± 1.35; 87.9 % White) and their mothers (M_{age} = 44.2 years; 93.1 % White). The families were relatively high in socioeconomic status in terms of education and income, with 34.1 % exceeding an annual combined household income of $100,000. Further, most mothers were married to their son’s biological fathers (81.0 %), had achieved college or post-graduate education (71.9 %), and were employed full-time (93.7 %).

Procedure

The I-YDP used multiple recruiting methods to obtain a sample of Midwestern male youth; participants were recruited from a child participant database maintained at the University of Iowa Psychology department, as well as through fliers distributed in the community, advertisements placed in newsletters, and on-line advertisements in the affiliated university hospital. To ensure a typically developing sample, exclusion criteria were: intellectual disability, autism spectrum disorder, reading disorder, a history of being held back a grade, neurological disorders, past head injury requiring hospitalization, and life-threatening medical illness, all assessed by maternal report. Participants provided informed consent/assent before beginning the study procedures and were compensated monetarily for their time. The University's Institutional Review Board approved all study protocols and materials.

Measures

Child Behavior Checklist (CBCL) [54]—Mothers reported on their son's anxious and depressive symptomatology using CBCL, a 118-item instrument rated on a 0 (not true) to 2 (very true or often true) scale. Consistent with the tripartite model [7], in the factor analyses on which CBCL syndrome scales are based, affective problems load onto a combination of withdrawal and depression versus anxiety and depression, rather than forming a depression versus anxiety factor [54]. Nonetheless, factor analyses have shown that the withdrawn/depressed scale primarily measures more depressive symptomatology, whereas the anxious/depressed scale assesses more anxious aspects of negative affectivity [54]. The current study therefore used the withdrawn/depressed (W/D) and the anxious/depressed (A/D) scales to measure symptoms of depression and anxiety, respectively. Given our use of a non-clinic, community sample expected to evidence a largely non-pathological range of anxious and depressive symptomatology, and as suggested for analyzing syndrome scales [54], raw scores were used in calculating scaled scores. Indeed, mean levels of both mother-reported anxious and depressive symptoms were nearly identical to levels reported in the technical manual for similar-aged community samples (e.g., [54]). The CBCL has shown acceptable internal consistencies (αs = .84 and .80 for the A/D and W/D, respectively) and strong test–retest reliability (rs = .82 and .89 for the A/D and W/D, respectively) over an average interval of 8 days. The CBCL has also reported appropriate content and criterion validity with regard to related questionnaires [54]. In the current sample, internal consistency reliabilities (Cronbach's alphas) and average interitem correlations (AICs) were .81 and .23 for the A/D and .80 and .35 for the W/D scales, respectively.

Youth Self-Report (YSR; [54])—Youth reported on their own anxiety and depression symptoms using YSR, a 112-item youth-report companion version of the CBCL. Consistent with the CBCL, the A/D and W/D scales were used to assess symptoms of anxiety and depression, respectively. Consistent with CBCL data and with published research recommendations (i.e., [54]), raw scores were used when calculating syndrome scales in the YSR. Further, as with the CBCL, mean levels of son-reported anxious and depressive symptoms were nearly identical to levels reported in the technical manual for similar-aged community samples [54]. The YSR has shown good internal consistency (αs = .84 and .71 for the A/D and W/D, respectively) and strong test–retest reliability (r = .74 and .67 for the

A/D and W/D, respectively) over an average interval of 8 days. The YSR has reported content and criterion validity with related questionnaires [54]. In the current sample, internal consistency reliabilities (Cronbach's alphas) and AICs were .75 and .20 for the A/D and .70 and .24 for the W/D scales, respectively.

Schedule for Nonadaptive and Adaptive Personality—Youth (SNAP-Y) [55, 56]—Youth reported on their own temperament traits using SNAP-Y, a 390-item true–false format, factor analytically derived, self-report instrument that assesses trait dimensions of personality from the normal to the pathological range. The SNAP-Y has three broad temperament-trait scales (NT, PT, and disinhibition vs. constraint), the first two of which are the affective dimensions of temperament used in the current study. The SNAP-Y scales have shown strong internal consistencies (αs for NT and PT = .89 and .86, respectively in a sample of 364 youths aged 12–18 years) and have demonstrated strong convergent and discriminant validity with other self-reported and interview-based measures of personality [56]. In the current sample, internal consistency reliabilities (Cronbach's alphas) and AICs were .89 and .24 for NT and .87 and .20 for PT, respectively.

