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**An exploration into the mediating role of perceived rejection in the predictive relationship  
between off-time pubertal timing and depression in adolescence**

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## Abstract

While depression in childhood is infrequent, this prevalence surges during adolescence. It has been proposed that puberty is a major contributor, as it leads to enhanced self-awareness, boosted social understanding, feelings of insecurity, social stress, and body image disturbance, particularly in girls. In addition, it has been proposed that individuals with heightened rejection sensitivity are more likely to develop emotional difficulties, such as depression, than those with lower rejection sensitivity. This opens the question not previously explored in literature; is perceived rejection a mediator of the relationship between early pubertal timing and subsequent depression in adolescence, and what are the gender differences in this relationship? Three hundred participants (156 female, 144 male) were included in this four wave study. Pubertal timing was explored through a self-report questionnaire at wave 4. Rejection sensitivity was measured through decoding perceived level of acceptance or rejection of thirty ambiguous facial expressions at wave 1. The dependent variable was participants' scores of depression that were measured at each wave using the CDI. Multiple regression analyses indicated that males who entered puberty late had significantly higher levels of depression, while the effect of early pubertal timing and depression was not significant in girls. Perceived rejection was significantly correlated with depression in girls only. Therefore, a mediation model was not found in either boys or girls.

*Key words:* pubertal timing, perceived rejection, depression, gender, adolescence

## **Introduction**

Adolescence has continuously been described as a critical developmental period during which risk of psychopathology increases, in particular unipolar depressive disorder (Lopez, Mathers, Ezzati, Jamison, & Murray, 2006; Zahn-Waxler, Shirtcliff, & Marceau, 2008). While depression in childhood is infrequent (Kessler, Avenevoli & Merikangas, 2001), this prevalence surges during adolescence (Green, McGinnity, Meltzer, Ford & Goodman, 2005) with gender differences emerging during early adolescence (Avenevoli et al., 2015; Costello, Copeland, & Angold, 2011). The underlying mechanisms causing this surge in depression are not fully understood, although a number of theories have been proposed (Hankin et al., 2015). For example, Thapar, Collishaw, Pine and Thapar (2012) posit that puberty is a major contributor, as it leads to enhanced self-awareness and boosted social understanding (Blakemore, 2008) particularly in girls (Nelson, Leibenluft, McClure & Pine, 2005; Silburg et al., 1999). Specifically, early pubertal timing has been previously associated with increased levels of psychopathology (Ullsperger & Nikolas, 2017), as it leads to feelings of insecurity, social stress, and body image disturbance (Magnusson, Stattin, & Allen, 1985). This uncertainty has continuously been linked to both rejection sensitivity (Silk et al., 2013) particularly in girls, which opens the question not previously explored in literature; is perceived peer rejection a mediator of the relationship between early pubertal timing and subsequent depression in adolescence, and to what extent does this relationship differ between genders?

## **Pubertal Timing and Depression**

Ullsperger and Nikolas (2017) have defined pubertal timing as one's relative pubertal development compared with their same-sex, same-age peers, which can be classified as early, on-time, or late. In relation to this, according to Mendle, Turkheimer and Emery (2007), girls

who experience earlier pubertal timing than their later maturing female peers are more inclined to find this transition challenging and to experience unfavourable consequences. Skoog, Özdemir, and Stattin (2016) have highlighted how this has been supported in studies conducted worldwide, namely in the US (Hamilton, Hamlat, Stange, Abramson, & Alloy, 2014), Canada (Trépanier et al., 2013), Finland (Kaltiala-Heino, Kosunen, & Rimpela, 2003), Norway (Wichstrøm, 2000), and the UK (Joinson, Heron, Lewis, Croudace, & Araya, 2011). In particular, a longitudinal study conducted by Trépanier and colleagues (2013) highlighted that girls who entered puberty earlier, for instance during ages 10-11 years, exhibited significantly higher scores on the Child Depression Inventory (CDI) than “on-time” maturing girls, who entered puberty during ages 12-13. In particular, the physiological changes of early puberty conflict with the normal development of late childhood, interfering with the development of their social and coping skills, and their sense of self (Benoit, Lacourse & Claes, 2013).

While literature has continuously reported on the detrimental effects of pubertal timing in adolescent girls, research regarding the relationship between off-time pubertal timing and depression in boys is limited, mixed, and has changed over time. Historically, it was proposed that positive consequences were linked to early pubertal timing in boys, such as increased self-confidence, popularity, and body satisfaction, as their maturing physique, such as the early development of muscles and possession of “manly” traits, puts them at a social and athletic advantage (Felson & Haynie, 2002; McCabe & Ricciardelli, 2004; Taga, Markey, & Friedman, 2006) and is associated with increased status and esteem and increased popularity (Teunissen et al., 2011). In addition, while early-maturing boys are typically more poised and sociable, late-maturing boys portray more feelings of inferiority, inadequacy, and social rejection (Mendle &

Ferrero, 2012). On the other hand, more recent research has contradicted this, and stated that early maturation may not be uniformly advantageous, but instead may also lead to a higher risk of internalising disorders (Huddleston & Ge, 2003). This suggestion supports the “Social Deviance Hypothesis”, which states that all off-time maturing boys, whether early or late, report more depressive symptoms (Conley & Rudolph, 2009).

