THE ROLE OF NEUROTICISM IN DEPRESSIVE AND ANXIOUS SYMPTOMS

AMONG ADOLESCENTS FROM URBAN AND RURAL CHINA

by

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ABSTRACT OF THE THESIS

The Role of Neuroticism in Depressive and Anxious Symptoms
among Adolescents from Urban and Rural China

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Lifetime prevalence rates of suicide and depression are on the rise in mainland China, especially among the youth. The current study examined whether the personality construct of neuroticism confers vulnerability to depressive symptoms in Chinese adolescents. More specifically, this study examined: (1) whether neuroticism predicted the prospective changes in depressive symptoms following the occurrence of negative life events, (2) the specificity of this prediction to depressive symptoms, and (3) the mediation and moderation models of sex differences in depressive symptoms. Adolescents ages 14-19 from Changsha (N=536) and Liuyang (N=570) participated in this multi-wave longitudinal study. Depressive symptoms, anxious symptoms, and neuroticism levels were assessed initially, and depressive symptoms, anxious symptoms, and negative life events were assessed monthly for the next six months. Results support the hypothesis that neuroticism confers vulnerability to depressive symptoms, specificity for depressive symptoms was not found, and no reliable sex differences were found among depressive symptoms, thus precluding the possibility of testing mediation and moderation models. In addition, neuroticism conferred vulnerability to anxious symptoms in the low neuroticism group. All findings were replicated across both sites.

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INTRODUCTION

Depression in China

The results of epidemiological studies conducted in China during the 1980s and 1990s suggested that the lifetime prevalence rate of affective disorders in mainland China (i.e., 0.46% - 0.83%) is lower than that observed in Western countries (Lee et al., 2009). The results, however, of more recent epidemiological studies suggest that the lifetime prevalence rate of affective disorders in China has risen in recent years (i.e., 3.6%; Lee et al., 2009) and now rivals those reported in Western countries. The public and media in mainland China have raised concerns over both the increasing rate of affective disorders (Zhenghua, 2004) and the disquieting suicide rate (Wang, 2004; Hesketh, Ding, & Jenkins, 2002). At the same time, there is a paucity of research examining factors that predict the development of depressive symptoms and/or episodes, especially among Chinese youth.

Neuroticism

Contemporary theories of child temperament and personality posit that individual differences exist in emotional reactivity as well as in the processes that moderate such reactivity (Durbin & Shafir, 2008; Tackett & Krueger, 2005). One trait that is common to most structural theories of child temperament and personality is neuroticism or negative affect/affectivity (Watson & Clark, 1994; Clark, Watson, & Mineka, 1994; Halverson et al., 2003; Shiner & Caspi, 2003). Youth high in neuroticism exhibit a tendency to experience negative emotions such as fear, sadness, anxiety, and anger, as well as difficulty regulating such negative affective states when they arise (Clark & Watson, 1999). The greater frequency and intensity of negative

affective states experienced by youth high in neuroticism is hypothesized to stem from a deficit in the ability to dampen or manage negative emotions and/or the possession of a low threshold for the elicitation of negative emotions (Durbin & Shafir, 2008). High levels of neuroticism have been posited to serve as a vulnerability factor for the development of both mood and anxiety disorders (Clark et al., 1994). In addition, the association between neuroticism and change in depressive/anxious symptoms over time has been conceptualized within a diathesis-stress framework (Clark & Watson, 1999; Tackett & Krueger, 2005). In other words, youth high in neuroticism have been hypothesized to be at risk for the development of such symptoms when experiencing high, but not low, levels of stress.

Neuroticism as a vulnerability factor

A large body of research has accumulated examining whether neuroticism serves as a vulnerability factor to the development of depressive and anxious symptoms in adult samples. Consistent with hypotheses, higher levels of neuroticism have been found to be associated with higher levels of depressive (Watson, Clark, & Carey, 1988; Saklofske, Kelly, & Janzen, 1995; Muris, Roelofs, Rassin, Franken, & Mayer 2005; Chioqueta & Stiles, 2005; Clark et al., 1994) and anxious (Watson et al., 1988; Muris et al., 2005) symptoms. Prospective studies have provided equally strong support by demonstrating that higher levels of neuroticism are associated with greater increases in depressive (Kendler, Gatz, Gardner, & Pedersen, 2006) and anxious (Khan, Jacobson, Gardner, Prescott, & Kendler, 2005) symptoms over time. Prospective studies have also demonstrated that higher levels of neuroticism are associated with a greater likelihood of experiencing the onset of a clinically significant depressive episode (Kendler et al.,

2006) or anxiety disorder (Khan, et al., 2005) over time. Finally, research examining whether the association between neuroticism and the development of depressive symptoms is moderated by the occurrence of negative events has demonstrated that higher levels of neuroticism are associated with increases in depressive symptoms over time among participants experiencing high, but not low levels of stress (Middeldorp, Cath, Beem, Willemsen, & Boomsma, 2008).

Far less research has examined whether neuroticism serves as a vulnerability factor to the development of depressive and anxious symptoms in child and adolescent samples. Preliminary research, however, has yielded findings consistent with those obtained in studies using adult samples. More specifically research with children and adolescents in Western countries has found higher levels of neuroticism to be associated with higher levels of both depressive (Chorpita, 2002; Chorpita, Plummer, & Moffitt, 2000) and anxious (Lonigan, Hooe, David, & Kistner, 1999; Chorpita, 2002; Muris, de Jong, & Engelen, 2004) symptoms in inpatient, outpatient, and school samples. Higher levels of neuroticism have also been found to predict the onset of major depressive episodes among high school students (Hayward, Killen, Kraemer, & Taylor, 2000) and university freshmen (Hutchinson & Williams, 2007). Last, consistent with a vulnerability-stress framework, neuroticism has been found to interact with the occurrence of negative events to predict increases in depressive symptoms among university students (Lakdawalla & Hankin, 2008; Hutchinson & Williams, 2007).