Schedule for Nonadaptive and Adaptive Personality—Other Report Form (SNAP-ORF) [57]—Mothers reported on their son's temperament traits (i.e., NT and PT) using the SNAP-ORF, an alternate-format version of the SNAP consisting of 33 items, with each item composed of two brief paragraphs describing the high and low ends of a SNAP scale subcomponent. Respondents rate targets' usual personality, that is, what targets are like most of the time, using a six-point Likert-type scale, ranging from "Very Much Like" the low end of the trait to "Very Much Like" the high end of the trait. The SNAP-ORF NT and PT scales have shown acceptable to high internal consistency for these very brief scales, as well as high interparental reliability in an undergraduate-student sample ([57]; M αs and AICs = .71/.45 for NT and .59/.45 for PT; interparent agreement r = .62 for both scales), as well as in a sample of middle- and high-school students ([58]; αs and AICs = .75/.50 and .67/.50 for NT and PT, respectively; interparent agreement rs = .45 and .59 for NT and PT, respectively). In the current sample, internal consistency reliabilities (Cronbach's alphas) and AICs were .73 and .67 for NT and .53 and .45 for PT, respectively.

Delis–Kaplan Executive Functions System (D–KEFS) [59]—Youth were administered the D–KEFS, a standardized assessment of executive functions in individuals between 8 and 89 years. The D–KEFS consists of various tasks that have demonstrated sensitivity in the detection of frontal-lobe dysfunction. It is the first set of EF tasks co-normed on a large and representative national sample designed exclusively for the assessment of EF. Eight of the D–KEFS tests have been standardized and normed for use with youth: (1) Trail Making Test, (2) Verbal Fluency Test, (3) Design Fluency Test, (4) Color-Word Interference Test, (5) Sorting Test, (6) Twenty Questions Test, (7) Word Context Test, and (8) Tower Test (for a full description of each test, see Delis et al., 2001). The D–KEFS has considerable research support for its general validity and internal consistency reliability, as well as test–retest reliability across two testing sessions [59]. Consistent with structural findings suggesting that various EF subdimensions load onto a single, common EF factor [60], as well as previous studies using a single, composite EF score (e.g., [61, 62], the

15 standard Achievement scores that emerge from the 8 D–KEFS tests were standardized (i.e., z-scored) and aggregated to form a single EF composite score used in the present study. In the current sample, the internal consistency reliability (i.e., Cronbach's alpha) and AIC for the composite EF score was .82 and .23, respectively.

Analyses

The multiple imputation program in SAS Version 9.1 was used to impute missing items for all participants, as none had more than 10 % of items missing. This approach uses maximum likelihood estimates for missing data and includes a random error component to prevent artificial inflation of item inter correlations.

First, zero-order correlations were calculated to examine the bivariate associations among affective dimensions of temperament (i.e., NT, PT), EF, and anxious and depressive symptomatology. Then, hierarchical multiple regression analyses were performed to examine how temperament and EF jointly and interactively explained anxious and depressive symptomatology. To directly examine the contribution of temperamental dimensions interactively, a NT × PT interaction term was created as were two temperament-by-EF terms: NT × EF and PT × EF. Lastly, a three-way NT × PT × EF product term was calculated. All variables were standardized (using z-scores) before calculating the interaction terms. Given the relatively wide age range of the sample, and known associations between age and anxious and depressive symptomatology, age was included in Step 1 as a covariate in all regression analyses. The remaining variables were entered into the hierarchical regression in the following order: Step 2, NT and PT; Step 3, the NT × PT interaction term; Step 4, EF; Step 5, the NT × EF and PT × EF interaction terms; and Step 6, the three-way NT × PT × EF interaction term. To probe the effect of any significant interactions, simple slopes analyses were conducted.

