Cognitive Vulnerabilities Amplify the Effect of Early Pubertal Timing on Interpersonal Stress Generation During Adolescence

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Abstract

Early pubertal timing has been found to confer risk for the occurrence of interpersonal stressful events during adolescence. However, pre-existing vulnerabilities may exacerbate the effects of early pubertal timing on the occurrence of stressors. Thus, the current study prospectively examined whether cognitive vulnerabilities amplified the effects of early pubertal timing on interpersonal stress generation. In a diverse sample of 310 adolescents (M age = 12.83 years, 55 % female; 53 % African American), early pubertal timing predicted higher levels of interpersonal dependent events among adolescents with more negative cognitive style and rumination, but not among adolescents with lower levels of these cognitive vulnerabilities. These findings suggest that cognitive vulnerabilities may heighten the risk of generating interpersonal stress for adolescents who undergo early pubertal maturation, which may subsequently place adolescents at greater risk for the development of psychopathology.

Introduction

Adolescence is a challenging developmental period during which individuals experience a dramatic increase in the occurrence of stressful life events, particularly stressors within interpersonal relationships (Ge et al. 1994). Although interpersonal stressors are common among all adolescents, those who undergo the pubertal transition earlier than their same-age, same-sex peers often experience a greater number of stressful events (Conley and Rudolph 2009). Specifically, early-maturing adolescents are at greater risk for a range of interpersonal challenges, such as peer rejection and victimization (Nadeem and Grahm 2005), physical victimization (Haynie and Piquero 2006), escalated familial conflict (Paikoff and Brooks-Gunn 1991), affiliation with deviant peers (Ge et al. 2002), criminal delinquency (Williams and Dunlop 1999), and earlier participation in romantic and sexual relationships (Kaltiala-Heino et al. 2003). Further, earlier pubertal timing exposes adolescents to an array of biological and psychosocial stressors at a time when they have insufficient cognitive, emotional, and social resources to manage them effectively (Petersen and Taylor 1980). In this sense, early pubertal timing may expose adolescents to additional interpersonal stressors, which, in turn, increases the risk of psychopathology (Conley and Rudolph 2012; for a review, see Mendle et al. 2007). However, given that not all early-maturing adolescents experience higher levels of stressful events or subsequent adjustment problems (Graber 2003), individual differences in vulnerability may contribute to the occurrence of interpersonal stressors among early-maturing adolescents.

According to the accentuation hypothesis (Caspi and Moffitt 1991; Ge and Natsuaki 2009), puberty is a novel and ambiguous situation that elicits or accentuates individual differences in response to a stressful life transition. Whereas adolescents without underlying vulnerabilities will respond adaptively to the pubertal changes, individuals with pre-existing vulnerabilities to psychopathology may have difficulty managing the pubertal transition, thereby exacerbating the negative effects of puberty (Caspi and Moffitt 1991). This is especially true for individuals who undergo pubertal maturation earlier than their peers. A number of studies have found that individuals who experience early pubertal timing and have pre-existing vulnerabilities, such as prior psychological symptoms (e.g., depression), behavioral problems, and maladaptive coping strategies, are at increased risk for internalizing and externalizing symptoms (Ge et al. 2001). For instance, Rudolph and Troop-Gordon (2010) found that early pubertal timing predicted subsequent depression among adolescents with a pre-existing vulnerability to depression, including a prior history of depression, depressive personality traits (e.g., negative self-focus), and maladaptive stress response. Thus, the impact of early pubertal timing on depression might be stronger among adolescents with pre-existing vulnerabilities to depression.

Although prior vulnerabilities may increase the effect of early pubertal timing on psychological difficulties, underlying vulnerabilities may also contribute to heightened interpersonal stressors among early-maturing youth. According to the stress generation perspective (Hammen 1991; see Liu and Alloy 2010), individuals who are depressed or vulnerable to depression experience more stressful life events than those who are not depressed or vulnerable to depression. This suggests that depression-prone individuals may possess certain characteristics or behaviors that actively contribute to the occurrence of interpersonal stressors in their lives. Key to this theory is the distinction between events that are dependent (i.e., events that are at least somewhat dependent on the behaviors and

characteristics of the adolescent) and independent (i.e., fateful events to which the adolescent would not be expected to contribute). For example, a fight with a friend would be categorized as an interpersonal dependent event because the adolescent directly or indirectly contributed to this event, whereas the death of a loved one would be characterized as an interpersonal independent event because its occurrence was beyond the control of the adolescent. Although most research has focused on the role of depressive and anxiety symptoms on stress generation (for a review, see Liu 2013), recent studies have extended this line of research to investigate the stress generation capacity of underlying vulnerabilities to depression, which often predict the onset of depression (Abela and Hankin 2008).