Neuroticism in China

Examination of neuroticism within the non-Westernized world has been sparse. Research surrounding the construction of the Chinese Personality Assessment Inventory (CPAI), however, has identified neuroticism as one of the main factors of personality in individuals from mainland China (Cheung, Cheung, Leung, Ward, & Leong, 2003; Cheung et al., 2001). Further, consistent with research utilizing Western samples, higher levels of neuroticism have been found to be associated with current depressive symptoms among college freshmen in Beijing as well as Hong Kong (Song et al., 2008). Neuroticism has also been found to be associated with: subjective well-being among the Chinese students (Zheng, Sang, & Lin, 2004), mental illness among the Chinese, psychiatric morbidity among the Japanese, negatively correlated with happiness among the Chinese and British, and the consistently stronger predictor of mental illness across Chinese (Hong Kong), Japanese, and British adults (Furnham & Cheng, 1999). Thus, although data suggests that etic and emic approaches (Cheung et al., 2001) in studying the personality construct of neuroticism among the Chinese population yield results congruent to Westernized populations, more research is needed among the Chinese population on measures of neuroticism as well as its association with symptoms of psychopathology.

Goals of the current study

The first goal of the current study was to examine the prospective association between neuroticism and depressive symptoms from a vulnerability-stress perspective. In order to provide a powerful examination of hypotheses, neuroticism and depressive symptoms were assessed at an initial assessment, and depressive symptoms and

negative life events were assessed during a series of 6 monthly follow-up assessments. The use of such a multi-wave longitudinal design allowed us to take an idiographic approach. More specifically we examined whether the slope of the association between negative events and depressive symptoms between adolescents varied across adolescents as a function of neuroticism. There are multiple advantages to utilizing such an idiographic approach. First, by obtaining repeated assessments of levels of depressive symptoms and negative events within individuals across an extended period of time, we are able to gather a relatively reliable estimate of each adolescent's degree of stress reactivity (i.e., slope of the association between negative life events and depressive symptoms). Given that vulnerability-stress theories are essentially theories of different stress-reactivity, this represents an ideal approach to examine our study's hypotheses. Second, for each adolescent, a high level of negative life events can be operationalized in reference to his/her own mean level of negative life events. This approach toward operationalizing likely minimizes the influence of individual differences on the reporting of negative life events on findings.

The second goal of the current study was to examine the specificity of neuroticism as a predictor of depressive symptoms taking into account possible cross-cultural symptom manifestations. Cultural psychopathologists posit that cultural factors shape the phenomenology of psychiatric symptoms (Kleinman, 2004). A condition called *shenjing shuairuo (SJSR)* (translated as "nerve weakness"), also known as *neurasthenia*, has been hypothesized to represent a somatised form of depression in China. *SJSR* has been characterized by symptoms of physical and mental fatigability, sleep disturbances, irritability, excitability, and memory difficulty (Lee, 1999).

Originally, *neurasthenia* came to China from the West. Due to the stigmatization of individuals with mental illness in China, *neurasthenia* generated acceptance and was diagnosed in as many as 80% of medical and psychiatric outpatients in mainland China and up to 50% of medical and psychiatric outpatients, up until the 1980s (Parker, Gladstone, & Chee, 2001). Research comparing diagnostic criteria for *neurasthenia* demonstrates a strong overlap with diagnostic criteria for symptoms of both depression and anxiety. In an international factor analysis study of depressive symptoms, Yen and colleagues identified three factors representative of different symptoms: (1) somatic symptoms, (2) negative affect symptoms, and (3) absence of positive affect symptoms (Yen, Robins, & Lin, 2000). Chinese outpatients reported a greater proportion of somatic symptoms relative to control non-patients, and non-patients reported a greater proportion of affective symptoms. In a similar method cross-cultural study, Chinese students reported a lower proportion of somatic symptoms and a higher proportion of absence of positive affect symptoms, as compared to their international peers (Yen, Robins, & Lin, 2000). Furthermore, in a study conducted by Kleinman and colleagues, 87% of *neurasthenia* patients could be diagnosed with DSM-III major depression and 69% could be diagnosed with a DSM-III anxiety disorder, and the majority of these patients responded favorably to treatment with tricyclic antidepressants.

These findings led Kleinman and Chinese researchers to conclude that *neurasthenia* in China represents "a culturally shaped type of somatization" used to express psychological distress in a socially acceptable fashion (Kleinman, 1999). Concomitant with the changes in Chinese diagnostic practices there has been a dramatic

decline in the diagnosis of *neurasthenia* (Lee, 1999) accompanied by a rise in the diagnosis of depressive disorders (Liu, Ma, Kurita, & Tang, 1999). Of significant importance is the knowledge that although researchers have noted these shifts, there continues to be wide usage of the *neurasthenia* diagnoses within some medical settings, particularly in rural China and among the lay public (Kleinman, 1999; Lee & Wong, 1995). Considering the role that neurasthenia continues to play within the mental health field in the Chinese culture, it's important to recognize the overlap between the diagnoses of neurasthenia, depression, and anxiety. It was therefore imperative to examine whether neuroticism was a predictor for the specific manifestations of depressive and/or anxious symptoms among the adolescents from two different sites in mainland China.

The third goal of our study was to examine two possible models of sex differences in depression should such differences be observed in the current sample. In Western samples there is a very well documented sex difference in rates of depression with girls being twice as likely as boys to exhibit depressive symptoms. Preliminary results in China suggest existence of sex differences in depression, although much smaller in magnitude. One possible model to account for sex differences in depression is a mediation model. Such a model would posit that girls' higher level of depressive symptoms are due to their possessing vulnerability and risk factors (e.g, higher levels of neuroticism, higher occurrence of negative events, etc.,). A second possible model to account for sex differences in depression posits that vulnerability and risk factors (e.g., neuroticism, negative events) are more strongly associated with depressive symptoms

in girls than in boys. It is important to note that these two models are not mutually exclusive but best viewed as complementary models.

Hypotheses

Hypotheses were tested in two independent samples, from Changsha (urban) and Liuyang (rural) mainland China. Research has shown important differences between urban and rural China in terms of socioeconomic, sociocultural, education, health, and mental health related variables (Hesketh, Ding, & Jenkins, 2002). A lack of accessibility to primary and specialist health care, lower socioeconomic and educational levels, and stigmatization of mental health diagnoses is more prominent within the rural areas of China. Depression and suicide rates have also been reported to be higher among rural dwellers, as compared to those in the urban areas (Hesketh et al., 2002). Therefore, replication of the results of the current study across our urban and rural samples would provide powerful support for generalizability of our findings. At the same time, differences between the sites in terms of levels of variables and/or the strength of the association between variables may provide important insights into the distinct pathways that lead to the development of depressive symptoms in youth from urban and rural settings in mainland China.

