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Pubertal Timing and Vulnerabilities to Depression in Early Adolescence: Differential Pathways to Depressive Symptoms by Sex

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Abstract

Although research implicates pubertal processes in the emergence of the sex difference in depression during adolescence, few studies have examined how cognitive and affective vulnerabilities influence the effect of pubertal timing on depressive symptoms. The current study prospectively examined whether early pubertal timing predicted increases in depressive symptoms among adolescents with more negative cognitive styles and lower emotional clarity, and whether this risk was specific to adolescent girls. In a diverse sample of 318 adolescents, early pubertal timing predicted increases in depressive symptoms among adolescent boys and girls with more negative cognitive styles and adolescent girls with poor emotional clarity. These findings suggest that earlier pubertal maturation may heighten the risk of depression for adolescents with pre-existing vulnerabilities to depression, and that early-maturing adolescent girls with lower levels of emotional clarity may be particularly vulnerable to depressive symptoms, representing one pathway through which the sex difference in depression may emerge.

Keywords

Depression; Puberty; Cognitive Vulnerability; Emotional Clarity; Adolescence

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Adolescence is a critical developmental period during which depressive symptoms dramatically increase (Ge, Lorenz, Conger, Elder, & Simons, 1994). Beginning around age 13, the sex difference in depressive symptoms emerges, with girls becoming more than

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twice as likely as boys to experience depressive symptoms by mid-adolescence (Hankin et al., 1998; Hankin, 2008). Even at the subclinical level, depressive symptoms are associated with both impaired functioning (Gotlib, Lewinsohn, & Seeley, 1995) and the onset of depressive disorders during later adolescence and adulthood (van Lang, Ferdinand, & Verhulst, 2007). Given the timing of girls' substantial increase in depressive symptoms, pubertal processes have been implicated. Considered to be the most salient developmental event during early adolescence, the pubertal transition is associated with a myriad of biological, physical, emotional, and social changes that have been linked to the rise of depressive symptoms (for a review, see Hayward, 2003).

Given the sex-specific nature of the pubertal trajectory, research has identified a number of direct and indirect pathways through which pubertal processes may heighten girls' risk of depressive symptoms during early adolescence (Hyde, Mezulis, & Abramson, 2008). Biologically, the rise in pubertal hormones (i.e. adrenal androgens, estrogen, testosterone) has been found to directly contribute to depressive symptoms among adolescent girls (Angold & Costello, 2006; Angold, Costello, & Worthman, 1998). Further, the physical changes associated with puberty, namely increased body mass index, have been found to have psychological consequences (i.e., greater body dissatisfaction), which, in turn, may lead to depressive symptoms in girls (Compian, Gowen, & Hayward, 2009; Rosenblum & Lewis, 1999). Beyond the hormonal and physical changes, the context in which puberty occurs also has significant social and emotional implications for adolescents. Specifically, considerable research has found that girls who undergo puberty earlier than their same-sex, same-age peers are at greater risk for depressive symptoms and disorders than their later developing peers (Conley & Rudolph, 2009; Ge, Conger, & Elder, 2001; Llewellyn, Rudolph, & Roisman, 2012; for a review, see Mendle, Turkheimer, & Emery, 2007). Findings on the effects of puberty for boys is somewhat less consistent, with many studies showing that earlier pubertal timing contributes to increases in depression symptoms (Ge et al., 2001; Ge et al., 2003; Mendle et al., 2010) and others suggesting that early maturation has little to no effect on boys (Conley & Rudolph, 2009; Mendle, Harden, Brookes-Gunn, Graber, 2012).

Advanced pubertal status relative to one's peers may confer a number of social and emotional risks, particularly during early adolescence (Ge et al., 2001). For instance, early-maturing girls exhibit more noticeable physical changes characteristic of puberty (e.g., breast development) earlier than their peers, which may place them at greater risk for peer sexual, relational, or reputational victimization (Compian et al., 2009; Nadeem & Graham, 2005; Peterson & Hyde, 2009). Additionally, societal perceptions and expectations of more pubertally-advanced girls may be incongruent with their cognitive and emotional resources (Ge & Natasuki, 2009; Susman & Dorn, 2009). Thus, beyond the stressful biological and social changes inherent in pubertal development, early pubertal timing may also create a socially and emotionally challenging environment for adolescent girls (Ge & Natasuki, 2009), which may increase the risk of depressive symptoms. Further, in addition to early pubertal timing, pubertal development in general is strongly linked to emotional processes (Dahl, 2004; Nelson, Leibenluft, McClure, & Pine, 2005), with research suggesting that adolescent girls experience increased emotional intensity and reactivity during puberty (DeRose & Brooks-Gunn, 2008; Silk et al., 2009). In this sense, the biological components of pubertal development could exacerbate the negative experiences of girls with early pubertal timing. Thus, adolescent girls who are more pubertally advanced may experience greater extreme variations in mood and more negative emotions than their less advanced peers, which may contribute to greater peer stress and depressive symptoms.

