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Depressive Symptoms amplify Emotional Reactivity to Daily Perceptions of Peer Rejection in Adolescence

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Abstract

During adolescence, interpersonal stressors such as peer rejection pose challenges to emotion regulation. Yet, very little is known about how these transactional processes unfold in adolescents' daily lives. This study investigated adolescents' (a) *emotional reactivity* to daily perceptions of peer rejection, which concerns concurrent changes in negative and positive emotions, and (b) *emotional recovery* from daily perceptions of peer rejection, which concerns subsequent changes in negative and positive emotions. Because depressive symptoms can compromise effectiveness of emotion regulation, it was investigated as a moderator for emotional reactivity and recovery to daily perceptions of peer rejection. The sample consisted of 303 adolescents (59% girls; M_{age} = 14.20, SD = 0.54; range 13 – 16 years) who reported depressive symptoms at baseline and completed ecological momentary assessments of emotions and perceived peer rejection at nine random time-points per day for six consecutive days. Results from multi-level modeling analyses showed that perceived peer rejection was related to emotional reactivity (i.e., higher levels of negative emotions and lower levels of positive emotions). This effect was stronger for those with higher depressive symptoms. For emotional recovery, perceived peer rejection had lasting effects on adolescents' negative emotions, but was not related to positive emotions. Depressive symptoms did not moderate effects of perceived peer rejection on emotional recovery. This study provides a more nuanced understanding of how depressive symptoms amplify the emotional impact of perceived peer rejection in adolescents' day-to-day lives.

Keywords

Emotional Reactivity and Recovery; Negative and Positive Emotions; Peer Rejection; Adolescents; Depressive Symptoms; Ecological Momentary Assessment

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Introduction

Adolescence is characterized by significant changes in interpersonal relationships. In particular, adolescents become more emotionally intimate and vulnerable in their relationships with peers, which propels and shapes their social and emotional development (Rudolph, 2014). The increased importance of peer relationships introduces novel interpersonal stressors that potentially put adolescents at risk for the development of depressive symptoms (Thapar, Collishaw, Pine & Thapar, 2012). Peer rejection is one of the most potent stressors that disrupts adolescents' emotion regulation (Platt, Kadosh, & Lau, 2013). Research shows that even simulated peer rejection is emotionally salient, particularly for depressed adolescents (Silk, Siegle, Lee, Nelson, Stroud, & Dahl, 2013). Interpersonal models of psychopathology underscore that depressive symptoms emerge and perpetuate through a continuous transactional process between social stressors that challenge adolescents' regulation of emotions (Hammen, 2009).

Although previous research advanced the knowledge of how social stressors and peer rejection amplify depressive symptoms by disrupting emotion regulation (Crone & Dahl, 2012), this work often focused on chronic experiences of peer rejection, which is typically derived from yearly sociometric assessments (e.g., Prinstein et al., 2018). Very little is known about how these transactional processes unfold in adolescents' daily lives. This is surprising because studies of daily life stressors and the impact on adolescents' emotions have the potential for elucidating mechanisms that impact the emergence and trajectory of depressive symptoms. To address this important gap, ecological momentary assessments were used to study emotion responses to perceptions of peer rejection in adolescents' day-to-day lives, increasing ecological validity and decreasing recall bias (Stone et al., 1998). Another advantage of ecological momentary assessment is that it allows for intensive sampling over the course of a day for several days and is well suited for the study of transactional patterns of emotional responses to social stressors (Silk, Steinberg, & Morris, 2003). These features enable a better understanding of temporal dynamics of emotions by providing a fine-grained distinction between emotional reactivity to and recovery from interpersonal stressors, which are characteristics of emotion regulation (Rottenberg, 2005). Thus, the goals of this study were to investigate adolescents' (a) *emotional reactivity* to daily perceptions of peer rejection, which concerns *concurrent* changes in negative and positive emotions, and (b) *emotional recovery* from daily perceptions of peer rejection, which concerns *subsequent* changes in negative and positive emotions. The interpersonal model of depression suggests that depressive symptoms compromise emotion regulation, depressive symptoms were investigated as a moderator for emotional reactivity and recovery to daily perceptions of peer rejection. Accordingly, amplification of adolescents' emotional responses to perceived peer rejection would result in higher levels of negative emotions and lower levels of positive emotions as a direct response (i.e. higher emotional reactivity) and this pattern would continue at the next measurement (i.e. less emotional recovery).