Hypothesis 1: Neuroticism will serve as a vulnerability factor to depressive symptoms among adolescents in both urban and rural mainland China. More specifically, higher levels of neuroticism will be associated with greater within-subject increases in depressive symptoms following within-subject increases in stress.

Hypothesis 2: Neuroticism will exhibit non-specificity as a predictor of depressive symptoms. More specifically, higher levels of neuroticism will be associated

with greater within-subject increases in anxious symptoms following within-subject increases in stress.

Hypothesis 3: Female adolescents will report higher levels of depressive symptoms than male adolescents in both our urban and rural samples. Consistent with a mediation model of sex differences in depression, females' higher levels of depressive symptoms will be accounted for by their higher levels of neuroticism and the greater frequency of negative events they report. Consistent with a moderation model of sex differences in depression, neuroticism will be more strongly associated with within-subject increases in depressive symptoms following within-subject increases in stress in girls than in boys.

METHODS

Participants:

Adolescents whose parents signed a consent form were invited to participate in this study. At both the Changsha and the Liuyang sites, the adolescents were between the ages of 14 and 19, and represented grades 10 through 12. The mean age at the Changsha (urban) site was 16.22 (*SD* = 0.89), with a total of 536 adolescents of whom 296 were female. The average age at the Liuyang (rural) site was 16.32 (*SD* = 0.93), with a total of 570 adolescents of whom 268 were female.

Procedure:

The study was conducted utilizing a multi-wave design including an initial assessment, and six monthly follow-up assessments. At the initial assessment demographic information was obtained, and adolescents were asked to fill out self-report measures of depressive symptoms (CES-D), anxious symptoms (MASC), and neuroticism (NEO-FFIN). For the next six months, once a month, the adolescents were asked to use self-report measures to assess their depressive symptoms (CES-D), anxious symptoms (MASC), and negative life events (ALEQ).

Measures:

The measures used in the study were developed using the back-translation method. The English versions were translated into Chinese by a bilingual translator from the Second Xiangya Medical College of Central South University. Then, the Chinese versions were back-translated into English by another bilingual translator from McGill University. The original versions were then compared with the back-translation. If inconsistencies appeared, the two translators worked together to make corrections to

the Chinese versions until all final versions were agreed upon. No items were eliminated or significantly changed during the translation process.

Depressive Symptoms: The Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977). It is a self-report measure of the frequency of occurrence of 20 depressive symptoms designed for use with general community samples. Each item is rated on a 4-point scale. Subjects are asked to indicate whether a particular depressive experience occurred "*Rarely or none of the time* (*less than 1 day*)" to "*Most or all of the time* (*5-7 days*)." Scores are summed and range from 0 to 60. Thus, higher scores are indicative of a greater number and frequency of depressive symptoms. Acceptable internal reliability has been demonstrated in youth and young adult samples (Radloff, 1977; 1991). The CES-D is intended as an instrument to measure depression in the general population. The CES-D has been demonstrated to be a valid assessment instrument with adolescent samples.

Anxious Symptoms: Multidimensional Anxiety Scale for Children (MASC; March, Parker, Sullivan, Stallings, & Conners, 1997). The MASC is a 39-item self-report measure of anxious symptoms in youth. Adolescents are asked to indicate how true each item has been to them in the past week on a scale of 0 (*never*), 1 (*rarely*), 2 (*sometimes*), or 3 (*often*). Total scores range from 0 to 117, with higher scores indicating higher symptoms of anxiety. In an examination of its psychometric properties (March et al., 1997), the MASC demonstrated good test-retest reliability (r =.93) and internal consistency (α = .87 to .89). Further, it shows convergent validity with other self-report measures of anxious symptoms (r =.63) and divergent validity

with self-reports of depressive symptoms ($r = .19$) and parent reports of hyperactive symptoms ($r = .07$).

Neuroticism: The NEO Five Factor Personality Inventory - Neuroticism Subscale (NEO-FFIN; Costa & McRae, 1992). The NEO-FFIN consists of 12 items developed to measure neuroticism. Subjects are asked to respond on a 5-point Likert-type scale, and possible responses range from 0 (*strongly disagree*) to 4 (*strongly agree*). Higher scores indicate higher levels of the personality trait neuroticism. Past research has shown that the NEO-FFIN possesses strong psychometric properties (Costa & McCrae, 1992).

Negative Life Events: The Adolescent Life Events Questionnaire (ALEQ: Hankin & Abramson, 2002). The ALEQ is a 70-item measure that assesses a wide range of negative events that occur in the lives of adolescents. Items include school/achievement problems, friendship/romantic difficulties, and family problems. Participants indicate on a scale of 0 (*never*) to 5 (*always*) how often each negative events happened to them during the past month. We obtained Cronbach's alphas ranging from 0.93 to 0.95 across administrations indicating strong internal consistency.

RESULTS

Descriptive Data

Intercorrelations between Time 1 measures (CES-D, MASC, NEO-FFIN, and Gender) are reported in Table 1 for both Changsha and Liuyang. Of particular relevance, in both samples, higher levels of neuroticism were associated with higher levels of both depressive and anxious symptoms.

Means and standard deviations for all Time 1 measures are presented in Table 2. The results from SITE × GENDER ANOVAs indicated that rural adolescents reported higher levels of both depressive symptoms ($F(1,115) = 8.13$, $p < .01$) and anxious symptoms ($F(1,124) = 11.51$, $p < .01$) than did urban adolescents. In addition, girls reported higher levels of depressive symptoms ($F(1,115) = 5.54$, $p < .05$), anxious symptoms ($F(1,124) = 90.74$, $p < .001$), and neuroticism ($F(1,109) = 35.30$, $p < .001$) than did boys.