According to this hypothesis, off-time pubertal timing leads adolescents, both boys and girls, to be more susceptible to psychological maladjustment as they are placed in a deviant position, both socially and physically, than their on-time developing peers, and therefore are required to face this transition in a less supportive context (Petersen, Crockett, Richards, & Boxer, 1988; Sarigiani & Petersen, 2000), facing feelings of stress, uncertainty, and body image issues (Magnusson, Stattin, & Allen, 1985).

### **Social Mediators of Depression**

During adolescence, peers become increasingly important sources of support, the power of peer influence increases, and thus adolescents form their identity and self-concept through peer experiences (Prinstein, Borelli, Cheah, & Simon, 2005). In particular, girls tend to develop more affiliative needs and a stronger relational orientation than boys (Rudolph, 2002), and typically create friendships based on greater levels of emotional support and intimacy (Furman & Buhrmester, 1992). In contrast, research has reported boys to be less interpersonally oriented, to prefer shared activities over closeness, and have less intimate peer relationships than girls do (Marston, Hare & Allen, 2010). This preference in relationship styles has been proposed to be primarily responsible for the higher levels of negative interpersonal stress, specifically in the

peer domain, reported by girls (Benenson & Christakos, 2003). Further, Conley, Rudolph and Byrant (2012) stated that peer stress has been found to be a significant mediator in the relationship between pubertal timing and depression in girls only.

Touching on this, Carter, Halawah, and Trinh (2018) discussed how early maturation can lead to obstacles in adolescents' positive peer relationships, such as disapproval from peers, increased social isolation, or peer victimisation (Conley & Rudolph 2005). For example, early maturing girls experience significant physical changes that distinguish them from their later developing peers, including height, breast size, larger hips, and subcutaneous fat gain, which are typically considered negative, or perceived as "fat", in Western societies. While Carter and colleagues (2018) mentioned that such physical differences could result in exclusion of early developers by peers, early maturers could also respond to their developing physique by interacting less with peers, and isolating themselves by avoiding peer contact. For example, while female early developers typically experience peer rejection on the basis of their changing physique, they also develop poor self-esteem due to their perceived deviance to their peers, (Williams, Doorley, & Esposito-Smythers, 2017), leading to a higher rejection expectancy.

Silk and colleagues (2012) referred to this as a cognitive bias developed by adolescents during puberty as a result of an increased hyper alertness and sensitivity to the social reactions of their peers, in particular peer rejection, known as rejection sensitivity. Rejection sensitivity can be defined as the tendency to expect, perceive and overreact to possible incidents of rejection (Thomas & Bowker, 2015), and has been reported as a moderator in the relationship between relationship stressors and depression in 16- to 18-year olds (Chango, McElhaney, Allen, Schad,

& Marston, 2012), and a predictor of depressive symptoms in 9- to 14- year olds (Zimmer-Gembeck, Nesdale, Webb, Khatibi, & Downey, 2016). As girls' friendships generally tend to involve more intimacy, caring, validation, but also more jealousy and co-rumination than boys (Rose, Carlson, & Waller, 2007), rejection, both real and perceived, is a particularly powerful source of psychosocial stress for them (Platt, Kadosh, & Lau, 2013).

As the Rejection Sensitivity Model (Levy, Ayduk, & Downey, 2001) posits, individuals with heightened rejection sensitivity are more likely to develop emotional difficulties, such as depression, than those with lower rejection sensitivity. Also proposed by the Interpersonal Life-Stress Model (Rudolph et al., 2000), rejection sensitivity may impair social relationships, as they lead to a self-perpetuating cycle of negative responses to peer behaviour, adverse social interactions, and depressive feelings of despair and loneliness (Zimmer-Gembeck, Trevaskis, Nesdale, & Downey, 2014). In turn, these unfavourable social experiences reinforce one's negative expectations and perceptions of social interactions, feelings of being unlovable, and thus, increase rejection sensitivity (Bondü, Sahyazici-Knaak & Esser, 2017; Teo, Choi, & Valenstein, 2013). As such, if off-time pubertal timing is linked to social insecurity such as rejection sensitivity, which in turn is associated to the development of depression, it might be that this particular social insecurity plays a mediating role in the relationship between off-time pubertal timing and depression.