Cognitive vulnerabilities to depression in particular have received considerable attention in recent years, with research demonstrating that cognitively vulnerable individuals experience more interpersonal and dependent events than non-cognitively vulnerable individuals, beyond the effects of depression diagnoses and symptoms (Safford et al. 2007). Specifically, two prominent and empirically supported cognitive vulnerabilities, negative cognitive style (i.e., the tendency for individuals to make negative attributions regarding the causes, meaning, and consequences of negative events; Abramson et al. 1989) and rumination (i.e., the tendency to focus repetitively and passively on dysphoric mood and its possible causes and meanings; Nolen-Hoeksema 1991), have been found to confer risk for depression among adolescents (for a review, see Abela and Hankin 2008), and more recently, to contribute to the occurrence of interpersonal dependent stressors (Hamilton et al. 2013; Kercher and Rapee 2009). These studies posit that adolescents with negative cognitive styles and ruminative tendencies may particularly be prone to experiencing interpersonal dependent stressors, including conflicts with parents or peers and even peer victimization (McLaughlin and Nolen-Hoeksema 2012), rather than independent (or fateful) events. In this sense, cognitively vulnerable adolescents may unintentionally behave in certain ways that evoke difficulties in interpersonal relationships, such as excessive reassurance seeking (Potthoff et al. 1995), but these behaviors or characteristics would not be expected to contribute to more independent interpersonal stressors.

Not surprisingly, the stress generation effect through which individuals contribute to greater interpersonal dependent stressors becomes more pronounced as individuals progress from middle childhood to adolescence, when individuals must also face the challenges of puberty (Cole et al. 2006). However, only one study has examined the accentuation hypothesis from a stress generation perspective; that is, whether individual differences in vulnerabilities exacerbated the effects of pubertal maturation on interpersonal stressors. Specifically, Rudolph (2008) examined the effects of early pubertal timing on stress generation among adolescents with and without depression, finding that depression predicted greater interpersonal dependent events among early-maturing adolescents, but not late-maturing adolescents. Although this study sheds light on the role of depression during early pubertal maturation on stress generation, no known study has examined whether cognitive vulnerabilities to depression exacerbate the effects of early pubertal timing on stress generation.

Early pubertal maturation may be particularly difficult for adolescents with cognitive vulnerabilities, independent of the effects of depressive symptoms, because they have more limited cognitive and emotional resources to negotiate the pubertal transition than early-maturing peers without these cognitive vulnerabilities. In particular, adolescents with negative cognitive styles may be more likely to respond negatively to physical maturation if they are maturing earlier than their social comparison group. Additionally, adolescents with negative cognitive styles may make more negative inferences regarding the cause, consequences, and implications of ambiguous situations that occur during puberty, which may lead to more subsequent stressors. Further, early-maturing adolescents may experience

greater mood fluctuations as a result of hormonal changes (Buchanan et al. 1992), and adolescents with a tendency to ruminate may be more likely to focus on the causes and meaning of their negative mood states, subsequently resulting in the occurrence of stressors. Thus, early-maturing youth with cognitive vulnerabilities may be more likely to contribute to the occurrence of interpersonal dependent events, rather than simply be exposed to more interpersonal stressors in general. In this sense, cognitive vulnerabilities may amplify the effects of early puberty on stressful events, specifically interpersonal dependent events.

Hypotheses of the Present Study

Building upon past research and theory, the purpose of the current study was to examine whether cognitive vulnerabilities amplified the effect of early pubertal timing on negative interpersonal events. Specifically, the current study evaluated whether early pubertal timing predicted interpersonal dependent and interpersonal independent events for adolescents with greater negative cognitive styles and rumination, controlling for adolescents' initial depressive and anxiety symptom levels. In line with the stress generation theory (Hammen 1991), we hypothesized that early maturation would predict higher levels of interpersonal dependent events, but not interpersonal independent events, among adolescents with more negative cognitive styles and ruminative tendencies, but not among those without these cognitive vulnerabilities.

Methods

Sample Recruitment

The current study's sample of 310 adolescents was recruited as part of the Temple University Adolescent Cognition and Emotion Project, an ongoing longitudinal study designed to examine the emergence of depression and anxiety among adolescents. Specifically, Caucasian and African American adolescents who were 12- or 13-years old were recruited from Philadelphia-area middle schools through either school mailings and follow-up phone calls (approximately 68 % of the sample) or advertisements placed in Philadelphia-area newspapers (approximately 32 % of the sample). Interested participants initially completed a screening over the phone to determine eligibility. To be eligible for the study, adolescents had to be 12 or 13 years old, self-identify as Caucasian/White, African-American/Black, or Biracial (Hispanic adolescents were eligible if they also identified as White or Black), and have a mother/primary female caretaker also willing to participate in the study. Adolescents were ineligible for the study if there was no mother/primary female caretaker available to participate; the mother or adolescent was psychotic, mentally retarded, had a severe developmental disorder, or a severe learning disability; or the mother or adolescent was unable to complete study measures due to the inability to read or speak English or for any other reason (see Alloy et al. 2012 for further details regarding recruitment).