Means and standard deviations for all follow-up measures are presented in Table 3. Several findings warrant attention. First, the results of SITE × GENDER ANOVAs indicated that rural adolescents reported higher levels of depressive symptoms than did urban adolescents at Follow-Up 3 ($F(1,074) = 4.43$, $p < .05$), Follow-Up 5 ($F(1,038) = 7.17$, $p < .01$), and Follow-Up 6 ($F(1,010) = 5.55$, $p < .05$). In addition, girls reported higher levels of depressive symptoms than did boys at Follow-Up 3 ($F(1,074) = 6.93$, $p < .01$), Follow-Up 4 ($F(1,1023) = 4.64$, $p < .05$), and Follow-Up 6 ($F(1,010) = 10.90$, $p < .01$). Second, the results of SITE × GENDER ANOVAs indicated that rural adolescents reported higher levels of anxious symptoms than did urban adolescents at Follow-Up 1 ($F(1,089) = 38.10$, $p < .001$), Follow-Up 2 ($F(1,079)$

= 29.76, $p < .001$), Follow-Up 3 ($F(1,077) = 25.00$, $p < .001$), Follow-Up 4 ($F(1,025) =$

21.58, $p < .001$), Follow-Up 5 ($F(1,043) = 27.73$, $p < .001$), and Follow-Up 6 ($F(1,015)$

= 41.58, $p < .001$). In addition, girls reported higher levels of anxious symptoms than

did boys at Follow-Up 1 ($F(1,089) = 80.44$, $p < .001$), Follow-Up 2 ($F(1,079) = 53.85$,

$p < .001$), Follow-Up 3 ($F(1,077) = 51.72$, $p < .001$), Follow-Up 4 ($F(1,025) = 35.94$, p

$< .001$), Follow-Up 5 ($F(1,043) = 39.71$, $p < .001$), and Follow-Up 6 ($F(1,015) = 55.66$,

$p < .001$). Last, the results of SITE $\times$ GENDER ANOVAs indicated that rural

adolescents a greater frequency of negative events than did urban adolescents at

Follow-Up 4 ($F(1,022) = 4.89$, $p < .05$), Follow-Up 5 ($F(1,037) = 13.43$, $p < .001$), and

Follow-Up 6 ($F(1,011) = 10.14$, $p < .01$) whereas urban adolescents reported a greater

frequency of negative events than did rural adolescents at Follow-Up 1 ($F(1,108) =$

5.01, $p < .05$). In addition, boys reported a greater frequency of negative events than did

girls at Follow-Up 1 ($F(1,108) = 6.89$, $p < .01$).

Prospective Diathesis-Stress Analyses - Depression

In order to test our hypothesis that higher neuroticism would be associated with

greater increases in depressive symptoms following the occurrence of negative events,

we completed the analyses using SAS (Version 9.2). Multilevel modeling, using

MIXED procedure and maximum likelihood estimation were used. The dependent

variable was within-subject fluctuations in CES-D scores during the follow-up period

(DEPRESSION). The primary predictors of fluctuations in CES-D scores were levels

of neuroticism (NEUROTICISM) and within–subject fluctuations in ALEQ scores

(STRESS) during the follow-up period. As NEUROTICISM is a between-subject

predictor, NEO-FFIN scores were standardized prior to analysis. As STRESS is a

within-subject predictor, ALEQ scores were centered at each adolescent's mean prior to analyses such that fluctuations in ALEQ scores reflect upward or downward fluctuations in adolescents' levels of stress compared to their own mean level of stress. Preliminary analyses were conducted examining whether gender served as a moderator of any relationships. No significant interactions involving gender were found.

It is important to specify appropriate mean and covariance structures, when fitting hierarchical linear models. A significance fact is that mean and covariance structures are not independent of one another, and it is therefore essential to select an appropriate covariance structure in order to obtain valid inferences for the parameters in the mean structure. Overparametrization of the covariance structure can lead to inefficient estimation and poor assessment of standard errors (Altham, 1984). That being said, too much restriction of the covariance structure can lead to invalid inferences when the assumed structure does not hold (Altham, 1984).

In our first set of analyses, we were interested in examining the effects of NEUROTICISM and STRESS on DEPRESSION. Consequently, in line with Diggle, Liang, and Zeger's (1994) recommendation that one use a "saturated" model for the mean structure while searching for an appropriate covariance structure, we chose a mean structure that included NEUROTICISM, STRESS, and the NEUROTICISM × STRESS interaction. Five additional effects were also included in this mean structure. First, as different adolescents report different levels of depressive symptoms when experiencing their own average level of stressors, a random effect for intercept was included. Second, given that STRESS is a within-subject predictor whose effect is expected to vary from participant to participant, a random effect for slope was included.

Third, in order to control for individual differences in baseline levels of depressive symptoms, Time 1 CES-D scores were included in the model. Fourth, in order to examine whether NEUROTICISM is associated with within-subject fluctuations in DEPRESSION independent of the association between NEUROTICISM and within-subject fluctuations in ANXIETY, ANXIETY was entered in the model. Last, in order to account for possible gender effects, adolescents' gender was entered in the model.

Commonly used covariance structures when multiple responses are obtained from the same individual over time (and consequently within-subject residuals over time are likely to be correlated) include: compound symmetry, banded Toeplitz, first-order autoregressive (AR[1]), and heterogeneous autoregressive (ARH[1]). In order to select one of these covariance structures for our analyses, we fitted models utilizing each structure and chose the "best" fit based on Akaike information criterion (AIC and AICC) and Schwarz Bayesian criterion (BIC). In all cases, the best fit for our data was an autoregressive structure (AR[1]). Such a covariance structure indicates two general patterns in CES-D scores during the follow-up interval (Littell, Pendergast, & Natarajan, 2000). First, as the interval between any two follow-up assessments increases, the degree of inter-correlation between adolescents' CES-D scores at these two time points decreases. Second, the variance in CES-D scores across administrations is constant. Having chosen the appropriate covariance structure, we next examined the random-effects component of our model.

Changsha (Urban) Sample: With respect to random effects, the AR[1] parameter ($r = .30$, $p < .001$), RE_INTERCEPT ($p < .001$) and RE_SLOPE ($p < .001$) were significant and thus were retained in the model. The final results with respect to

the fixed-effects component of the model are presented in the left panel of Table 4. As hypothesized, the NEUROTICISM × STRESS interaction was a significant predictor of depressive symptoms during the follow-up period.