Peer Rejection and Emotional Reactivity and Recovery

Traditionally, peer rejection during childhood and adolescence has been measured based on peer nominations within a classroom or grade (Coie, Dodge, & Coppotelli, 1982). Rejected

adolescents are widely disliked by their peers and marginalized from the larger group (Mikami, Lerner, & Lun, 2010). As such, peer rejection is considered an objective chronic interpersonal stressor, which interferes with the development of emotion regulatory capacities (Grant et al., 2014). Rejected adolescents miss out on the positive socialization functions of peers including social support and modeling of effective emotion regulation. Moreover, rejected adolescents might be overwhelmed by the effects of the interpersonal stress and, consequently, experience high levels of negative emotions (Southam-Gerow & Kendall, 2002). Drawing on stress appraisal and coping research, Lazarus and Folkman (1984) emphasized the importance of subjective appraisals of interpersonal stressors as either threatening, harmful or challenging. In other words, the way adolescents perceive peer rejection events may determine the degree to which these events are stressful, and thus impact emotional reactivity and recovery. This also implies that appraisals of peer rejection may show variability over time, which has not been examined in developmental research.

Little is known about daily perceptions of peer rejection and its effects on adolescents' positive and negative emotions when they are actually experiencing peer rejection in the moment. This micro-level of analysis is important because previous ecological momentary assessment studies showed that stressful events become more linked to adolescents' negative emotions, indicating that adolescents become more vulnerable to the effects of interpersonal stressors (Larson, Moneta, Richards, & Wilson, 2002). Emotions become increasingly entrenched within social contexts (Silk et al., 2013). Although previous ecological momentary assessment studies showed that both healthy and depressed adolescents experience the most positive and least negative emotions when in company of peers as compared to other social contexts and being alone, previous studies have not assessed the appraisals of peer company (Silk et al., 2013). Thus, it is currently unclear how adolescent's daily perceptions of peer rejection predict their emotional reactivity and recovery.

Depressive Symptoms as a Moderator of Emotional Reactivity and Recovery

Interpersonal models of depression theorize that depressive symptoms are related to emotional responses and interpersonal stressors in daily life (Rudolph et al., 2016). Previous studies indicated that depressive feelings might impair adolescents' ability to regulate emotions in response to peer stress, resulting in adolescents being more emotionally affected and sensitive to peer stressors (Agoston & Rudolph, 2011). This means that perceived peer rejection may trigger higher emotional reactivity, increasing negative emotions, and decreasing positive emotions in adolescents with higher levels of depressive symptoms. In addition, because adolescents with depressive symptoms employ fewer adaptive emotion regulation strategies (Larsen et al., 2013; Schäfer, Naumann, Holmes, Tuschen-Caffier, & Samson, 2017), they may experience difficulties in recovering from perceived peer rejection (Thompson et al., 2012). In this case, increased negative emotions and decreased positive emotions might linger longer and still be present at subsequent time points after the perceived peer rejection event (Agoston & Rudolph, 2011).

Studies investigating emotional reactivity using ecological momentary assessment methods suggest that clinically depressed adults showed higher reactivity in negative emotions to perceived stressful events, such as negative social interactions as compared to healthy

controls (Bylsma, Taylor-Clift, & Rottenberg, 2011). However, differences between clinically depressed and healthy controls are not always supported because both groups showed similar heightened reactivity in negative emotions, but no changes in positive emotions in response to general negative events (Thompson et al., 2012). An ecological momentary assessment study among adolescents found that clinically depressed adolescents showed higher negative emotions and a lower ratio of positive to negative emotions when in company of peers as compared to healthy controls (Silk et al., 2013). However, it was unclear whether peer company was perceived as pleasant or stressful. Moreover, studies with non-clinically depressed adolescents are scarce; but from a prevention perspective, it is important to investigate how perceived peer rejection affects emotions in subclinical levels of depression to identify possible problematic dynamics before clinical depression emerges. Schneiders et al. (2006) showed that young adolescents who were at risk for the development of psychopathology reported experiencing significantly more negative events with peers and family. However, these high-risk adolescents were not more emotionally reactive to perceived peer rejection. In a follow-up study, high-risk young adolescents reported feeling more depressed when in the company of family, but no differences were found for the peer context (Schneiders et al., 2007). It is possible that these differences emerge during middle and late adolescence because peers become more salient for adolescent emotional experiences, and daily stressful peer experiences may become stronger predictors of emotional reactivity (Kendall et al., 2014).