Participants

The sample for the current study consisted of 310 adolescents (53 % African-American; 55 % female) who completed an initial baseline assessment (Time 1) and one follow-up assessment (Time 2) approximately nine months apart (M = 283.33 days; SD = 97.40 days). Participants were enrolled on an ongoing basis, so that data collection began for the first participants in 2010 and was completed for the final participants in 2012. The study sample was 12.83 years old (SD = .61). Twenty-five percent of families participating in the study had total incomes falling below $30,000; 34 % of the families' incomes were between $30,000 and $59,999, 19 % were between $60,000 and $89,999, and 22 % above $90,000. Overall, 47 % of adolescent participants were eligible for free school lunch, a measure of

financial need that accounts for the number of dependents being supported on the family's income.

An original sample of 346 adolescents completed the Time 1 assessment. However, 36 families declined further participation (89.5 % retention rate). Only adolescents with complete data on all study measures were included in the present study; thus, list-wise deletion was used for the final sample of 310. Adolescents who did not complete the Time 2 assessment were more likely to be African American (χ^2 = 6.44, p < .05).

Procedures

Two assessments spaced approximately nine months apart (M = 283.33 days; SD = 97.40 days) were utilized in the current study to provide a prospective design. At Time 1, adolescents completed self-report questionnaires assessing pubertal development, cognitive vulnerabilities (rumination and negative cognitive style), and current depressive and anxiety symptoms. At the Time 2 assessment, adolescents and their mothers completed self-report questionnaires assessing experiences of stressful life events that occurred in the adolescent's life between the Time 1 and Time 2 assessments; adolescents were then interviewed to verify reported events and to obtain further information on occurrences. Adolescents were compensated for their participation at each study visit.

Measures

Pubertal Timing—The Pubertal Development Scale (PDS; Petersen et al. 1988) assesses pubertal development via self-report. The PDS rates five characteristics: growth spurt in height, body hair, skin change, breast change (girls only)/voice change (boys only), and facial hair growth (boys)/menstruation (girls). Each characteristic (except menstruation) is rated on a 4-point scale (1 = *no development*, 2 = *development has barely begun*, 3 = *development is definitely underway*, 4 = *development is complete*). For girls, whether they experienced menstruation is rated using a dichotomous response (1 = no, 4 = yes) and included in the total PDS score (Rudolph 2008); however, age of menstruation was not included in the PDS score. Higher scores indicate more mature pubertal status. The PDS has good psychometric properties and good convergent validity based on self- and physician-rated Tanner stages (Petersen et al. 1988). Similar psychometrics have been obtained in a multi-ethnic sample (Siegel et al. 1999). Separately for males and females, the PDS total score was regressed on age, and the residual obtained was used as a continuous measure of pubertal timing (Dorn et al. 2003). Internal consistency for the PDS in this sample was α = .66 for girls and α = .74 for boys at Time 1.

Depressive Symptoms—Depressive symptoms were assessed using the Children's Depression Inventory (CDI; Kovacs 1985), which is a 27-item self-report measure designed to assess affective, behavioral, and cognitive symptoms of depression in youth ages 7–17. Each of the 27 items is rated on a 0–2 scale and items are summed for a total depression score (ranging from 0 to 54), with higher scores indicating more depressive symptoms. The CDI has good reliability and validity (Klein et al. 2005). Internal consistency in this sample was α = .85 at Time 1.

Anxiety Symptoms—The Multidimensional Anxiety Scale for Children (MASC; March et al. 1997) is a 39-item self-report questionnaire assessing anxiety symptoms in youth. It includes symptoms of physiological arousal, social anxiety, harm avoidance, and separation anxiety. Adolescents responded to each item on 4-point Likert scales with response options of never, rarely, sometimes, or often. Higher scores indicate greater symptom levels and only the total MASC score was used. The MASC has been demonstrated to have excellent

retest and internal reliability, and good convergent and discriminant validity (March et al. 1997). There was adequate internal consistency in this sample at Time 1 (α = .86).

Negative Cognitive Style—The Adolescent Cognitive Style Questionnaire-Modified (ACSQ-M; Alloy et al. 2012) is a modified version of the ACSQ (Hankin and Abramson 2002), which assesses adolescents' cognitive styles based on their interpretations of the causes, consequences, and self-worth implications of negative life events. In addition to events in the achievement and interpersonal domains from the original ACSQ, the ACSQ-M also contains negative events in the physical appearance domain, another area of increasing importance during adolescence. The ACSQ-M presents adolescents with 12 hypothetical negative events in the achievement, interpersonal, or appearance domains (4 events per domain). Adolescents are asked to make inferences regarding the stability ("will it cause [the same event] to happen in the future?"), and globality ("will it cause problems in other parts of your life?") of causes, as well as the consequences ("will other bad things happen to you in the future because of [the event]?") and self-worth implications ("Is there something wrong with you because of [the event]?") of each event. Each dimension is rated on a 1–7 scale, with higher scores indicating a more negative cognitive style.