In order to examine the form of the NEUROTICISM × STRESS interaction, the model summarized in the left panel of Table 4 was used to calculate predicted CES-D scores for adolescents exhibiting either high or low levels of neuroticism (plus or minus 1.5 SD) who are experiencing either high or low levels of negative events in comparison to their own average level of negative events (plus or minus 1.5 × mean within-subject SD). The results of such calculations are presented in Figure 1. As both DEPRESSION and STRESS are within-subject variables, slopes are interpreted as the increase in an adolescent's CES-D score that would be expected given a one point higher score on the ALEQ. Analyses were conducted for each NEUROTICISM condition examining whether the slope of the relationship between negative events and depressive symptoms significantly differed from zero. Analyses indicated that adolescents with high levels of neuroticism reported significantly higher levels of depressive symptoms when experiencing high levels of stress than when experiencing low levels of stress ($t(2405) = 8.07$, $p < .001$). In contrast, for adolescents with low levels of neuroticism, within-subject fluctuations in stress were not significantly associated with within-subject fluctuations in depressive symptoms ($t(2405) = 1.64$, ns). Planned comparisons of the slopes of the relationship between stress and depressive symptoms revealed that the slope was significantly greater in adolescents exhibiting high levels of neuroticism (slope = 0.13) than in adolescents exhibiting low levels of neuroticism (slope = 0.03; $t(2405) = 3.53$, $p < .001$).

Liuyang (Rural) Sample: With respect to random effects, the AR[1] parameter ($r = .22$, $p < .001$), RE_INTERCEPT ($p < .001$) and RE_SLOPE ($p < .001$) were significant and thus were retained in the model. The final results with respect to the fixed-effects component of the model are presented in the right panel of Table 4. As hypothesized, the NEUROTICISM × STRESS interaction was a significant predictor of depressive symptoms during the follow-up period.

In order to examine the form of the NEUROTICISM × STRESS interaction, the model summarized in the right panel of Table 4 was used to calculate predicted CES-D scores for adolescents exhibiting either high or low levels of neuroticism (plus or minus 1.5 SD) who are experiencing either a high or low level of negative events in comparison to their own average level of negative events (plus or minus $1.5 \times$ mean within-subject SD). The results of such calculations are presented in Figure 1. Analyses were conducted for each NEUROTICISM condition examining whether the slope of the relationship between negative events and depressive symptoms significantly differed from zero. Analyses indicated that adolescents with high levels of neuroticism reported significantly higher levels of depressive symptoms when experiencing high levels of stress than when experiencing low levels of stress ($t(2619) = 5.45$, $p < .001$). In contrast, for adolescents with low levels of neuroticism, within-subject fluctuations in stress were not significantly associated with within-subject fluctuations in depressive symptoms ($t(2619) = 1.80$, *ns*). Planned comparisons of the slopes of the relationship between stress and depressive symptoms revealed that the slope was significantly greater in adolescents exhibiting high levels of neuroticism (slope = 0.09) than in adolescents exhibiting low levels of neuroticism (slope = 0.03; $t(2619) = 1.99$, $p < .05$).

Prospective Diathesis-Stress Analyses - Anxiety

Similar analyses were conducted in order to examine whether higher neuroticism would be associated with greater increases in anxious symptoms following the occurrence of negative events. For these analyses, however, the dependent variable was within-subject fluctuations in MASC scores during the follow-up period (ANXIETY). The primary predictors of ANXIETY were NEUROTICISM, STRESS, and NEUROTICISM × STRESS. In regards to additional effects controlled for in the model, these included random effects for intercept (RE_INTERCEPT) and slope (RE_SLOPE), Time 1 MASC scores, fluctuations in each participant's levels of depressive symptoms during the follow-up period (DEPRESSION), and gender.

Changsha (Urban) Sample: With respect to random effects, the AR[1] parameter ($r = .21$, $p < .001$), RE_INTERCEPT ($p < .001$) and RE_SLOPE ($p < .001$) were significant and thus were retained in the model. The final results with respect to the fixed-effects component of the model are presented in the left panel of Table 5. The NEUROTICISM × STRESS interaction was a significant predictor of ANXIETY.

In order to examine the form of the NEUROTICISM × STRESS interaction, the model summarized in the left panel of Table 5 was used to calculate predicted MASC scores for adolescents exhibiting either high or low neuroticism (plus or minus 1.5 SD) who are experiencing either a high or low levels of negative events in comparison to their own average levels of negative events (plus or minus 1.5 × mean within-subject SD). The results of such calculations are presented in Figure 2. As both ANXIETY and STRESS are within-subject variables, slopes are interpreted as the increase in an individual's MASC score that would be expected given a one point

higher score on the ALEQ. Analyses were conducted for each NEUROTICISM condition examining whether the slope of the relationship between negative events and anxious symptoms significantly differed from zero. Analyses indicated that both adolescents exhibiting high ($t(2416) = 7.88$, $p < .001$) and low ($t(2416) = 10.31$, $p < .001$) levels of neuroticism reported significantly higher levels of anxious symptoms when experiencing high levels of stress than when experiencing low levels of stress. Unexpectedly, planned comparisons of the slopes of the relationship between stress and anxious symptoms revealed that the slope was significantly greater in adolescents exhibiting low levels of neuroticism (slope = 0.31) than in adolescents exhibiting high levels of neuroticism (slope = 0.21; $t(2416) = -2.02$, $p < .05$).

Liuyang (Rural) Sample: With respect to random effects, the AR[1] parameter (r = .34, p < .001), RE_INTERCEPT (p < .001) and RE_SLOPE (p < .001) were significant and thus were retained in the model. The final results with respect to the fixed-effects component of the model are presented in the right panel of Table 5. The NEUROTICISM× STRESS interaction was a significant predictor of ANXIETY.

In order to examine the form of the NEUROTICISM × STRESS interaction, the model summarized in the right panel of Table 5 was used to calculate predicted MASC scores for adolescents exhibiting either high or low neuroticism (plus or minus 1.5 SD) who are experiencing either high or low levels of negative events in comparison to their own average level of negative events (plus or minus 1.5 × mean within-subject SD). The results of such calculations are presented in Figure 2. Analyses were conducted for each NEUROTICISM condition examining whether the slope of the relationship between negative events and anxious symptoms significantly differed from zero.