Previous ecological momentary assessment studies did not investigate how adolescents with depressive symptoms recover from perceived peer rejection. However, in an ecological momentary assessment study, Silk et al. (2003) showed in a sample of adolescents, that those with higher levels of depressive symptoms were less able to effectively regulate feelings of sadness, anger, and anxiety. Consequently, adolescents with higher levels of depressive symptoms were less likely to recover from these negative emotions later in the day. It is possible that a similar pattern of emotional response may occur when adolescents with depressive symptoms are feeling rejected in the company of their peers. This supposition is supported by the evidence from a sample of college students, whose higher reactivity was related to more negative appraisals of interpersonal stressors (O'Neill, Cohen, Tolpin, & Gunthert, 2004), implying that the effects of stress lingered longer, making it more difficult to recover from interpersonal stressors.

Current Study

The increased importance of peer relationships over the course of adolescence heightens adolescent vulnerability to difficulties in peer relationships, such as peer rejection. However, we know little about how daily perceptions of peer rejection and its effects on adolescents' positive and negative emotions when they are actually experiencing peer rejection in the moment. The present study employed ecological momentary assessment methodology to test the impact of perceived peer rejection on adolescents' daily negative and positive emotions. Specifically, we investigated (a) *emotional reactivity* to daily perceived peer rejection, operationalized as concurrent changes in negative and positive emotions and (b) *emotional recovery* from daily perceived peer rejection, which are subsequent changes in negative and positive emotions. Additionally, because interpersonal model of depression suggests that

depressive symptoms compromise effective emotion regulation (Hammen, 2009), we investigated whether adolescents with higher levels of depressive symptoms were more emotionally reactive to daily perceived peer rejection by showing heightened levels of negative emotions and lower levels of positive emotions than those with low levels of depressive symptoms. We also investigated whether adolescents with higher levels of depressive symptoms had more difficulties recovering from daily perceived peer rejection by showing higher levels of negative emotions and lower levels of positive emotions after a perceived peer rejection event than those with low levels of depressive symptoms. All analyses included gender as a control, given that adolescent girls experience higher levels of episodic interpersonal stress, which affects them stronger, as they are more likely to become depressed compared to boys (Shih, Eberhart, Hammen, & Brennan, 2006).

Methods

Participants

Participants were recruited from four high schools that are located in the eastern Netherlands. All second-year students (comparable to 8th grade in the United States, N = 933) received an information letter about the purpose and design of the current study (see van Roekel et al., 2014 for details). Parents provided active consent for their child to participate in the study, and adolescents provided assent. No exclusion criteria were used: all adolescents with active consent from their parents could participate in the study. In total, 339 adolescents (36.33%) expressed an interest in participating; however, due to organizational issues, illness, or withdrawal of consent, 36 adolescents (10.62%) did not participate. The final sample consisted of 303 adolescents (59% girls) aged between 13 and 16 years (M = 14.20, SD = 0.54). All educational levels were represented: 23.4% attended preparatory secondary school for technical and vocational training, 35.8% attended preparatory secondary school for college, and 40.8% attended preparatory secondary school for university. The majority of the adolescents were born in the Netherlands (97.1%).

The participants filled out nine assessments per day at random time points during 90-min intervals for six consecutive days, which resulted in 11,242 (69.82 %) momentary assessments (out of 16,362 possible assessments). To ensure reliable measurements of the variables of interest, we excluded adolescents from the analyses who completed less than one-third of the total number of assessments (i.e., fewer than 18 assessments, N = 17, 5.61%), which is in line with previous momentary assessment studies (van Roekel et al., 2014; Rogers, Ha, Updegraff, & Iida, 2018). This resulted in a sample of 286 adolescents (n = 167 girls, 58.4%) aged between 13 and 16 years (M = 14.19, SD = 0.54) with 11,056 assessments. On average, participants completed 38.66 assessments (SD = 9.29; range 18–54). Note that sensitivity analyses were performed to investigate whether similar results emerge when using a cut off score of 20% missing reports. Results did not change when excluding participants who completed less than 20% of the momentary assessments.

Attrition—We performed analyses to examine whether sample characteristics differed between the excluded sample and the final analytic sample. Independent t-tests showed no differences with regards to gender ($X^2(1) = 0.04$, $p = 0.83$), age ($t(297) = 1.80$, $p = 0.07$),

depressive symptoms ($t(295) = 0.51$, $p = 0.61$), aggregated measures of perceived peer rejection ($t(300) = 0.54$, $p = 0.67$), positive emotions ($t(301) = 0.43$, $p = 0.67$), and negative emotions ($t(301) = 0.97$, $p = 0.34$).