However, despite the risks associated with early pubertal timing, many adolescents undergo the pubertal transition with few difficulties (Graber, 2003). Thus, recent research has sought to identify personal characteristics that increase the risk of depressive symptoms during this developmental period, particularly for girls. According to the accentuation hypothesis (Caspi & Moffit, 1991; for a review, see Ge & Natusaki, 2009), early pubertal maturation represents a novel and ambiguous period during which individual differences in personal vulnerabilities are expressed and amplified. Specifically, this model proposes that adolescents without pre-existing vulnerabilities should be able to cope effectively with the stressful nature of pubertal development, even when it is early relative to peers, whereas individuals with underlying vulnerabilities will have difficulty managing this environment, thereby exacerbating the negative effects of early puberty and the likelihood of emotional and behavioral difficulties. Although numerous studies have empirically tested this hypothesis (Caspi & Moffitt, 1991; Ge, Conger, & Elder, 1996; Ge et al., 2001; Sontag, Graber, Brooks-Gunn, & Warren, 2008), fewer studies have evaluated this theory in relation to personal vulnerabilities to depression. For example, a recent study by Rudolph and Troop-Gordon (2010) examined the interactive effects of early pubertal timing and personal risk factors on depressive symptoms, finding that early maturing girls with negative self-focus and maladaptive coping skills experienced greater increases in depressive symptoms than early maturing girls without these characteristics.

Surprisingly, given the abundance of research investigating the adverse effects of contextual factors on the pubertal transition (for a review, see Ge & Natasuki, 2009), few studies have examined factors that may confer vulnerability to, or resilience against, the impact of early pubertal timing on depression during adolescence. Although adolescence is generally considered to be a period of increasing cognitive and emotional abilities (Steinberg, 2005), it is also a time during which cognitive and affective vulnerabilities to depression first emerge. In particular, cognitive styles have received considerable empirical support as vulnerabilities to depressive symptoms and disorders during adolescence (for a review, see Abela & Hankin, 2008). Specifically, negative cognitive styles, characterized by the tendency to attribute negative events to stable and global causes and to infer negative consequences and negative self- characteristics following the occurrence of stress (Abramson, Metalsky, & Alloy, 1989), are theorized to emerge during the transition from middle childhood to early adolescence when individuals develop the cognitive capacity for formal operational thought and abstract thinking (Cole et al., 2008; Gibb & Alloy, 2006). Indeed, numerous studies have found that adolescents with negative cognitive styles are vulnerable to experiencing increases in depressive symptoms following high levels of stress (e.g., Lee, Hankin, & Mermelstein, 2010; Stange, Alloy, Flynn, & Abramson, 2013a; for reviews, see Abela & Hankin, 2008; Lakdawalla, Hankin, & Mermelstein, 2007). Thus, adolescents with negative cognitive styles may be more likely to react negatively to the changes and stress associated with earlier puberty, thereby increasing their risk for depressive symptoms. Additionally, given that earlier puberty is generally associated with more adverse effects for girls (i.e., greater exposure to peer stress and lower body esteem), adolescent girls with an underlying cognitive vulnerability to depression may be particularly vulnerable to depressive symptoms during this time. However, no known research has examined how negative cognitive style may heighten the risk of depressive symptoms during an early pubertal transition.

In addition to cognitive vulnerability, research also has suggested that deficits in emotional clarity, defined as the ability to identify, understand, and distinguish one's own emotions and emotional experiences, is an important risk factor for depressive symptoms (Gohm & Clore, 2000). Compared to individuals with higher levels of emotional clarity, those who have difficulty understanding their emotions are theorized to spend more time and effort managing emotional experiences, and thus allocate fewer resources towards goal-directed thought and behavior (Gohm & Clore, 2000, 2002). Consequently, low emotional clarity may interfere with the development of adaptive responses to negative emotions (Gohm & Clore, 2000), which may further increase stress and prolong the experience of negative emotion. In fact, several recent studies have found that lower levels of emotional clarity predict increases in depressive symptoms among children and adolescents (Flynn & Rudolph, 2010; Stange et al., 2013a,b). Given that pubertal development exacerbates emotional intensity and reactivity, particularly for girls (Spear, 2009), emotional clarity may become especially important for adolescent girls undergoing puberty as they attempt to understand novel and complex emotions. However, adolescent girls undergoing the pubertal transition earlier than one's peers may lack the resources to help navigate these emotional experiences. Further, because pubertal development has been found to be associated with an increasing awareness of emotion among girls (Burnett, Thompson, Bird, & Blakemore, 2011), early-maturing adolescent girls who lack this ability may be particularly vulnerable to depressive symptoms. Thus, early pubertal timing may heighten the risk of depressive symptoms specifically among adolescent girls who possess low emotional clarity. To date, no study has examined whether low emotional clarity increases the risk of depressive symptoms in the context of early pubertal development.

The current study examined whether earlier pubertal timing increases the risk of depressive symptoms among adolescents with underlying vulnerabilities to depression. Specifically, we evaluated whether earlier pubertal maturation conferred vulnerability to depression among adolescents with more negative cognitive styles or low emotional clarity, and whether this vulnerability was sex-specific given the differential effects of puberty on adolescent boys and girls. Thus, we hypothesized that more advanced pubertal development relative to peers would predict increases in depressive symptoms, but only among adolescents with a more negative cognitive style or lower emotional clarity. Further, we expected these effects to be particularly strong among adolescent girls, given research documenting that girls are more negatively impacted by early advanced pubertal status than boys (Hyde et al., 2008).