Analyses indicated that both adolescents exhibiting high ($t(2648) = 7.93$, $p < .001$) and low ($t(2648) = 11.52$, $p < .001$) levels of neuroticism reported significantly higher levels of anxious symptoms when experiencing high levels of stress than when experiencing low levels of stress. Unexpectedly, planned comparisons of the slopes of the relationship between stress and anxious symptoms revealed that the slope was significantly greater in adolescents exhibiting low levels of neuroticism (slope = 0.35) than in adolescents exhibiting high levels of neuroticism (slope = 0.31; $t(2648) = -2.80$, $p < .01$).

DISCUSSION

The current study examined whether neuroticism confers vulnerability to the development of depressive symptoms following the occurrence of negative events in adolescents. Consistent with hypotheses, higher levels of neuroticism were associated with greater within-subject increases in depressive symptoms following within-subject increases in levels of stress. Findings were robust in that they replicated across our urban and rural samples despite important demographic differences between these two groups. It is important to note that the pattern of findings observed in the current study is similar to those obtained in past research conducted with adolescents in Western cultural contexts (Kendler, Gatz, & Pedersen, 2006; Hayward, Killen, Kraemer, & Taylor, 2000; Hutchinson & Williams, 2007) highlighting important similarities in the pathways leading to the development of depressive symptoms in Chinese and Western youth. In addition, it is important to note that the current findings expand upon those obtained in past research examining the association between neuroticism and depressive symptoms in Chinese samples (Furnham & Cheng, 1999; Zheng, Sang, & Lin, 2004) as the current study used a multi-wave longitudinal design as opposed to a cross-sectional design.

Specificity for the association between neuroticism and depressive symptoms was not found as neuroticism was also a prospective predictor of change in anxious symptoms. At the same time, contrary to hypotheses, higher levels of neuroticism were associated with lesser within-subject increases in anxious symptoms following within-subject increases in stress levels. Importantly, this unanticipated finding replicated across our urban and rural samples suggesting that it is not simply a spurious

association. One possible interpretation of this finding is that whereas neuroticism serves as a predictor of increases in depressive symptoms following the occurrence of negative events, it serves as a predictor of chronically elevated levels of anxiety. Such chronically elevated levels of anxiety may lead individuals exhibiting higher levels of neuroticism to experience lesser increases in anxious symptoms following increases in stress as they already show high levels of anxious symptoms prior to the occurrence of stressors (i.e., ceiling effect). Additional research is needed examining whether such chronically elevated levels of anxiety in individuals exhibiting high levels of neuroticism is due to the acuity of the state or to the exposure of previous symptoms of anxiety (Bienvenu, Samuels, Costa, Reti, Eaton, & Nestadt, 2004). In addition, such research should aim to replicate the current pattern of findings using alternative measures of anxious symptoms in order to rule out the possibility that current results were due to a ceiling effect exhibited specifically by the current measure of anxious symptoms.

Regarding sex differences, although, girls reported higher levels of depressive symptoms than did boys at the time of the initial assessment, reliable sex differences in depressive symptoms were not observed during the six months follow-up interval in either our urban or rural sample. Such a lack of a reliable sex difference in depressive symptoms precluded our test of both mediation and moderation models of sex differences in depression. It is important to note that the results of the current study are not inconsistent with the findings of past research as several studies conducted in mainland China have failed to report sex differences in depressive symptoms (Furnham & Cheng, 1999; Song et al., 2008). At the same time, although girls and boys did not

reliably differ from one another in terms of levels of depressive symptoms, girls reported higher levels of anxious symptoms than did boys at all seven assessments. It is possible that girls' higher levels of anxious symptoms are due to their exhibiting higher levels of neuroticism. At the same time, as such an association was not hypothesized in the current study, future research is needed examining this possibility.

Limitations and Future Directions

Several limitations of the current study should be noted. First, self-report measures were used to assess depressive/anxious symptoms. Although both the CES-D and the MASC exhibit high levels of reliability and validity, it is difficult to make conclusions about clinically significant depression and anxiety using self-report measures. Future studies should utilize semi-structured interviews in order to examine whether the current findings generalize to the development of clinically significant episodes of depressive and anxious symptoms. Similarly, a self-report measure (ALEQ) was utilized for the assessment of initial and follow-up frequencies of negative life events. Although ALEQ exhibits good internal consistency, it may provide an inaccurate measure of the frequency and quality of life stress among adolescents, as compared to semi-structured interviews. Thus, future research utilizing self-report as well as semi-structured interviews needs to explore the most accurate measures of the frequency and quality of negative life events.

Second, the current study assessed all variables utilizing self-report measures originally developed in the West. Future research should therefore attempt to replicate the current pattern of findings using indigenous measures of all constructs. Third, although this study was conducted in two separate areas of mainland China, it is unclear

whether similar findings would be obtained in samples of adolescents residing in other regions of China. Future research should attempt to replicate the current findings in samples of youth residing in regions of China that differ from urban and rural Hunan province in theoretically meaningful ways in order to further examine issues pertaining to generalizability. Fourth, the current study examined the association between neuroticism and depressive/anxious symptoms and although we did not find specificity to depressive symptoms, we did find an unexpected association with anxious symptoms. This will need to be explored further in future studies of younger and older samples, and in Western as well as other non-Western countries.

In conclusion, this study demonstrates: that neuroticism confers vulnerability to depressive and anxious symptoms; the non-specific nature of the association between neuroticism and depression, and neuroticism and anxiety; the different strength of the association between neuroticism and depressive, and neuroticism and anxious symptoms at times of low vs. high stress; and the lack of meaningful sex differences, among Chinese youth within two locations in mainland China. Additional prospective and cross-cultural research examining neuroticism's role as a vulnerability to depression/anxiety is needed to expand upon the current findings, especially among today's youth.

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TABLE(S)

Table 1. Intercorrelations between Time 1 Measures in Changsha and Liuyang.