Because we studied a sample of early adolescents and research suggests that inferential styles may be less internally consistent and stable during this time (Abela and Hankin 2008), we used each adolescent's weakest link on the ACSQ in our analyses in lieu of the overall full-scale ACSQ score. The weakest link consists of the score for the most negative dimension of inferential style (i.e., stability, globality, consequences, self-implications). According to Abela and Sarin (2002), adolescents' negative inferences about the negative events should increase the likelihood of developing depression regardless of whether the inferences are about the causes, consequences, or self. Consistent with this, a number of studies have found that adolescents' weakest link scores more strongly predict increases in depressive symptoms and negative events than the full scale (Abela and Hankin 2008). The ACSQ and ACSQ-M have demonstrated excellent internal consistencies, good retest reliabilities, and adequate factor structures as measures of negative cognitive style among adolescents (Hankin and Abramson 2002; Alloy et al. 2012). Internal consistencies in this sample for the five individual dimensions were α = .83–.89 at Time 1.

Rumination—The Children's Response Styles Questionnaire (CRSQ; Abela et al. 2004) is a 25-item self-report questionnaire assessing youths' responses to sad or depressed mood with rumination, distraction, or problem-solving. Adolescents rate the frequency of their thoughts or feelings when they are sad on 4-point scales ranging from never (1) to almost always (4), with higher scores within a subscale indicating a greater tendency to use that response style when experiencing sad/depressed mood. The current study used only the rumination subscale. The CRSQ has shown good validity and moderate internal consistency in previous studies (Abela et al. 2004). Internal consistency for the rumination subscale in this sample was α = .77 at Time 1.

Negative Life Events—The Adolescent Life Events Questionnaire (ALEQ; Hankin and Abramson 2002) is a self-report questionnaire designed to assess the occurrence of negative or stressful life events that typically occur during adolescence, including family, peer, and school/achievement events. At the Time 2 assessment, adolescents and their mothers completed separate versions of the 63-item ALEQ and indicated all events that occurred in the adolescent's life since the Time 1 assessment. Following completion of the ALEQ, adolescents completed the Life Events Interview (LEI; Safford et al. 2007) with trained interviewers. Interviewers used a priori probes specific to each event to determine whether events endorsed on the ALEQ by adolescents and/or their mothers met a priori definitional

criteria and occurred during the outlined time period. Any events that did not meet the stringent criteria were disqualified, thus reducing the potential for reporter bias.

All events were categorized as either dependent (occurring at least in part because of the characteristics or behavior of an individual) or independent (fateful events to which an individual would not be expected to contribute; e.g., Hammen 1991). A team of four doctoral students in clinical psychology independently provided a priori dependence and independence ratings for all 63 events ($\kappa = .76$). Any discrepancies of ratings were discussed before a consensus rating was made, resulting in a total of 42 dependent and 21 independent events. All events were further categorized as either interpersonal (e.g., romantic break up) or achievement (e.g., failed a test), resulting in 47 interpersonal events (31 dependent; 16 independent), 10 achievement events (all 10 were categorized as dependent), and 6 events that were judged as neither interpersonal nor achievement-based (not included in the current analyses). Because interpersonal stressors were the focus of the current study, analyses were conducted using only interpersonal dependent events (e.g., "Your parent(s) punished or grounded you" or "you have an argument or fight with a friend") and interpersonal independent events (e.g., "A close family member(s) was arrested" or "a close friend moved away"). All qualifying events based on the LEI were totaled in each category, with higher scores indicating more exposure to the type of stressors in each category. The total number of events in each domain (interpersonal dependent and interpersonal independent) at Time 2 was used in the current study. The ALEQ and LEI have demonstrated excellent reliability and validity (e.g., Hankin and Abramson 2002; Safford et al. 2007).

Data Analysis

Prior to beginning data analysis, assumptions of linear regressions were examined for all primary study variables. All variables met assumptions for linearity and normality, with the exception of interpersonal independent events, which exhibited moderate skewness (1.27) and kurtosis (2.46). Therefore, a square root transformation was used on the interpersonal independent events variable and all further analyses were conducted with both the raw data and the transformed variable. Because the transformed variable revealed a similar pattern of results, only the variable using raw data was included in the manuscript for ease of interpretation.

To examine whether pubertal timing interacted with negative cognitive style and rumination to predict interpersonal life events at Time 2, controlling for initial levels of depressive and anxiety symptoms, multiple hierarchical linear regressions were conducted. Poisson regressions were also conducted because the dependent variables were counts of events. In these analyses, each type of Time 2 interpersonal events (dependent and independent) served as the dependent variable. To examine the unique effects of Time 1 pubertal timing and cognitive vulnerabilities beyond the effects of internalizing symptoms, Time 1 levels of depressive and anxiety symptoms were entered in Step 1 of the regression along with sex and race (Miller and Chapman 2001). In Step 2 of the regression, the main effects of pubertal timing and cognitive vulnerabilities (separately) were entered. Finally, the interactive effects of pubertal timing and negative cognitive style, as well as pubertal timing and rumination, were entered in Step 3.

Results

Descriptive Analyses

Table 1 presents intercorrelations and descriptive statistics of study variables. Rumination and negative cognitive style weakest link were significantly positively correlated with each other and with symptoms of depression and anxiety, but were not correlated with pubertal

timing. Interpersonal dependent and independent events were significantly positively correlated with each other and with internalizing symptoms. Pubertal timing was significantly correlated with interpersonal dependent and independent events.