Method

Participants

Sample recruitment—Three hundred and eighteen participants were drawn from a study intended to evaluate sex and racial differences in the development of depression among Caucasian and African-American adolescents (*XXX et al., 2012; removed temporarily for blinding*). Caucasian and African-American adolescents, ages 12 to 13, and their primary female caregivers, were recruited from XXX [*location removed temporarily for blinding*]-area public and private middle schools. Participants were recruited in two ways. First, after receiving permission from the XXX School District, we mailed a letter of introduction and description of the study to parents of students attending middle schools in the district. To indicate their interest in the study, caregivers could call or return a prepaid postcard, although most families were recruited through follow-up phone calls from project staff inviting female caregivers and their adolescent children to participate (approximately 68% of the sample). Second, advertisements describing the study were placed in XXX-area newspapers and caregivers called in to indicate their interest (32% of the sample).

Mothers (93.7% of caregivers were the adolescents' mothers) interested in participating with their adolescent children completed a screening via phone to determine eligibility. Eligible adolescents were 12 or 13 years old; self-identified as Caucasian/White, African-American/ Black or Biracial (adolescents could be Hispanic or non-Hispanic as long as they also identified as White, Black, or Biracial); and their primary female caregiver was willing to participate. Adolescents were ineligible for the study if there was no mother/primary female caregiver available to participate; the adolescent or caregiver did not read or speak English well enough to be able to complete the study assessments; or the adolescent or caregiver was mentally retarded, had a severe learning disability or other cognitive impairment, had a severe developmental disorder (e.g., autism), was psychotic, or exhibited any other medical or psychiatric problem that would prevent them from completing the study assessments.

Study sample—The sample included 318 adolescents (Mean = 12.83 years old; *SD* = 0.61) and their mothers/female caregivers who completed at least the baseline assessments and one follow-up assessment. The study sample was 54% female and 53% African American. There was a range among families of socioeconomic status, with 25.2% of participants falling below $30,000 annual family income, 35.0% falling between $30,000 – $59,999, 17.5% falling between $60,000 – $89,999, and 22.3% falling above $90,000. Forty-seven percent of the sample was eligible for free lunch at school.

Procedures

At a baseline (Time 1) assessment that lasted 2–3 hours, adolescents completed measures of depressive symptoms, negative cognitive styles, emotional clarity, and pubertal development. At a follow-up (Time 2) visit approximately 10 months later (Mean = 300 days; *SD* = 140 days), adolescents completed a measure of depressive symptoms.

Measures

Depressive Symptoms—The Children's Depression Inventory (CDI; Kovacs, 1985) is a commonly-used self-report measure assessing depressive symptoms in youth. It consists of 27 items that reflect affective, behavioral, and cognitive symptoms of depression. Items are rated on a 0–2 scale and are summed for a total depression score, with higher scores indicating more depressive symptoms. The CDI has demonstrated good reliability and validity as a measure of depressive symptoms (Klein, Dougherty, & Olino, 2005). Internal consistency in this sample was α = .86 at Time 1 and .80 at Time 2.

Cognitive Style—The Adolescent Cognitive Style Questionnaire-Modified (ACSQ-M; Alloy et al., 2012) is a modified version of the original ACSQ (Hankin & Abramson, 2002) that assesses inferential styles 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 negative life events. The original ACSQ assessed cognitive styles for negative events in the achievement and interpersonal domains, whereas the ACSQ-M also assesses cognitive styles in the appearance domain, another content area that is of importance to adolescents. Adolescents are presented with 12 hypothetical negative events in the achievement, interpersonal, or appearance domains (4 events per domain) and are asked to make inferences about the causes (internal-external, stable-unstable, and global-specific), consequences, and self-worth implications of each event. Each dimension is rated from 1 to 7, with higher scores indicating a more negative cognitive style, and dimension scores range from 12 to 60. A composite score was computed by summing each of the four subscales. The ACSQ has demonstrated excellent internal consistency, good retest reliability, and adequate factor structure among adolescents (Alloy et al., 2012; Hankin & Abramson, 2002). Internal consistencies in this sample were α = .84 – .88 for the four individual dimensions and α = .94 for the composite score.

Emotional Clarity—The Emotional Clarity Questionnaire (ECQ; Flynn & Rudolph, 2010) is a seven-item self-report questionnaire adapted for children from an instrument used with adults (TMMS; Salovey, Mayer, Goldman, Turvey, & Palfai, 1995) that assesses perceived emotional clarity. The ECQ asks children to rate the way they experience their feelings (e.g., "I usually know how I am feeling," "My feelings usually make sense to me," and "I am often confused about my feelings" [reverse scored]) on a five-point Likert scale ranging from “not at all” to “very much.” Item scores are summed with higher scores indicating greater levels of emotional clarity. Total scores range from 5 to 35. The ECQ has demonstrated good internal consistency, and convergent validity has been established with the identification of affective information presented via facial expressions (Flynn & Rudolph, 2010). In the current study, the ECQ demonstrated good internal consistency, a = .82.