### **The Current Study**

In previous measures of rejection sensitivity, affective schema-based information processing has been employed in cases with depression (Rusting, 1998), and it has since been

proposed that individuals typically attend to experiences in accordance with their personality traits. For example, insecurity and low self-esteem, commonly experienced in early developers, have been associated with biased processing of schematic information indicative of rejection (Dandeneau & Baldwin, 2004; Dewitte, Koster, De Houwer, & Buysse, 2007; Gyurak & Ayduk, 2007; Koch, 2002). While previous research exploring rejection sensitivity employed vignettes in their methodology (eg. Mor & Inbar, 2009), this study will instead employ the interpretation of schematic facial expressions. The reason for this is that vignettes may not be relevant for all participants, or they may interpret the vignettes differently, whereas emotion decoding of faces reflects a more unconscious daily process relevant to all participants, such as reading the emotions of peers. More importantly, in vignettes it is not always known if participants' indications of what they say they would feel actually matches with what they would really feel in a similar real situation. Further, schematic faces are the preferred method of measurement as it ensures that perceptions will be associated with emotional cues only, and will not be influenced by other facial characteristics such as attractiveness, dominance, or age (Hess, Adams & Kleck, 2004). Participants will be presented with these schematic faces, and required to determine how much they perceive that "person" to like/dislike them. It is predicted that depressed participants will report greater levels of dislike, or greater levels of perceived rejection, than non-depressed participants.

Using this new way to measure rejection sensitivity, the aim of this research is to explore whether perceived rejection mediates the impact of early pubertal timing on the onset of depression, and whether this mediation is particularly strong in girls. This investigation could have scientific and societal relevance as it could add to the ongoing discussion regarding the



possible predictors of depression in adolescence, aiding researchers and practitioners in attempting to prevent the development of depression during this vulnerable time. Further, it will add to the lack of previous literature regarding the mediating role of perceived rejection on the relationship between early maturation and depression in adolescent girls.

Taking the aforementioned literature and previous research into account, four hypotheses were formed. First, girls who mature earlier will have higher levels of depression than boys and their later maturing girl peers. Additionally, it is hypothesised that girls will report more perceived rejection than boys. A third hypothesis is that boys who mature later will experience higher levels of depression than their peers. Finally, a fourth hypothesis is that perceived rejection will significantly mediate the relationship between early maturation and depression in adolescence, particularly in girls. The study is of a longitudinal design involving 4-waves of data collection, where the outcome variable, depression, will be compared using the highest CDI score from all 4 waves.

## **Method**

### **Participants**

The participants included in this study ( $n = 300$ ) were selected from a larger sample of 606 participants gathered from two Dutch secondary schools (van Beek & Dubas, 2008) based on the availability of data regarding their pubertal timing. The rest of the sample included in wave 1 were randomly missing from wave 4 as they either withdrew participation at an earlier wave, or were not present due to exams during the data collection at wave 4. Data from this

larger study was collected in four waves, each nine months apart. The sample included 156 girls and 144 boys. At wave 1, participants were aged between 12.07 and 17.78 years where the mean age was 14.38 years ( $SD = 1$ ). Ethical approval was granted by the medical ethical committee of Utrecht University.

## Measures

**Pubertal timing.** Pubertal timing was explored through a self-report questionnaire at wave 4 (age range 15-19 years) in order to ensure that the majority participants would have gone through puberty at this stage. Participants were asked to indicate the age at which they experienced their peak height velocity. Girl participants were required to indicate the age at which they experienced their first menstruation, and the boys were required to indicate the age at which their voice began to break. Both boy and girl participants were also required to indicate if they perceived their physical development to occur at the same time, earlier, or later than their same aged peers on a scale between 1-5, 1 indicating much earlier, 3 indicating the same time, and 5 indicating much later. Scores from this questionnaire were then grouped into three variables; growth spurt age, menstruation/voice change age, and perception of physical development (see Table 1). Each variable was explored to find the best predictor of depression in the sample. Participants with missing scores for all three measures of pubertal timing were excluded from the analysis. If a score was missing for one pubertal timing measure, such as growth spurt, a mean imputation was conducted whereby the missing score was replaced with the mean growth spurt of other participants who reported the same age of menarche/voice change.

**Perceived rejection.** Participants' rejection sensitivity was measured at wave 1 through decoding their perceived level of acceptance or rejection of 24 facial expressions showing variability in the intensity and ambiguity of negative emotional signals (see van Beek & Dubas, 2008). Van Beek and colleagues previously measured participants' perceptions of the intensity of the emotions displayed on the faces, however in the current study perceived rejection was measured based on the participants' interpretation of how much they felt each person liked or disliked them when asked to imagine they were in a conversation with them. This was scored on a scale from -3 to 3, with more negative scores indicating more perceived rejection. Cronbach's alpha ( $\alpha = .78$ ) indicated good reliability of this measure. A gender specific mean imputation was performed to account for any missing scores. See Appendix A for a full display of the faces employed.

**Depressive symptoms.** Participants' scores of depression were measured at each four waves through the use of the Dutch version of the Child Depression Inventory (CDI; van Beek, Hessen, Hutteman, Verhulp, & van Leuven, 2012). A Cronbach's alpha score of .81 indicates good reliability of the scale (van Beek & Dubas, 2008). The CDI consists of 28 items, and participants were instructed to self-report how applicable descriptions were to themselves from three options; 0-3, where a score of 0 indicated not at all depressed, and 3 indicated clearly depressed. The sum of these items was then used as the participants' overall depression score per wave; with higher scores signifying higher levels of depression. As the aim of the study was to predict depression, the highest score from the four waves was used as the participants' final outcome variable. This was deemed more suitable than calculating the mean score from all four waves as depression is episodic, thus using the total mean could lead to lower overall scores that

may not reflect reality. Only participants who had missing scores from all four waves were removed from the analysis.