Of note, ratings from multiple informants consistently evidence low convergent correlations across multiple psychopathological symptoms in youth, particularly with regard to anxious and depressive symptomatology [63, 64]. As context is important in youth assessment, the use of multiple informants, each with their own unique perspective, captures a more comprehensive and accurate picture of youth psychosocial functioning, which may vary across different settings (e.g., home, school; [65]). Indeed, the use of multi-informant ratings is considered essential in evidence-based assessment of youth psychosocial functioning [66] and recent work suggests that discrepant reports from youth and parents may serve as an indicator of poor family functioning (e.g., [67]), highlighting the importance of examining reporter perceptions separately. As such, to examine potential differences by informant, all analyses were run separately for youth- and mother-report.

Results

Associations Among Anxious and Depressive Symptomatology, Temperament, and EF

As shown in Table 1, both youth- and mother-reported A/D and W/D scales were strongly correlated with each other (r = .54 and .67, respectively). Associations of temperament with anxious and depressive symptomatology were largely consistent across informants.

Specifically, both the A/D and W/D scales were positively correlated with NT and negatively correlated with PT, with the magnitude of the associations significantly greater for NT than for PT for the A/D scale ($Z = 8.05$, $p < .001$ for youths; $Z = 2.65$, $p < .01$ for mothers) and vice versa for the W/D scale (i.e., the magnitude of the association greater for PT than NT). However, for the W/D scale, the difference was significant only for mother report (in youths, $Z = 0.96$, $p > .10$; in mothers, $Z = 2.18$, $p < .05$). In contrast, associations between both anxious and depressive symptomatology and temperament with EF varied by informant: EF was not associated with either youth-reported anxious and depressive symptomatology or temperament, whereas mother-reported A/D and NT scales were both significantly and negatively associated with EF. Moreover, the association with mother report was significantly stronger than with youths' self-report for the A/D scale ($Z = 1.98$, $p < .05$) and marginally stronger for the NT scale (Z = 1.68, $p < .10$).

Predicting Anxious and Depressive Symptomatology from Temperament and EF

To examine the unique associations between affective dimensions of temperament, EF, and anxiety and depression, a series of hierarchical linear regressions were performed predicting each of the psychopathology dimensions separately for youth- and mother-reported temperament and anxious and depressive symptomatology. As shown in Table 2, age was associated only with youth-reported A/D scale ($\beta = .12$, $t = 2.15$, $p < .05$) and not W/D scale ($\beta = -.03$, $t = -.59$, $p > .10$) or either scale in mother-reported data (βs < −.02, ts < 1.19, ps > .10). After accounting for age, NT was found in Step 2 to be positively associated with both the youth- and mother-reported A/D (βs = .76, .47, ts = 15.48, 7.21, respectively, ps < .001) and W/D (βs = .49, .30, ts = 7.70, 4.89, respectively, ps < .001) scales. Further, PT was negatively associated with both youth- and mother-reported A/D (βs = −.11, −.22, ts = −2.38, −3.27, respectively, ps < .05 and W/D (βs = −.25, −.49, ts = −3.95, −7.92, respectively, ps < .001) scales.

In addition to main effects of temperament, the interaction of NT and PT significantly contributed to the explanation of both anxiety and depression syndrome scales across informants (all βs > I.09 I, ts > I2.29I, ps < .05). Specifically, the association between NT and anxiety and depressive symptomatology was found to be moderated significantly by PT. To probe the nature of these interactions, as described above, simple slopes analyses were conducted. As shown in Figs. 1 and 2, these analyses indicated that PT moderated the effect of NT on both anxiety and depression syndrome scales. More specifically, at higher levels of NT, a lower PT level contributed more to anxiety and depressive symptoms compared to when NT was lower.