Pubertal Timing—The Pubertal Development Scale (PDS; Petersen, Crockett, Richards, & Boxer, 1988) is a six-item self-report questionnaire that assesses pubertal development. The PDS evaluates 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*). Total scores can range from 5 to 20, with higher scores indicating more mature pubertal status. In our sample, 3.6% of girls reported “no development”, 25.9% had “development has barely begun”, 61.4% had “development is definitely underway”, and 9.0% had “development is complete.” For boys, 14.5% had “no development”, 55.8% had “development has barely begun”, 33.3% had “development is definitely underway”, and 1.4 % had “development is complete.”

The PDS has previously demonstrated good psychometric properties and convergent validity based on self- and physician-rated Tanner stages (Petersen et al., 1988), including in ethnically-diverse samples (Siegel, Yancey, Aneshensel, & Schuler, 1999). Adolescents’ mothers also reported on their child’s pubertal development via the PDS; however, because mothers’ PDS report correlated $r > .80$ with the child’s PDS report, we used only the child’s report in our analyses. Prior to conducting analyses, the PDS total score was regressed on age separately for males and females, and the residual obtained was used as a continuous measure of pubertal timing (Dorn, Dahl, Woodward, & Biro, 2006; Dorn, Susman, & Ponirakis, 2003; Susman et al., 2007). Internal consistency for the PDS in this sample was $\alpha = .70$ for girls and $\alpha = .72$ for boys at Time 1.

Results

Descriptive Analyses

Descriptive statistics for each time point by sex are presented in Table 1. Analyses were also conducted to determine if there were any significant demographic differences (sex, race, SES based on eligibility for free lunch) on primary outcome variables (*t*-statistics for sex differences presented in Table 1). At Time 1, girls had significantly greater pubertal development than boys, but there were no significant differences in levels of emotional clarity or negative cognitive style by sex. In terms of symptoms, there were no significant sex differences in depressive symptoms at Time 1 or Time 2.

There were significant racial differences on pubertal development, with African American adolescents reporting significantly greater pubertal development than Caucasian adolescents ($t = 3.12$, $p < .01$). Thus, race was included as a covariate in all analyses. There were no significant racial differences on emotional clarity, negative cognitive style, or depressive symptoms at Time 1 or Time 2.

Table 2 displays correlations among primary study variables. As expected, emotional clarity and negative cognitive style were significantly correlated with each other, and were correlated with depressive symptoms at both Time 1 and Time 2. Additionally, pubertal development was significantly correlated with depressive symptoms at Time 2, but was not correlated with all other study variables.

Prospective Analyses

To examine whether there was a significant three-way interaction between pubertal timing, sex, and either negative cognitive style or emotional clarity in predicting depressive symptoms at follow-up, controlling for initial depressive symptoms, we conducted three hierarchical linear regressions.[1] Continuous predictor variables were centered at their means prior to analysis (Aiken & West, 1991), and dichotomous variables (sex and race) were dummy coded as 0 and 1. In Step 1, covariates were entered, including Time 1 depressive symptoms and race. In Step 2, we entered the main effects of pubertal timing, sex, and either emotional clarity or negative cognitive style. In Step 3, the two-way interaction terms between each of the three main effect variables were entered. Finally, the three-way interaction term (pubertal timing × sex × emotional clarity or negative cognitive style) was entered in Step 4. To evaluate the independent interactive effects of emotional clarity and negative cognitive style with pubertal timing and sex predicting depressive symptoms, a combined regression model with all of the main effects and interaction terms of the two separate models was also tested.

Contrary to hypotheses, there was not a significant three-way interaction between pubertal timing, negative cognitive style, and sex predicting increases in depressive symptoms at follow-up (Table 3; Figure 1). However, there was a significant two-way interaction between pubertal timing and negative cognitive style, indicating that this two-way interaction was significant for both boys and girls. To probe the form of this interaction, we tested for lower-order effects at one standard deviation above and below the mean for pubertal timing and negative cognitive style. Consistent with hypothesis, early pubertal timing predicted increases in depressive symptoms among adolescents with a more negative cognitive style ($t = 3.18$, $p = .002$), but not among those with a less negative cognitive style ($t = .66$, $p = .51$; Figure 1).

Additionally, a significant three-way interaction emerged between pubertal timing, emotional clarity, and sex predicting increases in depressive symptoms at follow-up (Table 4). To probe the form of this three-way interaction, we tested for lower-order effects at each level of the dichotomous variable (sex), and subsequently tested for lower order effects at one standard deviation above and below the mean for pubertal timing and emotional clarity (Aiken & West, 1991). As hypothesized, there was not a significant two-way interaction between pubertal timing and emotional clarity among male adolescents ($t = 1.24$, $p = .22$), but this interaction was significant among female adolescents ($t = -2.34$, $p = .02$). The nature of this interaction was such that among female adolescents, early pubertal timing predicted increases in depressive symptoms among girls with lower emotional clarity ($t = -3.46$, $p = .02$), but not among girls with greater emotional clarity ($t = 1.13$, $p = .26$; Figure 2).