### **Statistical Analysis**

**Procedure.** As pubertal timing typically occurs earlier in girls than in boys, it was necessary to explore the percentiles for each gender in order to determine the specific pubertal timing groups, in particular to determine the criteria for “off-time” pubertal timing. This was conducted in order to select the most suitable criteria anatomising the early, on-time or late groups. A number of cut off points were attempted, including the 10<sup>th</sup>/90<sup>th</sup> percentiles, and the 25<sup>th</sup>/75<sup>th</sup> percentiles were found to be the most predictive cut off points for both genders. For boys, participants who indicated a growth spurt or voice change age below the 25<sup>th</sup> percentile (< 12 years for growth spurt, < 12.25 years for age at voice change) were considered early maturers, those who reported an age between the 25<sup>th</sup> and 75<sup>th</sup> percentile were considered on time, and those who reported an age above the 75<sup>th</sup> (> 14.11 years for growth spurt, > 14.75 years for voice change) percentile were considered late maturers. In girls, participants who reported a growth spurt or age of menarche at or below the 25<sup>th</sup> percentile (< 11 years for growth spurt, < 12 years for age of menarche) were considered early maturing, those who reported a growth spurt or age of menarche between the 25<sup>th</sup> and 75<sup>th</sup> percentile were grouped as on-time, and those who experienced their growth spurt or age of menarche at or above the 75<sup>th</sup> percentile (> 14 years for growth spurt, > 15 years for age of menarche) were considered late maturing.

**Assumptions.** Before conducting a multiple regression analysis, several assumptions were tested. The histogram and normal Q-Q plot indicated that the participants’ highest CDI

scores were skewed to the left, as can be expected; therefore a log transformation was computed to ensure normal distribution of the outcome variable. Following this, the data displayed no further violations of the assumptions of a multiple regression. An analysis of standard residuals was conducted and signified that the data did not contain outliers (Std. Residual Min = -2.79, Std. Residual Max = 2.34). Absence of multicollinearity was confirmed as the tolerance value was greater than 1 (.68) and the VIF was less than 10 (1.47). The data met the assumption of independent errors (Durbin-Watson value = 1.91). Homogeneity of variance and linearity were confirmed by the scatterplot of standardised residuals. Finally, the assumption of non-zero variances was met (Pubertal Timing = .67, Perceived Rejection = .23, CDI = .11). Independent t-tests were conducted in order to determine the differences between groups (eg. boys vs girls, early vs on-time). A regression analysis was then performed with pubertal timing predicting CDI scores at step 1, and perceived rejection entered as the possible mediator at step 2. Statistical analysis was conducted on SPSS Version 25.

## Results

### Descriptives

Using growth spurt as a comparable variable, girls entered puberty approximately 1 year earlier than boys (see Table 1). Two independent t tests were conducted to compare both CDI scores and perceived rejection scores between genders (see Table 2). It was found that girls reported significantly more perceived rejection than boys ( $t(298) = 3.947, p < .001$ ). While the means suggested that girls generally seemed to be more depressed than boys, this difference was not statistically significant.

Table 1. *Pubertal Timing Measures in Girls and Boys*

	<i>N</i>	Growth Spurt (yrs)*	<i>SD</i>	Age of Menarche/Voice Change (yrs)	<i>SD</i>	Perception of Physical Development	<i>SD</i>
Boys	144	13.32	6.17	12.24	4.51	2.93	.74
Girls	156	12.30	6.04	12.76	1.69	2.88	.87

\* $p < .001$ , sig. difference between genders

Table 2. *Mean CDI and Perceived Rejection Scores in Boys and Girls*

	<i>n</i>	CDI	<i>SD</i>	Perceived Rejection*	<i>SD</i>
Boys	144	7.49	6.17	-.84	.43
Girls	156	8.45	6.04	-1.05	.48

\* $p < .001$ , sig. difference between genders

### Main Analyses

First, the mean CDI and perceived rejection scores were compared between each pubertal timing measure for both girls (see Table 3) and boys (see Table 4). The means suggested that higher levels of depression were reported by girls who experienced an early age of menarche (see Table 3) and boys who experienced late maturation at all three measures (see Table 4).