Additionally, we also examined whether there were sex differences on primary study variables. Relative to boys, girls had significantly greater levels of pubertal development ($t = 9.05$, $p < .001$), and they experienced more interpersonal dependent events ($t = 3.59$, $p < .001$) and independent events ($t = 2.85$, $p < .01$). Girls did not differ significantly from boys in rumination ($t = 1.71$, $p = .09$), negative cognitive style weakest link ($t = 0.52$, $p = .61$), or Time 1 symptoms of depression ($t = 1.90$, $p = .06$) and anxiety ($t = 1.20$, $p = .23$).

Prospective Analyses

As hypothesized, there was a significant interaction between Time 1 pubertal timing and negative cognitive style predicting interpersonal dependent events at Time 2 (Table 2), controlling for Time 1 depressive and anxiety symptoms and the main effects of pubertal timing and negative cognitive style. To investigate the form of this interaction, we evaluated the effects of early pubertal timing on interpersonal dependent events at one standard deviation above and below the mean of negative cognitive style (Aiken and West 1991). There was a significant effect of early pubertal timing on interpersonal dependent events among adolescents with more negative cognitive styles ($t = 2.41$, $p = .02$), but not among adolescents with lower levels of negative cognitive styles ($t = -.87$, $p = .39$; Fig. 1). Specifically, early-maturing adolescents with more negative cognitive styles experienced approximately eight interpersonal dependent events, whereas later-maturing adolescents with more negative cognitive styles experienced approximately three interpersonal dependent events. In contrast, there was not a significant interaction between pubertal timing and negative cognitive style predicting interpersonal independent stressors at Time 2 (Table 2).

There also was a significant interaction between pubertal timing and rumination predicting interpersonal dependent events at Time 2 (Table 3), controlling for initial internalizing symptoms and the main effects of pubertal timing and rumination. The form of this interaction was such that early pubertal timing predicted higher levels of interpersonal dependent events among adolescents with more ruminative tendencies ($t = 2.23$, $p = .03$), but not among adolescents with lower levels of rumination ($t = -.69$, $p = .49$; Fig. 2). Specifically, earlier-maturing adolescents with ruminative tendencies experienced approximately eight interpersonal dependent events, whereas later-maturing adolescents with high levels of rumination experienced approximately three interpersonal dependent events. In contrast, pubertal timing and rumination did not interact to predict interpersonal independent events at Time 2 (Table 3). The results for the Poisson regressions were consistent with those presented in the hierarchical linear regressions, and thus, only linear regression results are presented (Poisson regression results available by request from the first author).

Discussion

Adolescents who undergo the pubertal transition earlier than their same-age, same-sex peers are at risk for experiencing a greater number of interpersonal stressors (Conley and Rudolph 2009). Given that many early-maturing adolescents undergo this transition with little difficulty, we evaluated whether cognitive vulnerabilities to depression, specifically negative cognitive styles and rumination, exacerbated the effects of early pubertal timing on the occurrence of negative interpersonal events. Identifying factors that confer risk for early-maturing adolescents is important in understanding which adolescents are most vulnerable to experience heightened negative interpersonal stressors during the pubertal transition.

Overall, our results indicated that early pubertal timing predicted more interpersonal dependent events for adolescents with higher levels of either negative cognitive style or rumination, but not among those with lower levels of either cognitive vulnerability. Moreover, this stress generation effect was specific to interpersonal dependent stressors; there were no effects when examining the influence of pubertal timing on interpersonal independent stressors.

Our findings are consistent with the accentuation hypothesis (Caspi and Moffitt 1991), which proposes that individuals with pre-existing vulnerabilities are particularly at risk for navigating early pubertal maturation with difficulty. We found that cognitive vulnerabilities, specifically negative cognitive style and rumination, confer risk for those who mature early to experience heightened levels of stressors relative to those without such vulnerabilities. However, the specificity of this finding to interpersonal dependent events suggests that early maturing adolescents with cognitive vulnerabilities are not simply exposed to more interpersonal stressors, but may actively contribute to the occurrence of interpersonal events. It is also worth noting that cognitive vulnerabilities exacerbated the effects of early pubertal timing on the occurrence of interpersonal dependent events despite controlling for adolescents' initial depressive and anxiety symptom levels. This is a conservative test of the accentuation hypothesis and indicates that the additional vulnerability to interpersonal stress generation conferred by negative cognitive styles and ruminative tendencies in early maturing adolescents is not simply due to these cognitive styles' association with increased levels of internalizing symptoms.

There are several potential explanations for these findings. Adolescents with early pubertal timing may experience a variety of social stressors, such as social alienation and peer rejection. Individuals who also possess the pre-existing tendency to interpret such events negatively (e.g., negative cognitive styles) may respond to such stressors in ways that generate more negative events in interpersonal relationships (e.g., reassurance seeking; Potthoff et al. 1995). In this sense, early maturing youth with cognitive vulnerabilities may have coping resources that are doubly strained—both by their early pubertal maturation and by their prior cognitive vulnerability, which may contribute to higher levels of interpersonal dependent events. Additionally, individuals with early pubertal timing tend to experience more negative mood than those with on-time or later pubertal timing (Brooks-Gunn and Warren 1989). Individuals who also possess a pre-existing tendency to focus passively on negative mood (i.e., ruminate) may respond to such negative mood in ways that generate more stressors (e.g., perceive and thus utilize social support less often; Nolen-Hoeksema and Davis 1999). Thus, negative cognitive style and rumination may amplify the effects of early pubertal timing on interpersonal dependent stressors. These results are important given that negative interpersonal dependent events are particularly likely to lead to increases in depressive symptoms among adolescents with cognitive vulnerabilities (e.g., Hamilton et al. 2013; Stange et al. 2013).