Finally, the combined regression model also yielded a similar pattern of significant results for both the interaction of negative cognitive style and pubertal timing ($t = 1.98$, $p < .05$), as well as the three-way interaction between emotional clarity, pubertal timing, and sex ($t = -2.57$, $p = .01$). Thus, early pubertal timing appeared to confer risk for depressive symptoms, but only among adolescents who had a negative cognitive style, and among girls who had lower emotional clarity.

[1]Given research documenting that negative cognitive styles may not coalescence until mid to late adolescence (Abela & Hankin, 2008), analyses were also conducted using the weakest link hypothesis (Abela & Sarin, 2002), whereby the highest scoring domain of the ACSQ (Causes, Consequences, or Self) was included for each adolescent. Results using the weakest link revealed the same findings.

Discussion

The current study prospectively examined pubertal timing in the context of cognitive and affective vulnerabilities as a predictor of increases in depressive symptoms among a community sample of early adolescents. Consistent with study hypotheses, early pubertal timing significantly predicted increases in depressive symptoms, but only among adolescents with negative cognitive styles or deficits in emotional clarity. This suggests that early pubertal maturation may heighten the risk of depression for adolescents with pre-existing vulnerabilities to depression. Further, there were also significant sex differences in our findings. Although negative cognitive style conferred risk to depressive symptoms for both early- maturing male and female adolescents, low emotional clarity only increased the risk of depressive symptoms among early-maturing adolescent girls. Thus, these findings suggest that whereas cognitive vulnerabilities may enhance the risk associated with early pubertal timing for both boys and girls, emotional vulnerabilities may only be specific to adolescent girls, representing one pathway through which the sex difference in depression may emerge.

The finding that early pubertal timing predicted increases in depressive symptoms among adolescents with negative cognitive styles merges two lines of research that have largely been conducted independently: the effects of pubertal timing and cognitive vulnerabilities to depression in adolescents. Although adolescence is a period of increased interpersonal stress in general (e.g. Ge et al., 1994), adolescents who undergo pubertal development earlier than peers of the same sex may experience more stress than their later-maturing peers (e.g. Conley, Rudolph, & Bryant, 2012; Simon, Wardle, Jarvis, Steggles, & Cartwright, 2003). Consequently, early-maturing adolescents with negative cognitive styles may infer more negative attributions, consequences, and self-characteristics about stressful life events that accompany early pubertal development. Given the noticeable physical changes that occur during pubertal development and the importance of social comparison during adolescence (Kroger, 1996), adolescents who are more pubertally advanced compared to same-age, same-sex peers may experience negative perceptions of their discrepant physical status. Thus, adolescents with negative cognitive styles may react with more negative attributions to the changes associated with early pubertal development than adolescents without negative cognitive styles, particularly when their peers are not undergoing similar changes. Further, negative cognitive styles may interfere with adolescents' coping resources (Dunbar et al., in press) to effectively manage the experience of early puberty at a time when their resources are already taxed.

As negative cognitive style rarely has been assessed in studies of pubertal processes and depression, these findings provide new insight into the effects of early pubertal timing on depressive symptoms for both boys and girls. Contrary to hypotheses, we did not find sex differences for the effects of pubertal timing and negative cognitive style on depressive symptoms. These results are surprising given that research on the negative effects of early pubertal maturation is more consistent for adolescent girls than boys. However, our findings suggest that adolescent boys and girls with negative cognitive styles may have similar cognitive responses to the experience of early pubertal maturation. The finding that early pubertal timing confers vulnerability to depression only among boys with negative cognitive styles may help to explain inconsistent findings on the effects of pubertal development on adolescent boys (e.g. Conley & Rudolph, 2009; Ge et al., 2003; Mendle et al., 2012). Although many boys may either respond positively or be unaffected by the physical and social changes associated with early pubertal maturation, adolescent boys with negative cognitive styles may react negatively to these changes and subsequently develop depressive symptoms. Taken together, these findings suggest that the interactive effects of early pubertal timing and negative cognitive style on depressive symptoms are not sex-specific and may contribute to the development of depressive symptoms for both adolescent girls and boys.

Additionally, our finding that advanced pubertal status relative to one's peers predicted increases in depressive symptoms among adolescent girls with low emotional clarity extends past research on pubertal development and affective processes during adolescence. During the pubertal transition, adolescents, particularly girls, become better at identifying emotions and increase awareness of their own emotions (Burnett et al., 2011). Thus, poor emotional clarity may become even more pronounced during puberty, thereby exacerbating the negative effects of the pubertal transition. Although the literature on emotional clarity in adolescence is limited, there is evidence that the pubertal transition increases girls' emotional intensity and reactivity to stress (Dahl & Gunnar, 2009). Thus, adolescent girls who undergo pubertal maturation earlier but lack the ability to understand their own emotions may be more at risk for depressive symptoms. Additionally, the relationship between low emotional clarity and depression in children has been shown to be mediated by maladaptive stress responses (Flynn & Rudolph, 2010) and deficits in emotional clarity are associated with low levels of adaptive coping and problem solving behavior (Gohm & Clore, 2000; Otto & Lantermann, 2006). Thus, emotional clarity may be especially beneficial for adolescent girls who are precociously confronting social expectations and situations brought about by earlier physical maturity, for which they are relatively emotionally unprepared (Ge & Natsuaki, 2009). In contrast, early-maturing girls with low emotional clarity may find it difficult to navigate the emotional demands of the physical and social challenges associated with puberty. Consequently, low emotional clarity may require adolescent girls to spend more time figuring out their emotions rather than pursuing goal-directed solutions, which may lead to rumination and less effective problem solving (Flynn & Rudolph, 2010). Thus, early pubertal maturation may heighten the risk of depressive symptoms for girls who have less emotional clarity, which may contribute to the sex difference in vulnerability to depression that emerges during the pubertal transition of adolescence.