Table 3. *Girls' Mean CDI and Perceived Rejection Scores for Each Pubertal Timing Measure*

Measure of pubertal timing	<i>n</i>	CDI	<i>SD</i>	Perceived Rejection	<i>SD</i>
<b>Growth spurt</b>					
Early	19	8.01	4.84	-.99	.42
On Time	103	8.56	6.18	-1.04	.50
Late	34	8.35	6.36	-1.14	.46
<b>Age of Menarche</b>					
Early	28	9.37	6.44	-.91	.52
On Time	112	8.22	5.57	-1.11	.47
Late	16	8.44	8.40	-.91	.50
<b>Perception of Physical Development</b>					
Early	38	8.93	5.42	-1.05	.53
On Time/Late	116	8.34	6.06	-1.05	.48

Table 4. *Boys' Mean CDI and Perceived Rejection Scores for Each Pubertal Timing Measure*

Measure of pubertal timing	<i>n</i>	CDI	<i>SD</i>	Perceived Rejection	<i>SD</i>
<b>Growth spurt</b>					
Early	38	6.84	4.61	-.72	.39
On Time	70	6.43	4.22	-.90	.45
Late	36	10.24	9.34	-.87	.44
<b>Age of Voice Change</b>					
Early	36	7.53	8.27	-.80	.46
On Time	72	6.76	4.04	-.90	.42
Late	36	8.91	7.12	-.77	.43
<b>Perception of Physical Development</b>					
Early/On Time	119	6.99	5.13	-.85	.42
Late	22	10.5	9.82	-.85	.43

A multiple regression analysis was then conducted in order to explore the possible gender interaction with pubertal timing in predicting later depression. A comparison of the means already suggested different predictors for boys and girls; early timing seemed to be important for girls (see Table 3) while late timing seemed to be important for boys (see Table 4). A significant interaction of gender was found ( $F(4, 292) = 1.86, p = .036, R^2 = .03$ ; see Table 5), accounting for 2.2% of the variance explained. This led the remaining analyses to be conducted separately for boys and girls.



Table 5. *Regression Findings for Pubertal Growth Spurt Timing Explaining Depressive Symptoms, Differentiated by Gender*

	Model 1: Pubertal Timing and Depression				Model 2: Gender Interaction with Pubertal Timing and Depression			
	<i>B</i>	<i>t</i>	$\beta$	<i>p</i>	<i>B</i>	<i>t</i>	$\beta$	<i>p</i>
Constant	.79	21.94	-	.00	.79	22.12	-	.00
Early Growth Spurt <sup>1</sup>	.02	.43	-.03	.67	.09	1.39	.13	.16
Late Growth Spurt <sup>1</sup>	-.02	-.36	-.03	.72	-.07	-1.26	.13	.16
Gender*Early <sup>2</sup>	-	-	-	-	-.11	-1.60	-.14	.11
Gender*Late <sup>2</sup>	-	-	-	-	.13	2.04	.14	.04
	<u>R<sup>2</sup></u>	<u>R<sup>2</sup> change</u>	<u>Sig. F change</u>		<u>R<sup>2</sup></u>	<u>R<sup>2</sup> change</u>	<u>Sig. F change</u>	
	.002	.002	.699		.025	.022	.036	

<sup>1</sup>*entered as dummy-variables*

<sup>2</sup>*gender dummy variables interaction with pubertal timing dummy variables*

**Girls.** Following an exploration of the mean scores for each pubertal timing measure (see Table 6), and a number of attempts to seek the best predictor of depression, age of menarche was found to be the best predictor when participants were regrouped into two categories; early and on-time/late, where early was considered to be all ages up to (not including) 12 years, and on-time/late considered to be age 12 and older. As this was a categorical variable, dummy-variables were created in order to include it in the prediction model, where early maturers were recoded as 1 and on-time/late maturers were recoded as 0. Although earlier age of menarche was found to be the best predictor of depression in girls the multiple regression analysis showed that these effects were not statistically significant ( $F(1, 154) = 1.71, p = .193, R^2 = .01$ ; Table 6). A multiple regression analysis also determined that early growth spurt did not have a significant

effect on depression scores ( $F(1, 154) = .02, p = .893 R^2 = .00$ ), nor did early perception of physical development compared to peers ( $F(1, 152) = 1.64, p = .20, R^2 = .01$ ). The results of the analysis portrayed a significant correlation between perceived rejection scores and CDI scores ( $r(154) = -.205, p = .01$ ). These results can conclude that early pubertal timing does not predict depression in girls. However, perceived rejection seems to be an independent predictor in the development of depression in girls during adolescence, explaining for 5% of the variance in later depressive symptoms.

Table 6. *Regression Findings for Pubertal Age of Menarche Explaining Depressive Symptoms in Girls*

	Model 1: Pubertal Timing and Depression				Model 2: Pubertal Timing, Perceived Rejection and Depression			
	<i>B</i>	<i>t</i>	$\beta$	<i>p</i>	<i>B</i>	<i>t</i>	$\beta$	<i>p</i>
Constant	.80	27.20	-	.00	.63	9.58	-	.00
Early Age of Menarche <sup>1</sup>	-.09	1.31	.11	.193	.12	1.73	.14	.085
Perceived Rejection	-	-	-	-	-.16	-2.84	-.23	.005
	R <sup>2</sup>	R <sup>2</sup> change	Sig. F change		R <sup>2</sup>	R <sup>2</sup> change	Sig. F change	
	.01	.01	.193		.06	.05	.005	