Procedure

This study consisted of two parts van Roekel et al., 2014). First, adolescents completed baseline assessments online during regular school hours, which took approximately 45 minutes. The second part started two to eight weeks later, which consisted of the ecological momentary assessments (Shiffman, Stone, & Hufford, 2008). The assessment period was six consecutive days, and the first measurement day was always on Friday. Adolescents were provided with smartphones one day prior to the first measurement day and kept them for six days. The program MyExperience (Froehlich, Chen, Consolvo, Harrison, & Landay, 2007) was pre-installed on smartphones, which is an open source tool designed to collect data during participants' everyday lives. The smartphones were programmed to emit buzzing signals nine times a day at random time points during 90-minute intervals, after which adolescents filled out the questionnaire. In case of a non-response within two minutes, participants would receive a reminder with a buzzing signal (maximum of three reminders).

Before the start of the ecological momentary assessments, adolescents were individually instructed on how to use the smartphones. Emphasis was placed on filling out the questionnaire as quickly as possible and pausing ongoing activities after receiving a signal van Roekel et al., 2014 for more information). Text messages were sent to the principal investigator whenever adolescents completed a questionnaire to monitor compliance. When two consecutive reports were missing, the adolescent received a text or phone call to remind them to fill out the questionnaire. After the momentary assessments, adolescents completed a short questionnaire to check whether any unusual events took place or any problems occurred during the 6-day assessment period. Adolescents received a reward of € 20 (US $ 27) when they completed at least 55% of the momentary assessments. The procedures used in the present study were approved by the Medical Ethical Committee Arnhem-Nijmegen (2009, No. 285).

Measures

Baseline Assessment

Depressive symptoms: Depressive symptoms was assessed at baseline with a Dutch version (Cuijpers, Boluijt, & van Straten, 2008) of the 20-item Center for Epidemiological Studies Depression Scale (CES-D; Radloff, 1977). Adolescents were given a scale ranging from 0 (*less than one day*) to 4 (*5–7 days*) to indicate how often during the past week they had been bothered by the listed depressive symptoms. The CES-D has well-established psychometric properties, including high test-retest reliability and high internal consistency (Radloff, 1977; Roberts, Andrews, Lewinsohn, & Hops, 1990). For adolescent samples, a score of 16 or more is generally considered to be indicative of potential depression. With this cutoff score, 19.2 % of the total sample (23.2% of the girls and 13.8% of the boys) were classified as having a potential risk for depression, which is comparable to values reported in other studies (e.g., Twenge & Nolen-Hoeksema, 2002). In this study, a continuous mean depression score was used in all analyses, as the CES-D was designed for use in the general

population and is more suitable to be used with a continuum approach to assessing depressive symptoms (MacPhee & Andrews, 2006). Cronbach's alpha across all items of the CES-D scale was 0.91.

Ecological Momentary Assessments

Perceived Peer Rejection—When adolescents were randomly buzzed throughout the day they were first asked if they were alone. If adolescents were not alone, they were asked to rate the extent to which they perceived their company as threatening and judging (i.e., "I feel threatened by this company" and "I feel judged by this company"). Two items measured how comfortable and accepted they felt in the company of peers (i.e., "I feel comfortable in this company" and "I feel accepted by this company") (van Roekel et al., 2015; van Roekel et al., 2016). Questions were answered on a scale ranging from (1) *not at all* to (7) *very much*, and the latter two questions were inversely coded. Responses were averaged to represent a score of perceived peer rejection. In addition, adolescents reported in an open-ended question with whom they were. Reports were included when adolescent reported to be in the company of peers (i.e., friends and classmates). No information was gathered about the number of peers and the quality of these friendships. An average composite across the four items was created.

Since perceived peer rejection, negative and positive emotions, were measured with ecological momentary assessments for six consecutive days with a maximum of nine measurements per day per person, the data were well suited to investigate emotional reactivity and recovery to perceived peer rejection. To this end, we first identified within-subject maximum reports of perceived peer rejection of the day. In the case of multiple highest-perceived peer rejection experiences, the last highest perceived peer rejection experience of the day was included to prevent overlap between subsequent emotional recovery and peer rejection periods. This procedure resulted in a maximum of six beep moments over the course of the six-day ecological momentary assessment period that represented the daily highest perceived peer rejection for each subject at Time 0 (T0).