In Step 4, EF was not found to contribute significantly to predicting either youth- or mother-reported A/D or W/D beyond the two temperament dimensions and their interaction (all βs < |.08|, ts < I1.44I, ps > .10). Further, for both youth- and mother-report, none of the temperament by EF interactions emerged as significant contributors to either of anxiety and depression syndrome scales (all βs < |.13|, ts < |1.57|, ps > .05).[1] However, EF did significantly interact with both NT and PT within a three-way interaction in the explanation

[1]In Step 5, the combined interaction terms NT × EF and PT × EF contributed significantly to the prediction of the mother-reported A/D scale, but neither term alone contributed significantly when entered together.

of youth-reported A/D ($\beta = .13$, $t = 2.79$, $p < .01$), but not youth-reported W/D nor either of the mother-reported anxiety and depression scales. To probe the nature of the significant three-way interaction for youth-reported A/D, simple slopes analyses were conducted at high and low levels of EF. As shown in Fig. 3, results indicated that at low levels, EF moderated the effect of the two-way NTxPT interaction on youth-reported Anxiety/Depressed. Specifically, when EF was high, the previously observed NT × PT interaction disappeared, whereas when it was low, the previously observed NT × PT interaction was strengthened. That is, when EF is high, NT, but not PT, remains positively associated with A/D. However, if EF is low, not only is NT associated with A/D, but low PT is as well. However, because the effect was found in only one of four cases examined and was not predicted, it needs replication before being interpreted further.

Discussion

The current study represents the first investigation to date of the joint and interactive contribution of self-reported affective dimensions of temperament and neuropsychological indicators of executive functioning to the explanation of anxious and depressive symptomatology in youth. Consistent with the tripartite model [7], results confirmed the joint and interactive contribution of temperament (NT and PT) in the explanation of anxious and depressive symptomatology. Further, although EF did not emerge as a unique predictor of anxious or depressive symptomatology, EF was found to contribute significantly to the explanation of A/D in the context of youth-reported, but not mother-reported NT × PT interaction. Collectively, results support the need to consider further both affective dimensions of temperament and EF in etiological models of anxious and depressive symptomatology as well as of cross-informant approaches to assessing youth anxious and depressive symptoms.

As noted earlier, the tripartite model asserts that symptoms of anxiety and depression are best understood in the context of interactions between NT and PT [7, 46, 47]. Results of the current study not only found distinct associations between both NT and PT and anxious and depressive symptomatology, but also revealed the incremental contribution of the NT × PT interaction to the explanation of both symptom dimensions. Importantly, these findings were largely consistent across both youth- and mother-report, underscoring the reliability of these results. Specifically, both youth- and mother-reported anxious and depressive symptomatology were negatively associated with NT and positively associated with PT, with a reverse pattern of the strength of associations between the two syndromes. Notably, the magnitude of association was significantly larger for NT than PT in A/D, whereas the strength of association was greater for PT than NT in W/D, although the difference was statistically significant only for the mother-reported scale. These findings are consistent with the tripartite model's assertion that high NT is associated with both anxious and depressive symptomatology, whereas low PT has a more specific association with depressive symptomatology ([7], although this relationship is not exclusive: see [46, 47]). Similar to findings in the adult literature, results of the current study provide further evidence for the robustness of the tripartite model across clinical and non-clinical samples of youth (e.g., [17]).

Results with regard to associations between EF and anxious and depressive symptomatology were less consistent across informants. More specifically, although we expected EF to be associated with both youth- and mother-reported symptom dimensions, only mother-reported A/D was found to be negatively associated with EF. That is, consistent with the extant literature examining parent-reported youth anxious and depressive symptomatology [11, 31, 32], youths with higher mother-reported A/D symptoms exhibited lower levels of EF. However, contrary to previous studies [8–11], EF was not associated with either of the youth-reported anxiety and depression symptom dimensions, nor was it associated with the mother-reported Withdrawal/Depressed scale. One potential explanation for these inconsistent findings may be differences in the base rate of anxious and depressive symptomatology across samples. Whereas previous studies have included clinical samples of mixed gender youth with anxiety and depression diagnoses [8, 10, 11], the current study, as noted earlier, used a community sample of male adolescents, which had mean levels of anxious and depressive symptomatology that were nearly identical to those typically seen among non-clinical similar-aged community samples [46, 54], and which also was of relatively high socio-economic status, which may have combined to yield differential outcomes.