Several limitations of this study should be acknowledged. First, we used only self-report measures of internalizing symptoms and pubertal development. However, given that perceived pubertal development is associated with negative outcomes (see Mendle et al. 2007 for a review), the perception of pubertal development from the self-report measure may be equally informative. However, future studies using clinical interviews of psychopathology and physician administered measures of pubertal development are needed. Second, this study only had two time points, which precluded us from examining mediation hypotheses. For example, given that rumination often is found to mediate risk factors for stress generation (McLaughlin and Nolen-Hoeksema 2012), it may be that rumination could mediate the synergistic stress generation effects of negative cognitive style and early pubertal timing. Despite these limitations, this study had several strengths as well, including

the use of a diverse sample of adolescents and interview measures of life events, which is important in stress generation research (Hammen 2006).

Conclusions

Overall, the current findings indicate that adolescents who mature earlier than their same-age, same sex peers may be at greater risk for experiencing interpersonal dependent stressors if they also have pre-existing cognitive vulnerabilities to depression. There are several implications of our findings in terms of both risk assessment and prevention, including the importance of assessing pre-existing cognitive vulnerabilities, such as negative cognitive style and rumination, during the pubertal transition, as this is a time of particular risk for interpersonal stress generation. It may be important for schools to provide resiliency programs for adolescents that target cognitive vulnerabilities to depression in children; intervening prior to the pubertal transition could prevent the development of negative cognitive style and ruminative tendencies cognitive vulnerabilities, as well as subsequent increases in stressful events and internalizing symptoms during adolescence. Our findings extend past research (Rudolph 2008) by focusing on the unique effects of cognitive vulnerabilities rather than depression during the pubertal transition. Given that cognitive vulnerabilities are more distal predictors of stress generation than depression, this may enhance the potential for implanting prevention programs and targeting early-maturing individuals prior to the development of depression. Such targeted interventions may have higher success rates in the prevention of depressive episodes than those that wait for children and adolescents to develop increased symptoms of depression. Further, our findings suggest that educators, parents, and adolescents should work collaboratively to enhance adolescents' understanding and acceptance of the pubertal maturation process, which might promote a more positive environment for early-maturing adolescents, and on the development of effective coping strategies for managing interpersonal stress during adolescence.

Acknowledgments

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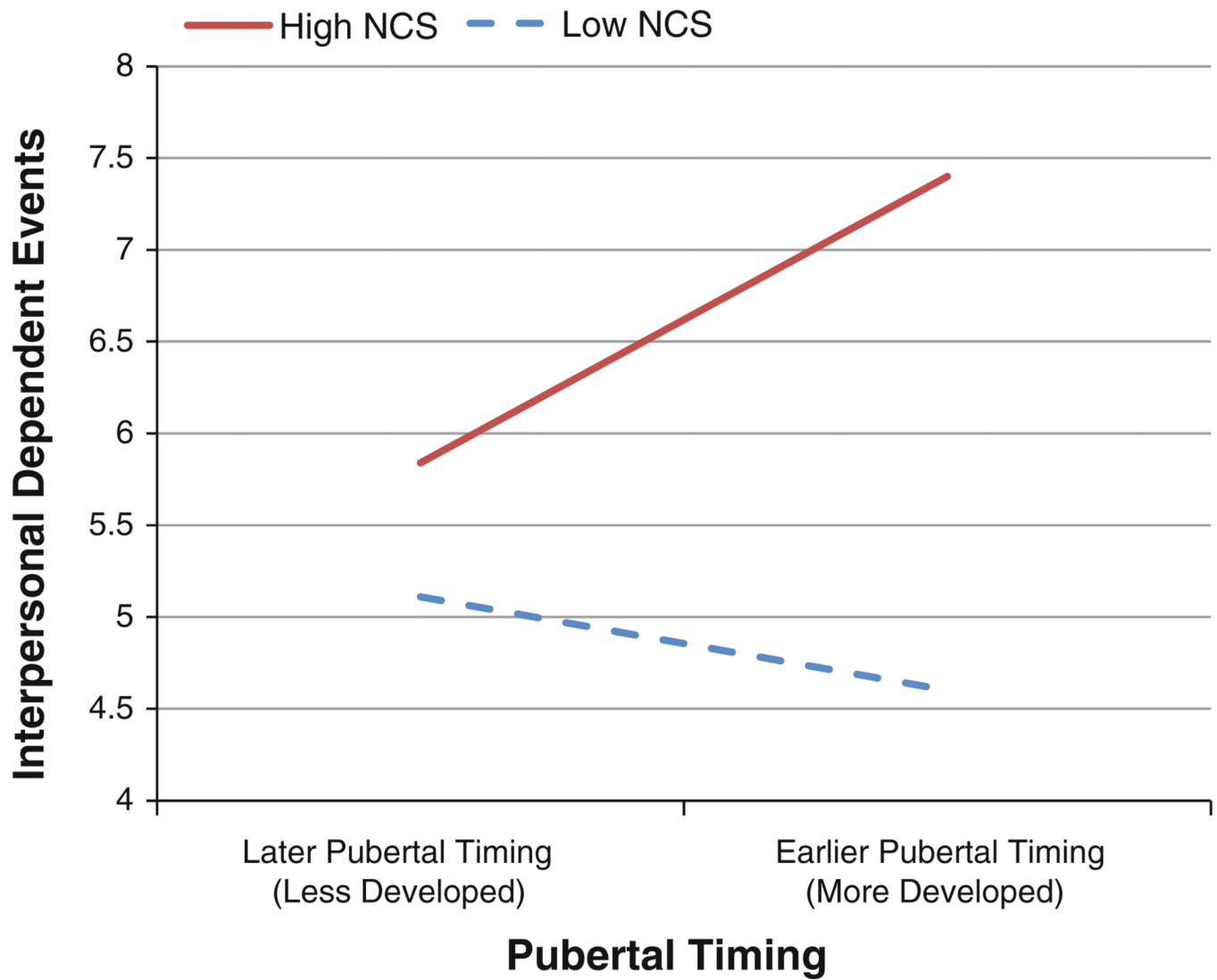
Fig. 1.
Interaction between pubertal timing and negative cognitive style (*NCS*) weakest link
predicting the total number of interpersonal dependent events. The high and low categories
in the figures are estimated at ±1 standard deviation from the mean