	1	2	3	4
Changsha				
1. Depressive Symptoms (CES-D)				
2. Anxious Symptoms (MASC)	.63***			
3. Neuroticism (NEO-FFIN)	.63***	.54***		
4. Gender	-.07	-.27***	-.20***	
Liuyang				
1. Depressive Symptoms (CES-D)				
2. Anxious Symptoms (MASC)	.55***			
3. Neuroticism (NEO-FFIN)	.60***	.56***		
4. Gender	-.07	-.27***	-.16***	

Note: Depressive Symptoms = Time 1 Center for Epidemiological Studies Depression Scale (CES-D) scores; Anxious Symptoms = Time 1 Multidimensional Anxiety Scale for Children (MASC) scores; Neuroticism = NEO Five Factor Inventory, Neuroticism subscale; Gender = coded variable whereby 0 = female and 1 = male.
* $p \leq 0.05$. ** $p \leq 0.01$. *** $p \leq .001$

Table 2. Means and Standard Deviations for Time 1 Measures: Site by Gender comparisons.

	Changsha		Liuyang	
	Boys	Girls	Boys	Girls
Depressive Symptoms	31.52_a (8.73)	32.69_{ab} (9.31)	33.00_{ab} (8.33)	34.27_b (8.92)
Anxious Symptoms	40.00_a (15.29)	49.21_b (16.12)	43.46_a (14.44)	52.24_b (15.94)
Neuroticism	32.64_a (7.12)	35.60_b (7.24)	32.53_a (7.59)	35.02_b (8.01)

Note: Depressive Symptoms = Time 1 Center for Epidemiological Studies Depression Scale (CES-D) scores; Anxious Symptoms = Time 1 Multidimensional Anxiety Scale for Children (MASC) scores; Neuroticism = NEO Five Factor Inventory, Neuroticism subscale; Means with different subscripts significantly differ ($p \leq 0.05$).

Table 3. Means and Standard Deviations for Follow-up Measures: Site by Gender comparisons.

	Changsha		Liuyang	
	Boys	Girls	Boys	Girls
CES-D Follow-Up 1	32.96_a (9.17)	33.69_a (9.82)	32.41_a (8.68)	32.96_a (8.39)
CES-D Follow-Up 2	31.84_a (8.99)	32.63_a (9.73)	33.15_a (9.72)	33.37_a (9.24)
CES-D Follow-Up 3	30.80_a (8.95)	32.86_{ab} (10.72)	32.19_{ab} (8.44)	33.06_b (9.90)
CES-D Follow-Up 4	30.75_a (9.42)	33.29_a (11.50)	31.69_a (9.05)	32.07_a (9.27)
CES-D Follow-Up 5	30.51_a (9.45)	31.44_{ab} (10.03)	31.90_{ab} (9.13)	32.96_b (9.58)
CES-D Follow-Up 6	30.49_a (9.79)	32.88_b (12.10)	31.85_{ab} (9.10)	33.51_b (10.04)
MASC Follow-Up 1	35.86_a (14.06)	43.71_b (17.76)	41.37_b (14.23)	50.00_c (16.23)
MASC Follow-Up 2	31.92_a (15.69)	41.25_b (18.35)	39.89_b (16.40)	45.80_c (18.35)
MASC Follow-Up 3	28.94_a (17.65)	38.34_b (18.55)	36.35_b (18.02)	42.40_c (19.88)
MASC Follow-Up 4	27.77_a (18.02)	35.75_b (20.49)	33.66_b (18.98)	40.18_c (21.46)
MASC Follow-Up 5	27.16_a (18.20)	35.60_b (19.76)	34.45_b (19.70)	41.24_c (21.24)
MASC Follow-Up 6	23.57_a (17.99)	34.64_b (21.32)	32.69_b (19.68)	39.96_c (22.03)
ALEQ Follow-Up 1	107.60_a (23.73)	105.38_{ab} (23.81)	105.58_{ab} (23.03)	100.70_b (20.75)
ALEQ Follow-Up 2	99.87_a (25.69)	101.50_a (25.96)	102.19_a (23.79)	97.08_a (21.83)
ALEQ Follow-Up 3	92.95_a (25.25)	95.52_a (26.19)	97.81_a (25.65)	94.36_a (24.81)
ALEQ Follow-Up 4	89.87_a (23.93)	92.54_{ab} (26.73)	94.81_b (27.39)	91.82_{ab} (24.14)
ALEQ Follow-Up 5	86.59_a (24.57)	88.61_a (23.50)	94.19_b (26.13)	91.93_{ab} (23.56)
ALEQ Follow-Up 6	85.76_a (23.63)	90.12_b (25.43)	92.82_b (27.56)	90.77_b (24.10)

Note: CES-D = Center for Epidemiological Studies Depression Scale (CES-D), Follow-Up scores; MASC = Multidimensional Anxiety Scale for Children (MASC), Follow-Up scores; ALEQ = Adolescent Life Events Questionnaire (ALEQ), Follow-Up scores; Means with different subscripts significantly differ ($p \leq 0.05$).

Table 4. Neuroticism Predicting Within-Subject Fluctuations in CES-D Scores during Follow-Up Interval.

	Changsha (Urban)				Liuyang (Rural)			
	β	*SE*	*F*	*df*	β	*SE*	*F*	*df*
Gender	1.43	0.41	12.35***	1,529	1.13	0.42	7.33**	1,557
Time 1 CES-D	3.86	0.26	220.64***	1,529	3.23	0.26	151.70***	1,557
Anxiety	0.20	0.01	507.38***	1,2405	0.19	0.01	486.47***	1,2619
Stress	0.08	0.01	66.82***	1,2405	0.06	0.01	36.93***	1,2619
Neuroticism	1.10	0.27	16.84***	1,529	1.20	0.27	19.83***	1,557
Neuroticism × Stress	0.03	0.01	12.48***	1,2405	0.02	0.01	3.96*	1,2619

Note: Gender = A coded variable whereby 0 = girl and 1 = boy; Time 1 CES-D = Time 1 Center for Epidemiological Studies Depression Scale (CES-D) scores; Anxiety = Within-subject fluctuations in Multidimensional Anxiety Scale for Children (MASC) scores during the follow-up interval; Stress = Within-subject fluctuations in Adolescent Life Events Questionnaire (ALEQ) scores during the follow-up interval; Neuroticism = NEO Five Factor Inventory, Neuroticism subscale.
* $p \leq 0.05$. ** $p \leq 0.01$. *** $p \leq .001$

Table 5. Neuroticism Predicting Within-Subject Fluctuations in MASC Scores during Follow-Up Interval.