With regard to associations between EF and temperament, again contrary to expectations, temperament was not significantly associated with EF, with the exception of mother-reported NT. That is, only youth with higher mother-reported NT exhibited lower levels of EF. Given the aforementioned conceptual and empirical overlaps between EF and temperament [15, 40, 41], the lack of association between EF and affective dimensions of temperament in the current study was surprising. However, it is important to note that whereas EF, as assessed via the D–KEFS in the current study, reflects cognitive self-regulation in largely affective-neutral conditions, NT and PT, being affective dimensions of temperament, represent more affect-specific propensities [44, 68] which may help to explain these unexpected results. Future research is needed to examine more fully and explicitly potentially differing associations between anxious and depressed symptomatology and EF as assessed through affective versus affect-neutral tasks.

Nonetheless, a three-way youth-reported temperament-by-EF interaction did emerge as a significant contributor in the explanation of youth-reported A/D. Specifically, at low levels, EF moderated the effect of two-way NT × PT interaction on youth-reported A/D. That is, for youth with lower but not higher levels of EF, PT moderated the effect of NT on A/D, showing a stronger effect than that observed in the two-way interaction. Replication is clearly needed; despite significance, these interactions explained a relatively low proportion of the variance. Nonetheless, these findings suggest the possibility of an important role for EF as an additional contributor within the tripartite model. More specifically, knowledge of how EF moderates the NT × PT interaction, each with a known link to anxious and depressive symptomatology, will contribute to advancing our understanding of the underlying etiological mechanisms associated with the development of anxious and depressive symptomatology in youth.

As described earlier, with regard to cross-informant reports, the use of multi-informant ratings is considered essential in evidence-based assessment of youth [69, 70]. However, a

large body of research, underscored by recent meta-analytic findings, has found repeatedly that ratings from different informants consistently evidence low to moderate convergent correlations across a wide range of psychological variables, including anxious and depressive symptomatology in youth (e.g., [63, 64]). This repeated finding of low to moderate convergent correlations across informants was evident in the current study not only in the bivariate cross-informant correlations, but also with regard to the convergent-divergent pattern of correlations across study variables. Indeed, in addition to an extant literature suggesting that youth report higher levels than their parents on both anxious and depressive symptomatology (e.g. [54],), as compared to externalizing symptomatology, parent-youth rating discrepancies are typically found to be higher when assessing internalizing symptomatology, due in part to the relatively low observability of symptoms (e.g., [54, 63, 71]).

Further, an emerging literature indicates that parent-youth informant discrepancies may serve as a proxy for potential family dysfunction; discrepant perception between parents and youth may indicate a high level of family conflict and poor communication among families and may signal an increased risk for the development of youth psychopathology [67, 72, 73]. Indeed, whereas the association between mother-reported youth A/D and temperament showed significant associations with youth EF as hypothesized, self-reported youth A/D and temperament evidenced no association with EF. Collectively, results of the current study, as well as previous findings, provide support for the importance of cross-informant approach to comprehensive assessment of youth anxious and depressive symptomatology.

Limitations

The cross-sectional, correlational nature of the current study does not allow causal or temporal inferences. Additionally, the current sample represented a relatively homogeneous sample comprised of predominantly White youths and their mothers who were moderate to high socioeconomic status, and some exclusion criteria (e.g., youth never held back a grade) may have restricted sample variability, especially in EF. Although this design may result in fewer potential confounding variables, the nature of the sample may also limit the generalizability of the results. For example, our use of an exclusively male sample precludes our ability to consider potential gender differences. Meta-analytic results (i.e., [74]) suggest that female youth evidence higher NT and lower PT than male youth, which may at least partially help to explain higher prevalence of anxious and depressive symptomatology among females than males [1, 2]. However, as compared to males, female youth have also been found to evidence higher levels of EC [74], a construct that conceptually and empirically overlaps with EF [39–41], which may potentially serve to offset the temperamental risk for developing anxious and depressive symptomatology. Nonetheless, it will be important for future research to examine more diverse samples to confirm that results of the current study reflect differences in informants' temperament, EF, and anxious and depressive symptomatology rather than racial/cultural, gender, or socio-economically based differences. Further, because of our use of a community sample, the inclusion of youth with more clinical levels of anxious and depressive symptomatology was limited, potentially resulting in attenuated associations. As such, future research is needed within clinical

populations in which the potential for associations, particularly with regard to EF, is more likely to emerge.