Positive and negative emotions: As in previous ecological momentary assessment studies (e.g., Peeters, Berkhof, Delespaul, Rottenberg & Nicholson, 2006; Wichers et al., 2007), positive emotions were measured by the items "joyful", "satisfied", "happy", "energetic", and "cheerful" and negative emotions by the items "insecure", "anxious", "worried", "low", and "guilty". Adolescents rated to what extent they experienced these emotions on a 7-point scale ranging from (1) *not at all* to (7) *very much*. Cronbach's alphas for both positive and negative emotions were calculated, which resulted in an alpha of 0.84 for positive emotions and 0.71 for negative emotions.

To measure emotional reactivity, the level of concurrent positive and negative emotions was identified at each of the highest perceived peer rejection (Time 0; T0). Levels of positive and negative emotions were identified one beep moment before the highest perceived peer rejection (Time −1; T-1) to control for previous emotions. To measure emotional recovery, negative and positive emotions were examined one time-point after the beep moment that

represented the highest perceived peer rejection experience of the day (Time+1; T+1), controlling for T0 emotions.

Time: A variable 'time' was created to control for the duration between T0 and T+1 in minutes. As signals occurred at random time points, the time between two consecutive assessments differed across and within participants.

Analytical Approach

Descriptive statistics for all variables were calculated. Descriptive statics for the momentary assessments scores were based on aggregated scores across all assessments to represent a mean score for each person. Multilevel models were used to examine emotional reactivity and recovery to perceived peer rejection within persons across days. We estimated the multilevel models using the MIXED procedure of SAS (SAS Institute, 2001). To model negative emotional reactivity to perceived peer rejection, we examined the level of negative emotions at each of these highest perceived peer rejection experiences (T0) while controlling for the previous level of negative emotions at the beep level (T-1). Positive emotional reactivity was similarly modeled. The within-individual level model for emotional reactivity allowed each individual's emotion on a given day to be modeled as a function of a persons' highest perceived peer rejection experience. The effects in the within-individual level model were considered to be random, i.e., allowed to vary from person to person. The within-individual equation was as follows:

$$\mathrm{NA}_{\mathrm{ij}} = \beta_{0\mathrm{j}} + \beta_{1\mathrm{i}}\mathrm{NA(T-1)}_{\mathrm{ij}} + \beta_{2i}\mathrm{PPR}_{\mathrm{ij}+} e_{\mathrm{ij}} \quad (1)$$

NA_{ij} is the level of negative emotions on the j^{th} day for subject i; $NA(T\text{-}1)_{\mathrm{ij}}$ is the level of past negative emotions (T-1) on the j^{th} day for subject i; PPR_{ij} is the individuals' level of the highest perceived peer rejection experience on day j; e_{ij} is the residual component specific to day j for subject i.

To investigate whether an individual's depressive symptoms moderated the effect of the perceived peer rejection experience on negative emotions, the variable Depressive Symptoms was included as a between-individual variable. Given that gender may affect emotions, gender was included as a control variable in the analyses. The between-individual equations were:

$$\begin{aligned} \beta_{0i} &= \gamma_{00} + \gamma_{01}\text{Deppressive Symptoms}_i + \gamma_{02}\text{Gender}_i + u_{0i}, \\ \beta_{1i} &= \gamma_{10} + u_{1i}, \\ \beta_{2i} &= \gamma_{20} + \gamma_{21}\text{Depressive Symptoms}_i + u_{2i}. \end{aligned} \quad (2)$$

To measure positive emotional reactivity to perceived peer rejection, the level of positive emotions was examined for each of the daily highest-perceived peer rejection while controlling for previous levels of positive emotions at the beep level (T-1).

Negative and positive emotions were examined one time-point after the beep moment that represented the highest perceived peer rejection experience of the day (T+1) while controlling for the level of, respectively, negative and positive emotions (T0) to capture

emotional recovery. The period between T0 and T+1 was controlled for, as variability in the time between measurements that may have impacted the extent to which adolescents were emotionally recovered from perceived peer rejection. As described before, the within-individual level model for emotional recovery allowed each individual's emotion on a given day to be modeled as a function of that persons' highest perceived peer rejection. The effects in the within-individual level model were considered to be random, i.e. allowed to vary from person to person. The within-individual equation was as follows:

$$\mathrm{NA(T+1)}_{ij} = \beta_{0i} + \beta_{1i}\mathrm{NA}_{ij} + \beta_{2i}\mathrm{PPR}_{ij} + \beta_{3i}\mathrm{Time}_{ij} + e_{\mathrm{ij}} \quad (3)$$

$NA(T+1)_{ij}$ is the level of negative emotions one beep moment after the highest perceived peer rejection experience at the j^{th} day for subject i (T+1); NA_{ij} is the level of negative emotions at the time of the highest perceived peer rejection experience of the day (T0) on the j^{th} day for subject i; PPR_{ij} is the individuals' level of the highest perceived peer rejection experience on day j; $Time_{ij}$ is the time between the highest perceived peer rejection experience on day j, and the measurement of NA_{ij}; e_{ij} is the residual component specific to day j for subject i.