	Changshaa (Urban)				Liuyang (Rural)			
	β	*SE*	*F*	*df*	*β*	*SE*	*F*	*df*
Gender	3.58	0.98	13.38***	1,532	2.00	0.90	4.91*	1,563
Time 1 MASC	8.41	0.58	212.49***	1,532	8.98	0.54	276.09***	1,563
Depression	0.51	0.03	324.25***	1,2416	0.55	0.03	363.20***	1,2648
Stress	0.26	0.02	264.01***	1,2416	0.29	0.02	292.59***	1,2648
Neuroticism	2.04	0.58	12.41***	1,532	1.48	0.54	7.45**	1,563
Neuroticism × Stress	-0.03	0.02	4.10*	1,2416	0.05	0.02	7.83**	1,2648

Note: Gender = A coded variable whereby 0 = girl and 1 = boy; Time 1 MASC = Time 1 Multidimensional Anxiety Scale for Children (MASC) scores; Depression = Within-subject fluctuations in Center for Epidemiological Studies Depression Scale (CES-D) scores during the follow-up interval; Stress = Within-subject fluctuations in Adolescent Life Events Questionnaire (ALEQ) scores during the follow-up interval; Neuroticism = NEO Five Factor Inventory, Neuroticism subscale.
* $p \leq 0.05$. ** $p \leq 0.01$. *** $p \leq .001$

FIGURES

Figure 1. Predicted slope of the relationship between negative events and depressive symptoms as a function of neuroticism among adolescents from Changsha and Liuyang.
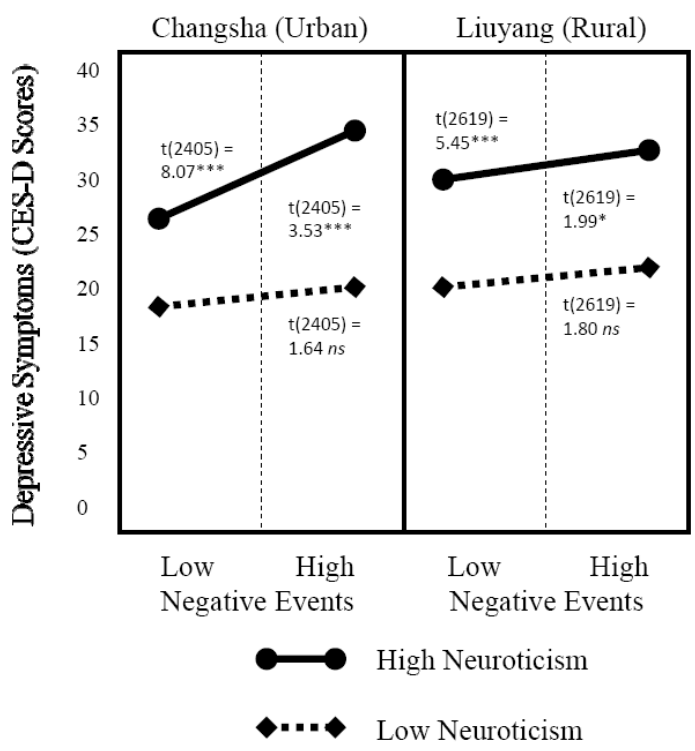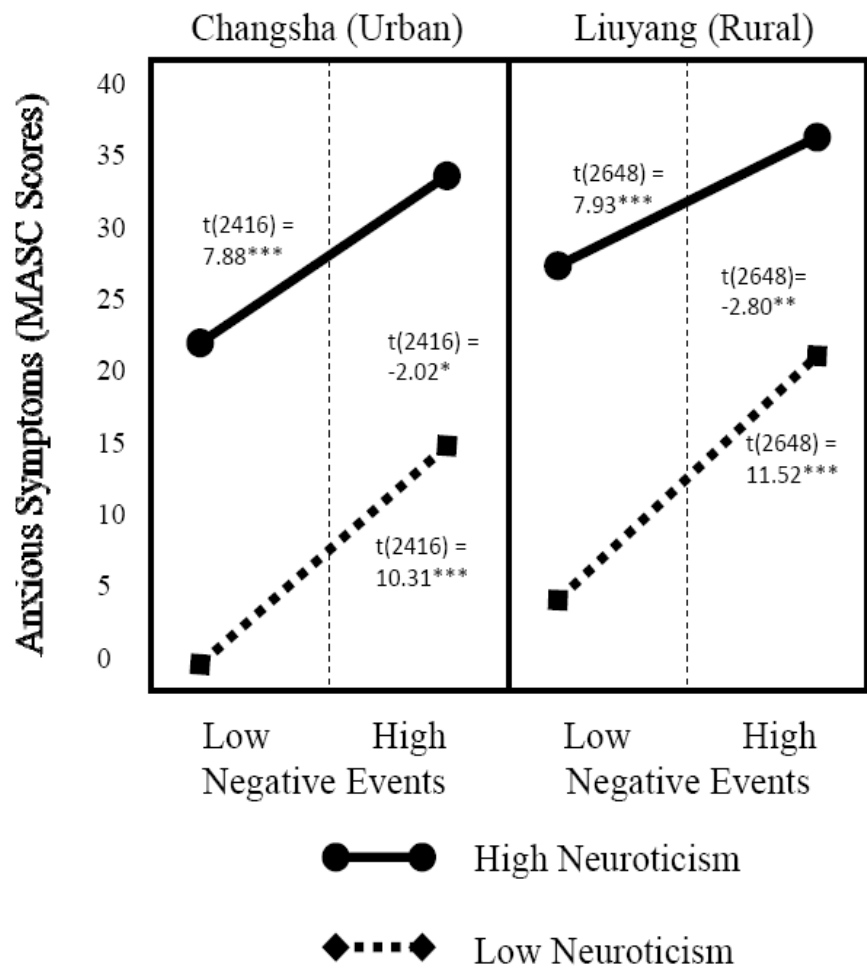
Figure 2. Predicted slope of the relationship between negative events and anxious symptoms as a function of neuroticism among adolescents from Changsha and Liuyang.

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