Additionally, our examination of youth- and mother reports separately allowing for examination of potential divergent and unique perspectives represents a significant strength of the current study. Nonetheless, the use of within-informant data may result in observed effects potentially being explained, at least partially, by shared informant variance. Consistent with typical clinical practice, future research would benefit from the inclusion of additional informants (e.g., teachers) as well as other research methods to test whether differential outcomes may emerge with different sources of information in the investigation of youth anxious and depressive symptomatology.

Finally, although our decision to examine a single indicator of EF was based on several considerations, including the number of independent variables we planned to include in our analytical models, EF has been found to consist of a number of sub-components (e.g., [75]). As noted earlier, the use of D–KEFS, which generally represents cognitive self-regulation in affective-neutral conditions, which might have attenuated associations with affective dimensions of temperament (i.e., NT and PT). Future researchers are therefore encouraged to examine potential differential associations between various EF dimensions and anxious and depressive symptomatology in youth using EF measures designed to assess emotion-regulation in affectively based conditions.

Summary

Results of the current study confirm the importance of examining the interactive contribution of temperament and EF within the context of the tripartite model in the explanation of youth anxious and depressive symptomatology. Indeed, the present findings highlight the important role that PT plays in moderating the effect of NT on anxious and depressive symptomatology among youth with lower levels of EF, which has implications for both research and clinical settings. Specifically, findings of the current study emphasize the importance of investigating neuropsychological functioning in conjunction with affective dimensions of temperament (i.e., NT and PT) because understanding their joint and interactive potential as risk/protective factors associated with anxiety and depression may serve to advance assessment of—and intervention with—youth who suffer from such symptoms. For example, as EF does not appear to be entirely “hard-wired” [76] (p. 462), results of the current investigation, along with previous work (e.g., [77]) suggest an opportunity for early identification of at-risk youth as well as the development of early intervention and targeted problem-specific prevention programs [1, 6] aimed at promoting socioemotional health with the enhancement of EF as a core goal.

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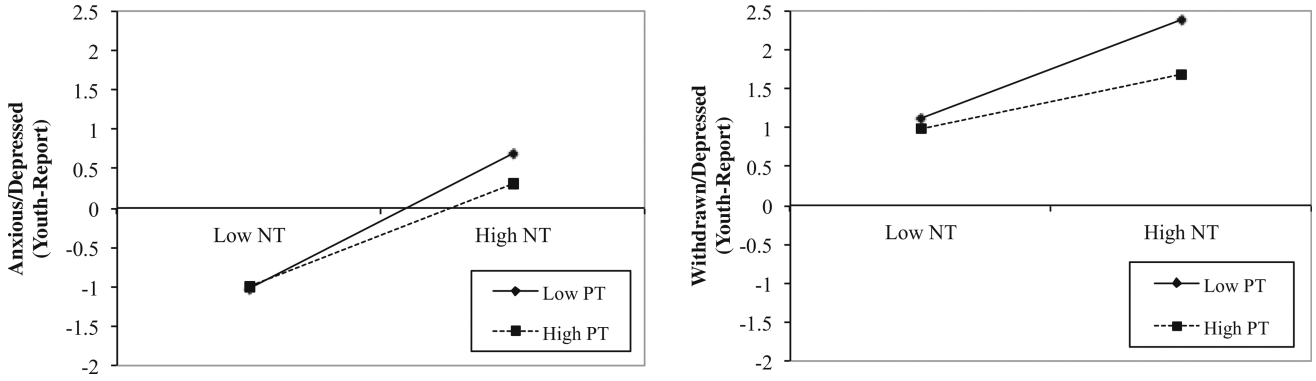

Fig. 1.