<sup>1</sup>age < 11 years, entered as dummy-variable

**Boys.** The best predictor of depression for boys was found to be growth spurt. As boys were divided into three pubertal timing groups, two dummy-variables were created. For the first dummy-variable, early maturers were recoded as 0, on-time as 0, and late as 1. For the second

dummy-variable, early maturers were recoded as 0, on-time as 1, and late as 0. In step 1 of the multiple regression, the main effect of late growth spurt timing on depression scores for boys was significant ( $F(2, 139) = 3.18, p = .045, R^2 = .04$ ; See Table 7), accounting for 4% of the variance explained. However, a non-significant correlation was found between perceived rejection and CDI scores, indicating that perceived rejection cannot be explored as a possible mediator between early growth spurt and depression. Two additional predictors and measures of pubertal timing, age at voice change and participants' perceived physical development, were explored. Although the mean CDI scores seem to suggest that greater levels of depression were reported in boys who signified late timing in both measures the results of the analyses indicate non-significant effects between both late voice change ( $F(2, 139) = 1.72, p = .182, R^2 = .02$ ) and merely a trend between late perception of physical development ( $F(1, 138) = 3.14, p = .079, R^2 = .02$ ) and depression. The results of these analyses can be interpreted to suggest that late pubertal timing in boys can have a predictive effect on depression; however this effect is not explained by perceived rejection.

Table 7. *Regression Findings for Pubertal Growth Spurt Timing Explaining Depressive Symptoms in Boys*

	Model 1: Pubertal Timing and Depression				Model 2: Pubertal Timing, Perceived Rejection and Depression			
	<i>B</i>	<i>t</i>	$\beta$	<i>p</i>	<i>B</i>	<i>t</i>	$\beta$	<i>p</i>
Constant	.75	14.47	-	.00	.72	10.59	-	.00
Early Growth Spurt <sup>1</sup>	-.02	-.31	-.03	.75	-.03	-.40	-.04	.689
Late Growth Spurt <sup>1</sup>	.14	1.88	.19	.045	.13	1.80	.18	.074
Perceived Rejection	-	-	-	-	-.03	-.56	-.05	.581
	<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> change	Sig. F change		<i>R</i> <sup>2</sup>	<i>R</i> <sup>2</sup> change	Sig. F change	
	.04	.04	.045		.05	.002	.581	

<sup>1</sup>Variables entered as two dummy-variables

## Discussion

The aim of this study was to explore whether the heightened perceived rejection commonly experienced during adolescence mediates the relationship between pubertal timing and later depression. Additionally, the study aimed to investigate the differences in these effects between genders. It was hypothesised that girls who experienced early pubertal timing would portray higher levels of depression than boys and girls who matured on time or late, as literature has proposed that this is a result of exposure to the psychosocial consequences of the pubertal transition at a young developmental stage, meaning that girls who enter puberty earlier are less prepared than their peers (Benoit, Lacourse & Claes, 2013).

### **Findings in Girls**

Contrary to expectations, the difference in girls' CDI scores between early and on time maturers in this study was not statistically significant, despite this link being continuously supported in previous literature (Conley, Rudolph, & Byrant, 2012). There are a number of possible explanations, both methodological and theoretical, for this unexpected lack of significant relationship. Firstly, previous literature that has supported the theory that early maturation in girls leads to depression typically used a more strict cut-off when defining early timing (eg Joinson, Heron, Lewis, Croudace, & Araya, 2011). In this study, it was impossible to replicate this as there were simply not enough participants who entered puberty so young, thus a less strict cut off point was employed. As a result of this non-significant finding, the mediation model could not be explored further; therefore the hypothesis that perceived rejection would mediate the effect of early pubertal timing on depression in girls could not be accepted.

The lack of expected relationship also questions the possibility of another variable leading to the apparent stark increase in depressive symptoms experienced by adolescent girls. Marcotte, Fortin, Potvin and Papillon (2002) considered an interaction of puberty and the transition from primary to post primary school; both stressful events that typically occur at the beginning of adolescence. In fact, research has consistently stated that normative developmental transitions, such as puberty and school transition, are more stressful if they occur at the same time, as an adolescent is unable to completely adjust to either change (Coleman, 1989; Nolen-Hoeksema & Girgus, 1994). Previous exploration has found higher depressive symptoms in girls whose pubertal timing and school transition occurred simultaneously (Petersen, Sarigiani, &

Kennedy, 1991), supporting the theory that the co-occurrence of these two stressful events leads to a heightened risk of depression among adolescent girls. With this in mind, it may be beneficial for future research to explore pubertal timing and school transition as a co-occurring variable.