Fig. 2.
Interaction between pubertal timing and rumination predicting the total number of interpersonal dependent events. The high and low categories in the figures are estimated at ±1 standard deviation from the mean
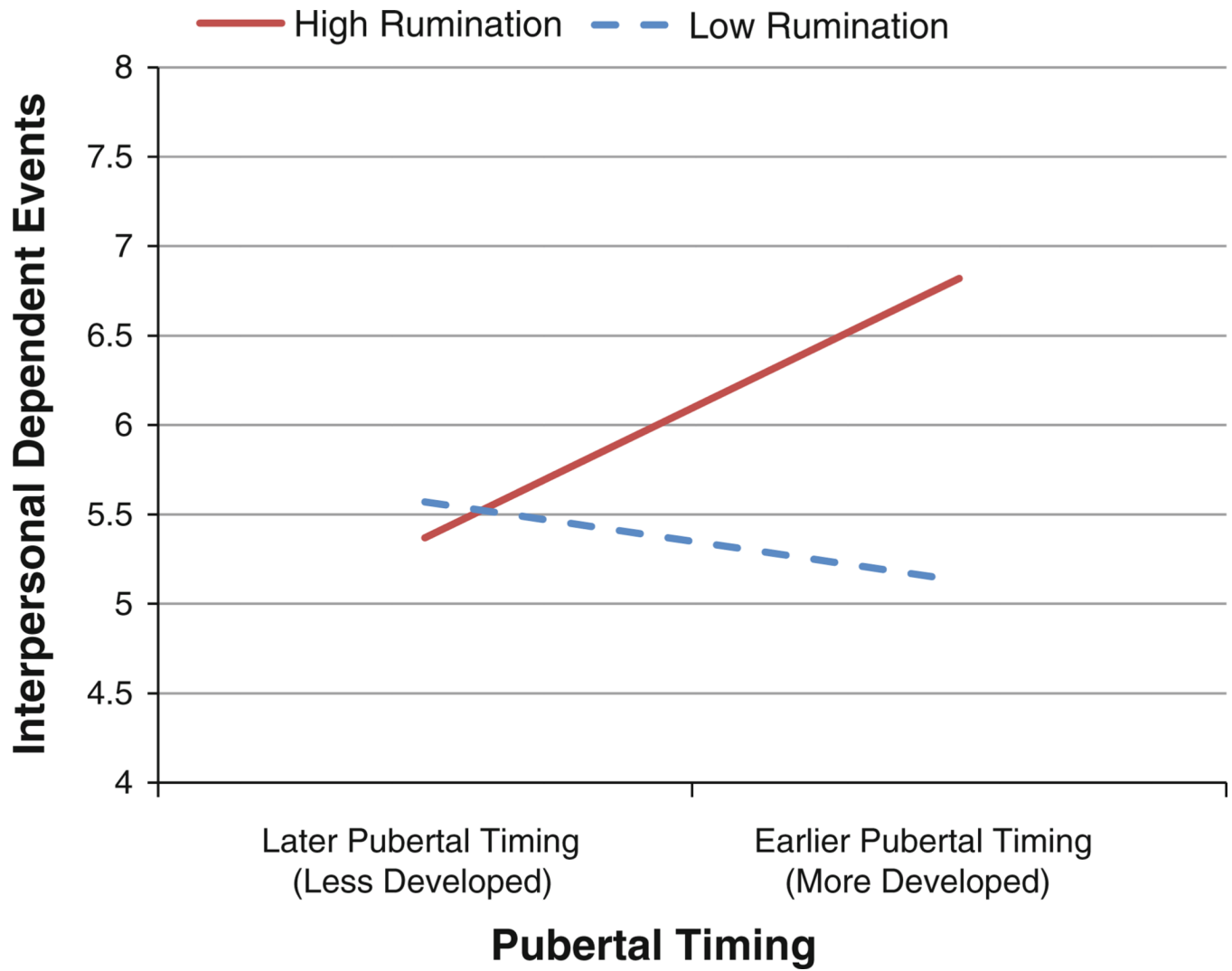
Table 1