Interaction between youth-reported NT and PT. *Left panel* anxious/depressed; *right panel* withdrawn/depressed. High and low values correspond to +1.0 and −1.0 SD from the mean, respectively. Anxious/depressed and withdrawn/depressed scores are standardized, $M = 0$, SD = 1

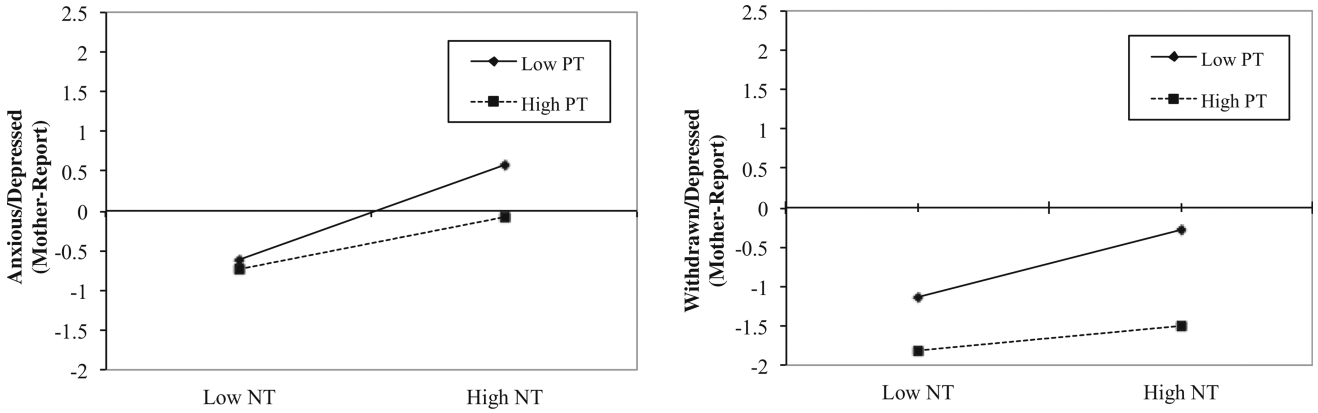

Fig. 2.

Interaction between mother-reported youth NT and PT. *Left panel* anxious/depressed; *right panel* withdrawn/depressed. High and low values correspond to +1.0 and −1.0 SD from the mean, respectively. Anxious/depressed and withdrawn/depressed scores are standardized, $M = 0$, SD = 1

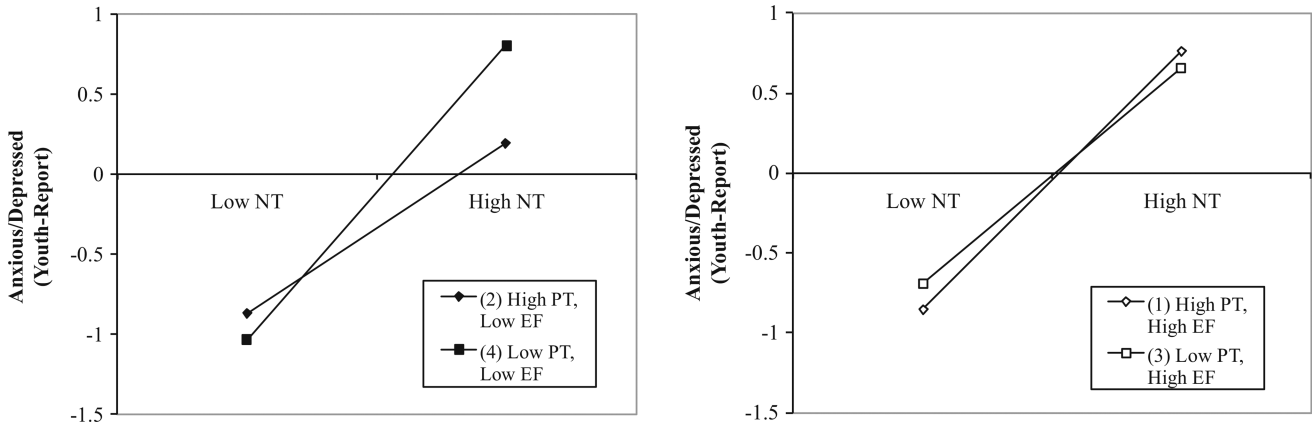

Fig. 3.