The present study did confirm that girls would perceive more rejection than boys. It was found that girls displayed significantly greater levels of perceived rejection than boys independent of early pubertal timing, therefore this hypothesis can be accepted. The finding that, in girls, perceived rejection is related to later depression is in line with previous research that suggests that girls tend to value peer interaction more, and thus worry about peer acceptance more than boys. For instance, Hankin et al. (2015) have discussed how girls are typically more relationally oriented, and tend to display more affiliative needs, particularly during adolescence (Rose & Rudolph, 2006). In general, adolescent girls exhibit significantly more peer related stress than do boys (Hankin, Mermelstein, & Roesch, 2007; Rudolph, 2002), and are more reactive to peer stress (Conley & Rudolph, 2009; Hankin et al., 2007). In addition, girls have been found to report significantly higher levels of depression and negative affect as a result of interpersonal stress than boys (Prinstein et al., 2005). Research has suggested that girls not only experience more peer-related stress, but are more reactive to this type of stress as they value their peer relationships more than boys do (Rudolph, 2002) and are more likely to place their friends' needs before their own (Cyanowski, Frank, Young, & Shear, 2000), which leads to a greater risk of developing depression as a result. Supporting this, Conley, Rudolph and Byrant (2012) found that peer stress was more than twice as powerful a predictor of depression in girls than in boys. In relation to the findings of this study, research has consistently stated that heightened levels of perceived rejection trigger the development of depression as a result of maladaptive coping

mechanisms that lead to an impairment in social relationships, thus triggering affective responses and negative cognitions (Ayduk, Downey, & Kim, 2001; Sandstrom, Cillessen, & Eisenhower, 2003).

### **Findings in Boys**

An interesting finding of the study was that boys who experienced late pubertal timing showed significantly higher levels of depression than boys who developed early or on time. This is in line with previous research stating that later pubertal timing leads to depression (Kaltiala-Heino, Kosunen, & Rimpela, 2003). Perceived rejection was not found to play a mediating role in the relationship between late-pubertal timing and depression in boys, implying that there may be an alternative explanation for their greater vulnerability to depression.

Previous literature has proposed body dissatisfaction as a potential mediator between late pubertal timing and depression in boys. As opposed to the thin ideal that mainly exists for girls, leanness and muscularity are socioculturally valued physical changes, which usually only occurs following the onset of puberty (Calzo et al., 2012). In particular, a study conducted by de Guzman and Nishina (2014) found that body dissatisfaction was predicted by both perceived late development in comparison to peers, and actual late pubertal development in adolescent boys. Future research should consider exploring the possibility that body dissatisfaction mediates the predictive relationship between late pubertal timing and depression in boys. In saying this, research into pubertal timing in boys has its challenges, and may explain the inconsistencies in pubertal timing literature for boys. For example, as opposed to menarche girls, boys lack a “hallmark” milestone in puberty. Age at spermarche, which is boys’ age at which they

experience their first ejaculation, has been suggested as a measure analogous to menarche (Dorn, Dahl, Woodward, & Biro, 2006), however, boys may not always feel comfortable reporting this, which may lead to inaccuracies when data collecting (Mendle, Harden, Brooks-Gunn & Graber, 2010). As a result, this challenges future research in broadening the understanding that currently exists regarding the psychosocial impact of pubertal timing in boys.

### **Strengths and Limitations**

A notable strength of the study is its four wave longitudinal design; which is particularly poignant when aiming to predict episodes of higher depressive symptoms over time. Also, this study employed a new measure of perceived rejection that is not seen in previous studies. Participants were required to read the expressions of the schematic faces and interpret how much that person liked talking to them. This unconscious process - just like reading body language or posture - is one that they perform in every human interaction they experience, and could have a lot of potential for use in future research. Therefore, this measure of decoding facial expressions could be adapted for use in future studies and include decoding of body language, posture, or other nonverbal cues that can be interpreted as rejecting. Albeit a small effect, this measure found that girls do perceive more rejection, and that this tendency is related to later depression.

At the same time, some limitations merit comment, and there is certainly room for improvement in future research. Participants had to report at what age they experienced their growth spurt, first menstruation, or voice change, which may not have been easy to correctly remember and so the data may be inaccurate. Therefore, future research should consider alternative measures for pubertal timing, such as recording their transitions while it happens as



opposed to relying completely on the participants' memory. For example, Benoit, Lacourse, and Claes (2013) employed the Pubertal Development Scale (PDS; Petersen, Crockett, Richards, & Boxer, 1988). This measure of pubertal development, where participants rate their physical changes on a scale from 1 (development not started) to 4 (completely developed), is well-validated and widely used, and could possibly provide more accurate results when applied repeatedly throughout adolescence.

## **Conclusions**

This study has implications for theory and research as it enriches the current growing understanding of the interaction between psychological, physical and social processes that play a role in the development of depression in adolescence. Additionally, it has added to the lack of previous literature regarding the predictive value of perceived rejection on the relationship between early maturation and depression through the use of a new measure. Given this normative sample, it seems worthwhile to further explore its predictive value in subclinical levels. In relation to its implications for practice, the findings in this study support the theory that puberty plays a role in the development of depression, even if this finding was not significant in girls, suggesting the need for greater support and resources for adolescents during this critical period. The significant finding that perceived rejection leads to greater levels of depression in girls is important to consider as specific resources in this area could be a potential protective factor to reduce their risk of depressive symptoms. In general, the findings of this study highlight the importance of considering gender differences in the development of adolescent depression when it comes to preventatives, treatment plans and interventions.

In conclusion, this study aimed to explore a potential mediation model of early pubertal timing, perceived rejection and depression, particularly in girls. Although no significant effects were found between early pubertal timing and depression in girls, the findings of this study still harbour important implications for theory and practice. Significant relationships between late pubertal timing and depression in boys, and perceived rejection and depression in girls, are highly informative when considering protective factors that may prevent depression, and interventions to treat it, all the while allowing for gender differences.