Descriptive statistics and bivariate correlations among study variables

Measure	1	2	3	4	5	6	7
1 CDI	–						
2 MASC	.34	–					
3 PDS	.07	–.09	–				
4 ACSQ	.20	.24	.01	–			
5 CRSQ	.48	.44	.08	.33	–		
6 Int Dep	.29	.20	.15	.26	.25	–	
7 Int Indep	.20	.05	.18	.07	.15	.44	–
Mean	7.02	40.14	13.17	37.65	24.66	5.75	2.04
SD	6.14	14.22	3.49	12.33	7.63	4.08	1.76

Correlations .13 are statistically significant (p < .05)

PDS pubertal timing score from the Pubertal Development Scale, *CDI* Children's Depression Inventory, *MASC* Multidimensional Anxiety Scale for Children, *ACSQ* Adolescent Cognitive Style Questionnaire weakest link, *CRSQ* Rumination subscale of the Children's Response Style Questionnaire, *Int Dep* interpersonal dependent events, *Int Indep* interpersonal independent events

Table 2

Pubertal timing and negative cognitive style (weakest link) predicting interpersonal stressful events at time 2

Step	Variable	Interpersonal dependent					Interpersonal independent				
		β	SE	t	ΔR²	f²	β	SE	t	ΔR²	f²
Step 1	T1 CDI	.19	.04	3.35**	.12***	.13	.16	.02	2.76**	.09***	.09
	T1 MASC	.07	.02	1.18			−.02	.01	−0.28		
	Sex	.17	.43	3.24**			.14	.20	2.48*		
	Race	<.01	.43	.09			−.17	.20	−2.99**		
Step 2	PDS	.07	.02	1.28	.04***	.05	.05	.01	.89	.01	.01
	ACSQ	.22	.21	3.95***			.05	.10	0.83		
Step 3	PDS × ACSQ	.12	.02	2.35*	.02*	.02	.03	.01	0.58	<.01	<.01

*
$p < .05$

**
$p < .01$

***
$p < .001$

Linear regressions were conducted to estimate results (β standardized coefficient, *SE* standard error, *t* = Student's *t* score; ΔR² change in R^2. R^2 represents percentage of variance accounted for at each step, f^2 = Cohen's *f*). Coefficients were derived from Step 3 of the final regression model. *T1* Time 1, *PDS* Pubertal timing score from the Pubertal Development Scale, *CDI* Children's Depression Inventory, *MASC* Multidimensional Anxiety Scale for Children, *ACSQ* Adolescent Cognitive Style Questionnaire weakest link. Sex is coded with male (0) and female (1). Race is coded with African American (0) and Caucasian (1)

Table 3

Pubertal timing and rumination predicting interpersonal stressful events at Time 2

Step	Variable	Interpersonal dependent					Interpersonal independent				
		β	SE	t	ΔR²	f²	β	SE	t	ΔR²	f²
Step 1	T1 CDI	.21	.04	3.33***	.12***	.14	.16	.02	2.54*	.09***	.09
	T1 MASC	.09	.02	1.41			−.02	.01	−0.31		
	Sex	.17	.44	3.01**			.14	.20	2.48*		
	Race	.02	.44	.29			−.17	.20	−2.96**		
Step 2	PDS	.06	.21	1.12	.01	.02	.05	.10	.80	<.01	<.01
	CRSQ	.09	.04	1.40			.05	.02	0.73		
Step 3	PDS × CRSQ	.12	.03	2.12*	.01*	.02	.07	.01	1.24	<.01	<.01

*
 $p < .05$

**
 $p < .01$

***
 $p < .001$

Linear regressions were conducted to estimate results (β standardized coefficient, *SE* standard error, *t* student's *t* score, ΔR^2 change in R^2 Cohen's *f*). Coefficients were derived from Step 3 of the final regression model. *T1* Time 1, *PDS* Pubertal timing score from the Pubertal Development Scale, *CDI* Children's Depression Inventory, *MASC* Multidimensional Anxiety Scale for Children, *CRSQ* Rumination subscale of the Children's Response Style Questionnaire. Sex is coded with male (0) and female (1). Race is coded with African American (0) and Caucasian (1). R^2 represents percentage of variance accounted for at each step. f^2 = Cohen's *f*.