As above, to investigate whether an individual's depressive symptoms moderated the effect of the perceived peer rejection experience on the recovery of negative emotions, the variable Depressive Symptoms was again included as a between-individual variable along with gender as a control variable. The between-individual equations were:

$$\begin{aligned} \beta_{0i} &= \gamma_{00} + \gamma_{01}\text{Depressive Symptoms}_i + \gamma_{02}\text{Gender}_i + u_{0i}, \\ \beta_{1i} &= \gamma_{10} + u_{1i}, \\ \beta_{2i} &= \gamma_{20} + \gamma_{21}\text{Depressive Symptoms}_i + u_{2i}. \end{aligned} \quad (4)$$

Similar models were estimated for recovery in terms of positive emotions after the highest perceived peer rejection experience of the day while controlling for past positive emotions (T0), age, and gender. Additionally, moderated effects of depressive symptoms on the recovery of positive emotions after the highest perceived peer rejection experience were investigated. The significance levels of simple slopes were investigated by using ± 1 SD from the mean to identify high and low values of depressive symptoms in the negative and positive emotions models.

Results

Descriptive Statistics

Table 1 shows the means and standard deviations for the included variables. During the assessment period of six days, participants reported, on average, low to moderate levels *(M* = 2.29, *SD* = 0.83) of daily perceived peer rejection. In addition, participants reported generally feeling positive with low levels of negative emotions over the assessment period right before, during, and after the perceived peer rejection experience. Table 2 shows the correlational analyses of the model variables at the between-person level. Girls reported higher levels of depressive symptoms, higher levels of perceived peer rejection, and more

negative emotions at T-1 and T0 than boys did. Age was not correlated with any of the variables, confirming that there was no need to control for age effects in final analyses. In addition, depressive symptoms related significantly to the level of negativity experienced when experiencing peer rejection. Adolescents with higher levels of depressive symptoms also reported, on average, higher levels of negative emotions and lower levels of positive emotions at T-1, T0, and T+1. Additionally, higher levels of perceived peer rejection were associated with higher levels of negative emotions and lower levels of positive emotions at all three time points. Negative emotions were inversely related to positive emotions at all three time points, indicating that when adolescents reported higher levels of negative emotions they reported, on average, lower levels of positive emotions.

Emotional Reactivity to Perceived Peer Rejection

Table 3 summarizes the results from the multilevel models examining emotional reactivity in negative and positive emotions to perceived peer rejection as well as the moderation of depressive symptoms. Results showed that perceived peer rejection was associated with higher levels of negative emotions, such that when adolescents perceived peer rejection at a particular time point, they also reported higher levels of negative emotions (within-individual effects). There was also a positive association between depressive symptoms and negative emotions, such that adolescents with higher levels of depressive symptoms reported higher levels of negative emotions in general (between-person effects). In addition, depressive symptoms moderated the within-individual association between perceived peer rejection and negative emotions (Figure 1a). Simple slope tests revealed that the regression slope of perceived peer rejection for adolescents with higher levels of depressive symptoms was positive and significantly different from zero ($t = 6.25$, $p < 0.001$). The simple slope of perceived peer rejection for adolescents with lower levels of depressive symptoms was also positive and significantly different from zero ($t = 2.66$, $p < 0.01$). This indicates that adolescents with higher levels of depressive symptoms showed greater increases in negative emotions in response to perceived peer rejection compared to those with lower levels of depressive symptoms. Thus, adolescents with higher levels of depressive symptoms were more reactive in their negative emotions to perceived peer rejection.

Results concerning reactivity in positive emotions showed that when adolescents perceived peer rejection at a particular time point, they reported lower levels of positive emotions (within-individual effects). There was a negative association between depressive symptoms and positive emotions, such that adolescents with higher levels of depressive symptoms reported lower levels of positive emotions in general (between-person effects). Moreover, depressive symptoms moderated the within-individual association between perceived peer rejection and positive emotions (Figure 1b). Here, the simple slope analyses showed that the regression slope of perceived peer rejection for adolescents with higher levels of depressive symptoms was negative and significantly different from zero ($t = -6.09$, $p < .001$). Additionally, the simple slope of perceived peer rejection for adolescents with lower levels of depressive symptoms was negative and significantly different from zero ($t = -2.76$, $p < .01$). Adolescents with higher levels of depressive symptoms showed significantly lower positive emotions in response to perceived peer rejection as compared to adolescents with less depressive symptoms.