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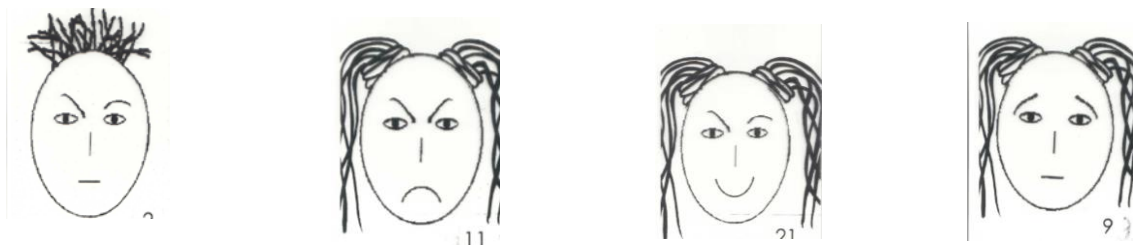


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### Appendix A



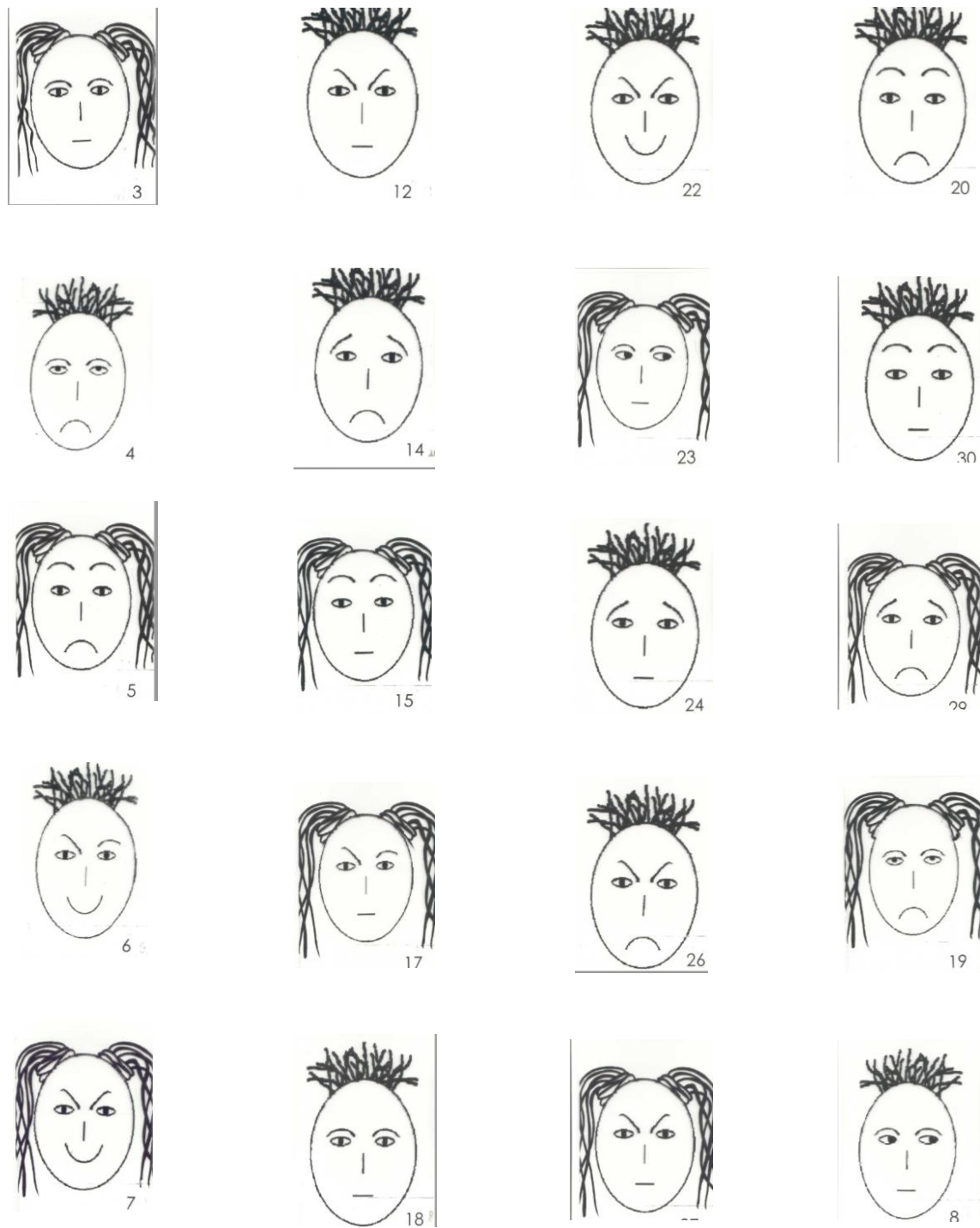


Figure 1. Low intensity faces used as perceived rejection measure