This study has a number of strengths, including the use of a prospective design with a racially and socioeconomically diverse community sample of early adolescents. Additionally, the current sample included adolescents just prior to the average age of the first onset of depressive disorder and before sex differences in depressive symptoms and cognitive vulnerabilities to depression first emerge (Hankin & Abramson, 2001). Further, the current study integrated several areas of research that have seldom been researched together, including cognitive and affective vulnerabilities to depression and pubertal timing.

Although this study had a number of strengths, several limitations should be noted. For one, the primary study measures of depressive symptoms, negative cognitive style, and emotional clarity were all assessed solely by self-report and may be subject to reporter or mono-method bias. However, self-report may be an effective method for evaluating certain subjective experiences such as these (Haeffel & Howard, 2010). In addition, we evaluated the development of depressive symptoms in a young adolescent sample in which overall symptom levels were relatively low at both time points. Although subclinical symptom levels may be impairing, particularly in adolescence (Gonzáles-Tejera et al., 2005), and increase the risk of the eventual onset of depressive disorder (van Lang et al., 2007), further study should examine how pubertal timing interacts with cognitive and affective vulnerabilities to predict the first onset of a depressive episode. Additionally, the study sample was 12–13 years old, which is an older sample of adolescents for examining the effects of puberty. However, adolescents in our sample had a range of pubertal development, with only 10% of the sample having reached complete pubertal maturation. Furthermore, this study restricted its investigation to negative cognitive style and emotional clarity. Future research should investigate the interaction of pubertal timing with other cognitive (e.g., rumination, maladaptive schemas) and affective (e.g., emotional regulation) vulnerabilities, as well as explore the effects of puberty on the development of these vulnerabilities. Finally, we only examined depressive symptoms as an outcome in this study. It is possible that negative cognitive style and low emotional clarity also lead to the development of other forms of psychopathology (e.g., anxiety) among early-maturing adolescents.

In summary, to our knowledge, this was the first study to prospectively evaluate whether early pubertal timing confers risk for depressive symptoms among adolescents with negative cognitive style or low emotional clarity, and whether this risk was specific to adolescent girls. Consistent with the accentuation hypothesis (Ge & Natsuaki, 2009), our study found that early-maturing adolescents with pre-existing cognitive or affective vulnerabilities were particularly vulnerable to increases in depressive symptoms. More specifically, for girls with low emotional clarity and adolescents of both sexes with more negative cognitive styles, early pubertal timing predicted increased depressive symptoms. As cognitive and affective vulnerabilities differentially predicted depressive symptoms by sex, early pubertal timing may confer risk for depressive symptoms through additional pathways for girls, which may additively contribute to the sex difference in vulnerability to depression that emerges in adolescence. Understanding why negative cognitive style increases vulnerability to depression for both boys and girls, whereas emotional clarity was only a risk factor for girls, may increase the ability to more selectively target adolescents for intervention. Although existing prevention and treatment programs for depression focus on cognitive styles in children and adolescents (e.g., the Penn Resiliency Program; Brunwasser, Gillham, & Kim, 2009; Gillham, Brunwasser, & Freres, 2008), our findings suggest that improving emotional clarity in girls may also be a promising area of depression intervention, particularly during the pubertal transition.