Emotional Recovery from Perceived Peer Rejection

The results from the multilevel models examining emotional recovery in negative and positive emotions to perceived peer rejection and moderation of depressive symptoms are summarized in Table 4. Results for recovery in negative emotions showed that when adolescents perceived peer rejection at a particular time point, they also reported higher levels of negative emotions at subsequent time point (within-individual effects). There was also a significant association between depressive symptoms and negative emotions, such that adolescents with higher levels of depressive symptoms reported higher levels of negative emotions in general (between-person effects). Interestingly, previous levels of negative emotions were not related to negative emotions after the perceived peer rejection. No moderation of depressive symptoms was found. For recovery in positive emotions, only depressive symptoms and levels of previous positive emotions were significantly associated with positive emotions. Adolescents with higher levels of depressive symptoms reported lower levels of positive emotions in general (between-person effects). Perceived peer rejection was not related to later positive emotions, indicating that perceived peer rejection did not have a lasting effect on positive emotions. The interaction between depressive symptoms and perceived peer rejection was not significant, thus no moderation of depressive symptoms was found.

Discussion

The increased importance of peer relationships during adolescence introduces novel interpersonal stressors such as peer rejection that challenges adolescent's emotion regulation, which has been linked to the development of depression (Thapar et al., 2012). Very little is known about how these transactional processes unfold in adolescents' daily lives (Rudolph, Lansford, & Rodkin, 2016). To address this important gap, ecological momentary assessments were used to study associations between adolescents' daily emotional reactivity to and recovery to perceived peer rejection, as well as the role of depressive symptoms in moderating these emotion dynamics in adolescents' day-to-day lives.

The results provided support for heightened emotional reactivity to perceived peer rejection such that adolescents experienced higher levels of negative emotions and lower levels of positive emotions during daily perceived peer rejection. In addition, adolescents with higher levels of depressive symptoms were more emotionally reactive to perceived peer rejection. Specifically, adolescents with higher levels of depressive symptoms showed a greater increase in negative emotions and a greater decrease in positive emotions during perceived peer rejection. In terms of emotional recovery, perceived peer rejection had lasting effects on adolescents' negative emotions but were not related to positive emotions. In addition, adolescents' depressive symptoms were related to higher levels of negative emotions and lower levels of positive emotions. However, depressive symptoms did not moderate the relationship between perceived peer rejection and emotional recovery. Adolescents with higher levels of depressive symptoms did not experience more difficulties recovering from perceived peer rejection than those with lower levels of depressive symptoms.

These findings appear to be in line with interpersonal theories of depression emphasizing the contribution of stressful interpersonal experiences to a vicious cycle in which depressive symptoms can be both a consequence and an antecedent of negative social experiences (Rudolph et al., 2016). This study showed that perceived peer rejection had a greater emotional impact in terms of increased emotional reactivity for adolescents with higher levels of depressive symptoms while controlling for previous levels of negative and positive emotions. This extends previous results of Weinstein, Mermelstein, Hedeker, Hankin, and Flay (2006), who showed that relationships with peers are consistently related to daily moods in high school students. Consistent with previous research that emphasized emotional problems in daily life for depressed adolescents (Silk et al., 2003), the current study found that adolescents with higher levels of depressive symptoms reported experiencing higher levels of negative emotions when they perceived peer rejection. The current results are also in line with a previous ecological momentary assessment study among clinically depressed adults who showed higher reactivity in negative emotions to perceived stressful events (Bylsma et al., 2011).

However, the findings regarding emotionally reactivity to perceived peer rejection for adolescents with higher levels of depressive symptoms are in contrast to evidence from clinically depressed adults who showed either blunted or no differences in emotional reactivity to daily stressful events (Peeters, Nicolson, Berkhof, Delespaul, & deVries, 2003; Thompson et al., 2012). This differing pattern may stem from the fact that the stressful events examined in these adult samples were not limited to social stress. Furthermore, the development of depressive symptoms often starts in adolescence, which in turn predicts a greater likelihood of a depressive episode during adulthood (Pine, Cohen, Cohen, & Brook, 1999). It is possible that patterns of emotional reactivity change over time. Specifically, social stressors initially may evoke a stronger emotional reactivity, but because chronic stress requires constant short-term physiological and emotional activation (e.g., McEwen, 2012), chronic peer rejection may lead to a blunted emotional reactivity. Future studies could investigate how these micro day-to-day peer stressors unfold over time and become chronic interpersonal stressors for adolescents. Identifying these dynamics can inform prevention and intervention programs focused on enhancing adolescents' ability to foster healthy and supportive peer relationships that could be protective against emotional difficulties and depressive symptoms.