Three-way interaction between youth-reported NT × PT interaction, EF, and anxious/depressed. *Left* @ low levels of EF; *right* @ high levels of EF. High and low values correspond to +1.0 and −1.0 SD from the mean, respectively. Anxiety/depressed and withdrawn/depressed scores are standardized, $M = 0$, SD = 1

Table 1

Associations among mother and son-reported anxious and depressive symptomatology, temperament, and EF

	A/D	W/D	NT	PT	EF
Anxious/depressed (A/D)	*.21*	**.67**	.49	−.25	−.18
Withdrawn/depressed (W/D)	**.54**	*.43*	.33	**−.52**	−.11
Negative temperament (NT)	**.78**	.23	*.35*	−.09	−.23
Positive temperament (PT)	−.24	−.32	−.17	*.36*	.11
Executive functioning (EF)	.01	−.03	−.07	.09	–
Mean					
Mother−report	2.60	1.86	8.34	19.60	–
Self-report	2.77	3.62	9.08	18.94	10.53
SD					
Mother-report	3.00	2.48	5.98	4.63	–
Self-report	2.39	3.27	6.08	5.63	1.49
Range					
Mother-report	0–15	0–15	0–24	0–20	–
Self-report	0–14	0–15	0–24	7–27	6.67–14.67

N = 171 for youth-report (below the diagonal) and 174 for mother report (above the diagonal). *SD* standard deviation. All *r*s ≥ .18 are significant, $p < .001$. Cross-informant convergent correlations are shown along the diagonal in italics. Correlations of ≥ .50 are considered large in magnitude (i.e., [78]) and shown in boldface

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Table 2

Predicting youth-reported anxious and depressive symptomatology from youth- and mother-reported temperament and EF

Predictors	**Youth-reported**				**Mother reported**			
	Anxious/depressed		**Withdrawn/depressed**		**Anxious/depressed**		**Withdrawn/depressed**	
	β	***t***	***β***	***t***	***β***	***t***	***β***	***t***
Step 1	**R^2 = .03** *		R^2 = .00		R^2 = .00		R^2 = .01	
Age	**.12**	**2.15** *	−.03	−.59				
Step 2	**ΔR^2 = .60** ***		**ΔR^2 = .34** ***		**ΔR^2 = .29** ***		**ΔR^2 = .36** ***	
NT	**.76**	**15.48** ***	**.49**	**7.70** ***	**.47**	**7.21** ***	**.30**	**4.89** ***
PT	**−.11**	**−2.38** *	**−.25**	**−3.95** **	**−.22**	**−3.27** **	**−.49**	**−7.92** ***
Step 3	**ΔR^2 = .01** *		**ΔR^2 = .02** *		**ΔR^2 = .02** *		**ΔR^2 = .03** **	
NT × PT	**−.10**	**−2.30** *	**−.15**	**−2.51** *	**−.13**	**−2.42** *	**−.13**	**−2.66** *
Step 4	ΔR^2 = .01		ΔR^2 = .00		ΔR^2 = .00		ΔR^2 = .00	
EF	.07	1.43	.05	.84	−.04	−.54	.00	.04
Step 5	ΔR^2 = .01		ΔR^2 = .01		**ΔR^2 = .03** *		ΔR^2 = .01	
NT × EF	−.01	−.26	−.07	−.99	−.10	−1.69	−.07	−1.23
PT × EF	.08	1.56	−.05	−.70	.12	1.71	−.00	−.02
Step 6	**ΔR^2 = .02** **		ΔR^2 = .01		ΔR^2 = .00		ΔR^2 = .01	
NT × PT × EF	**.13**	**2.79** **	.10	1.67	.04	.79	.07	1.21

N = 171

NT negative temperament, *PT* positive temperament, *EF* executive functioning

*** $p < .001$;

** $p < .01$;

* $p < .05$.

Significant effects ($p < .05$) are shown in boldface