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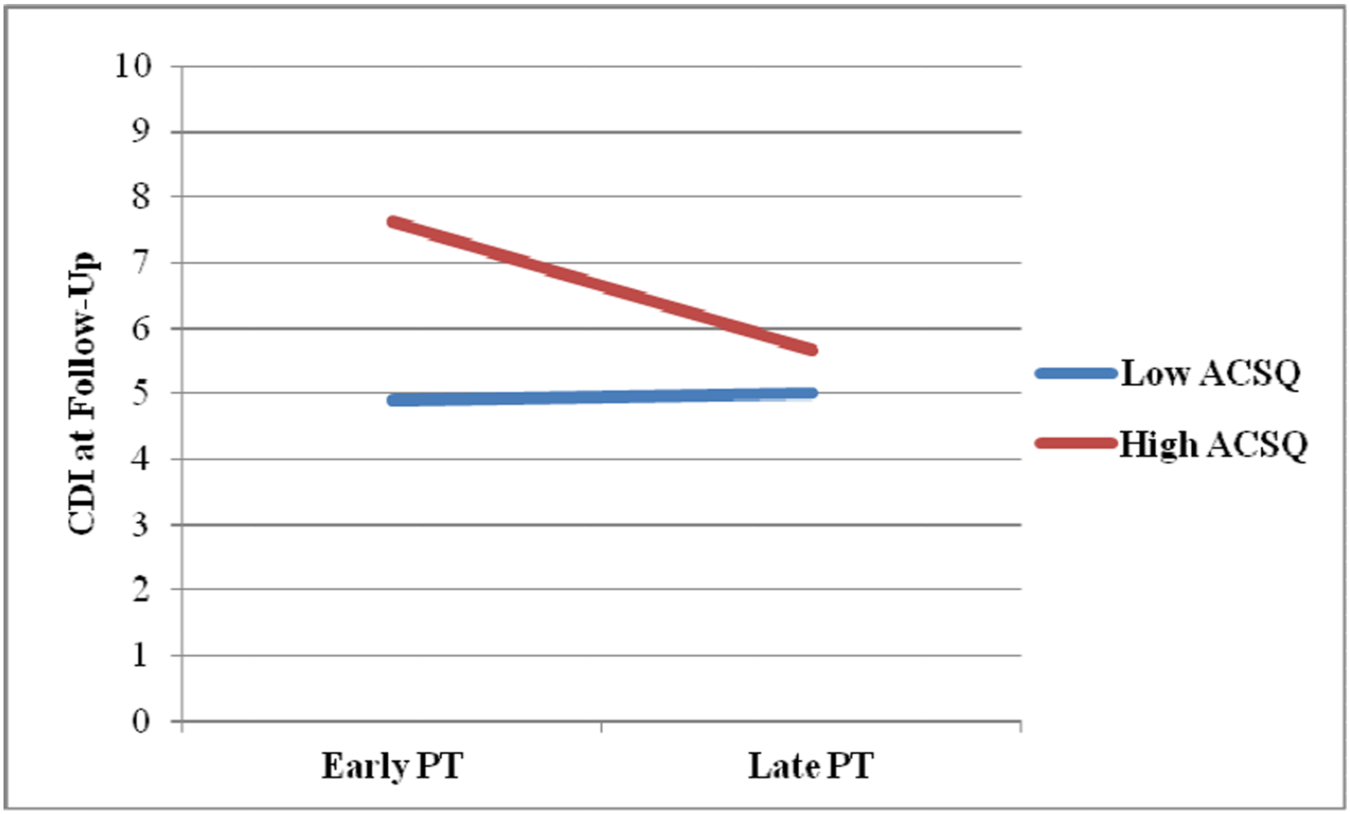

Figure 1.
Two-way interaction between negative cognitive style and pubertal timing predicting depressive symptoms at follow-up.

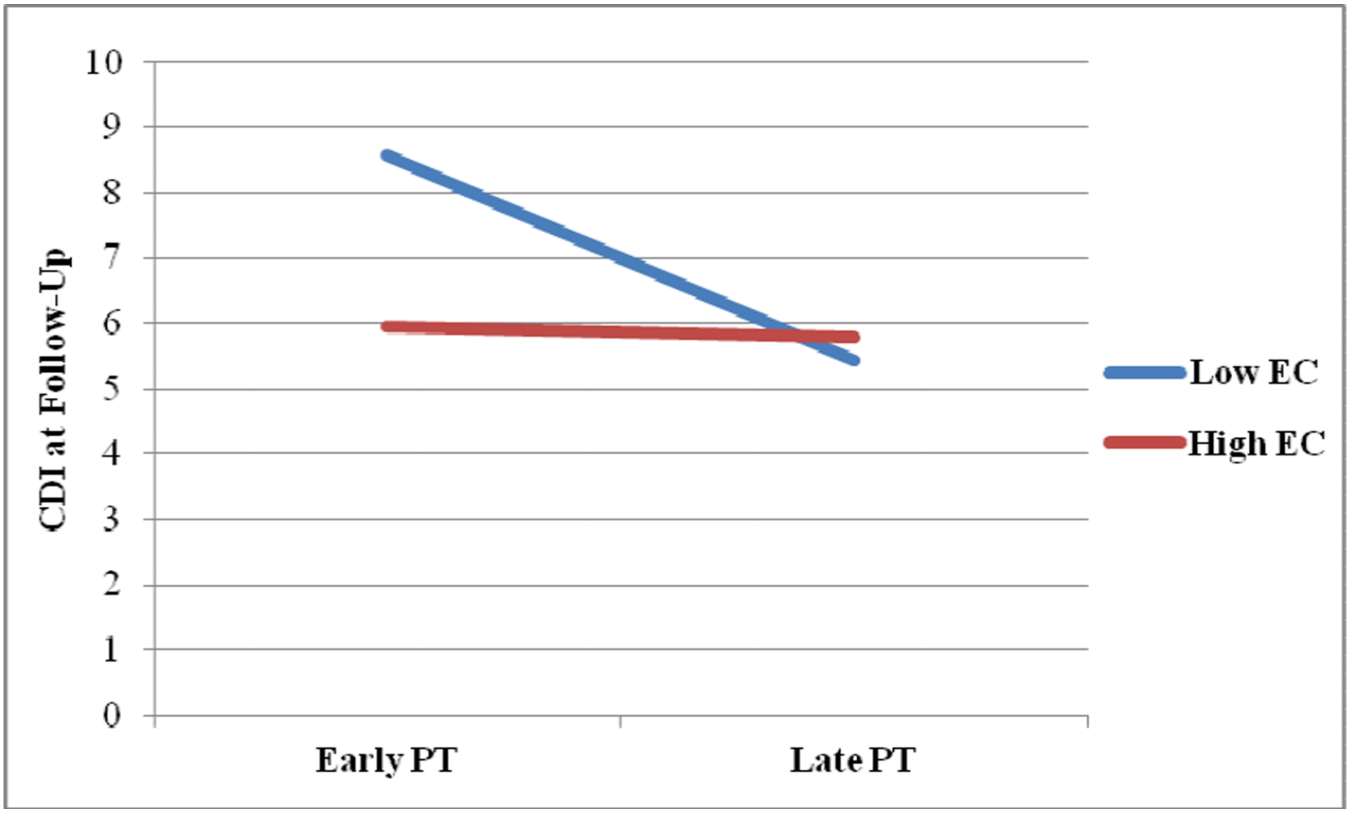

Figure 2.
Two-way interaction between emotional clarity and pubertal timing among girls predicting depressive symptoms at follow-up.

Table 1

Descriptive Statistics and Sex Differences in Study Variables

Measure	Overall Sample		Boys		Girls		Sex Difference
	M	***SD***	***M***	***SD***	***M***	***SD***	***t***
T1 CDI	7.01	6.21	6.39	5.13	7.54	6.98	1.65
T1 ECQ	24.79	4.17	25.08	3.96	24.54	4.33	−1.15
T1 ACSQ	115.92	39.33	119.70	41.25	112.67	37.41	−1.60
T1 PDS	13.06	3.50	11.33	2.96	14.55	3.24	9.18***
T2 CDI	5.81	5.32	5.36	4.95	6.19	5.60	1.38

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Note. T1 = Time 1 (baseline); T2 = Time 2 (follow-up); CDI = Children’s Depression Inventory; ECQ = Emotional Clarity Questionnaire; ACSQ = Adolescent Cognitive Style Questionnaire; PDS = Pubertal Development Scale. Sex coded as 0 = female, 1 = male.

Table 2

Bivariate Correlations between Study Variables

	1	2	3	4	5	6
1. T1 CDI	---					
2. T2 CDI	.57***	---				
3. T1 ECQ	−.35***	−.22***	---			
4. T1 ACSQ	.24***	.28***	−.12*	---		
5. T1 PDS	.04	.15**	−.01	−.04	---	
6. Sex (Female)	−.09	−.08	.07	.09	−.46***	---

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Note. T1 = Time 1 (baseline); T2 = Time 2 (follow-up); CDI = Children's Depression Inventory; EC Q= Emotional Clarity Questionnaire; ACSQ = Adolescent Cognitive Style Questionnaire; PDS = Pubertal Development Scale. Sex coded as 0 = female, 1 = male.

Table 3

Interaction between Pubertal Timing, Negative Cognitive Style, and Sex Predicting Depressive Symptoms at Follow-Up

Regression Step	Variable	β	*T*	ΔR^2	Δf^2
Step 1	T1 CDI	.53	11.19***	.36***	.55***
	Sex	−.04	−.94		
	Race	−.02	−.36		
	PT	.08	1.73		
	ACSQ	.16	3.31**		
Step 2	PT × Sex	−.10	−1.72	.02*	.02*
	ACSQ × Sex	<.01	−.09		
	PT × ACSQ	.10	2.20*		
Step 3	PT × ACSQ × Sex	−.11	−1.89	<.01	.01

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Note. T1 = Time 1 (baseline); T2 = Time 2 (follow-up); CDI = Children's Depression Inventory; ACSQ = Adolescent Cognitive Style Questionnaire; PT = Pubertal Timing. Sex is coded as 0 = female, 1 = male.

Table 4

Interaction between Pubertal Timing, Emotional Clarity, and Sex Predicting Depressive Symptoms at Follow-Up

Regression Step Step 1	Variable	β	T	ΔR^2	Δf^2
Step 1	T1 CDI	.56	11.25***	.32***	.49***
	Sex	−.03	−.53		
	Race	<.01	−.03		
	PT	.09	1.82		
	ECQ	−.03	−.54		
Step 2	PT × Sex	−.09	−1.55	.01	.02
	ECQ × Sex	.09	1.46		
	PT × ECQ	−.03	−.66		
Step 3	PT × ECQ × Sex	.18	3.20**	.02**	.03**

* $p < .05$,

** $p < .01$,

*** $p < .001$.

Note. T1 = Time 1 (baseline); T2 = Time 2 (follow-up); CDI = Children's Depression Inventory; ECQ = Emotional Clarity Questionnaire; PT = Pubertal Timing. Sex is coded as 0 = female, 1 = male.