No support was found for the hypothesis that adolescents with higher levels of depressive symptoms would show less emotional recovery from perceived peer rejection. This pattern is in contrast to the existing evidence obtained in laboratory-based studies in which the social stressor was induced (e.g., unpleasant imagery, sad movies; Bylsma, Morris, & Rottenberg, 2008). The current study's approach to measuring daily stressors might not have been able to elicit an equally strong stress-related stimulus required to impact the time to emotional recovery as observed in the laboratory-induced stress, thus resulting in different patterns of emotional reactions. Perceived peer rejection events were identified based on within-subject maximum reports of peer rejection of the day. Whereas this data-driven approach is preferable over an end of the day subjective recall of the most negative event (Tan et al., 2012), perceived peer rejection was on average not experienced as highly stressful. It is recommended that the future research may direct efforts at assessing more extreme daily

peer stressors, such as exclusion or bullying, which may trigger more potent emotional responses and subsequently diminished opportunity for emotional recovery among youth with elevated levels of depressive symptoms. It is noteworthy that a majority of the perceived peer rejection occurred during school times (van Roekel et al., 2014), and because Dutch students change classrooms every hour, these organizational features of the school system might have functioned as a forced emotion regulation or coping strategy for some students.

The present study's findings have a limited generalizability to emotional responses to negative social experiences (i.e., daily perceptions of peer rejection), and future research efforts need to better understand the ability to emotionally benefit from positive peer experiences. In particular, Bylsma et al. (2011) found support of the "mood-brightening effect" in which clinically depressed individuals showed significantly more improvements in their mood during and after a positive event as compared to healthy individuals. This effect was replicated in Thompson et al. (2012), who found greater decreases in negative emotions in response to positive events for depressed individuals. Accordingly, future studies should investigate whether depressed adolescents show the most improvements in mood following a positive peer experience.

The question remains whether increased reactivity to perceived peer rejection is problematic for youth with elevated depressive symptoms, given that depressive symptoms do not seem to impact emotional recovery processes in the current sample. Whereas no support was found for a significant interaction effect between perceived peer rejection and depressive symptoms, depressive symptoms still predicted higher levels of negative emotions after the perceived peer rejection. This finding underscored that adolescents with depressive symptoms reported more negative emotions in general. Moreover, given that depressed individuals have been shown to experience daily negative events more frequently (Thompson et al., 2012) and be more negatively impacted by such events, as was found in this study, the combination of these two processes might contribute and amplify the intensity of depressed mood during adolescence. Longitudinal research is needed to determine how frequency, intensity, and reactivity to perceived peer rejection predict future depression.

Strengths and limitations

An important strength of this study was its use of intensive assessments in adolescents' naturalistic environment that minimized recall bias and enabled the simultaneous measurement of peer-related stressors and emotions while adolescents were experiencing them. Nevertheless, an important limitation is the study's reliance on self-reports. Despite the fact that this study was able to disentangle depressive symptoms from emotional reactivity during perceived peer rejection, using youth self-reported measures for these constructs may have contributed to the shared source variance. Although adolescents may be reliable in reporting about perceived peer rejection experiences, it would be helpful if future research include peer reports. While depressive symptoms are a strong predictor of clinical depression, it would be important to replicate the current results in clinical samples (e.g., Silk et al., 2013). Additionally, the correlational nature of the current study limits conclusions on the directionality and causality in the links between emotional reactivity,

recovery, and depressive symptoms because emotional reactivity to perceived peer rejection can be a predictor, concomitant, or consequence of depressive symptoms. Future studies would also benefit from measuring individual differences in emotion regulation or coping strategies and examining those as mechanisms and moderators of emotion reactivity and recovery to daily perceptions of peer rejection. Although ecological momentary assessment research designs only enable brief assessments (Silk et al., 2003), it would be important to investigate whether adolescents with elevated levels of depressive symptoms used strategies that were less successful in immediately reducing negative emotions and increasing positive emotions after perceived peer rejection.

Conclusion

Despite peer rejection being among the most salient stressors that teenagers face, we still know little about how adolescents experience rejection in their daily lives and how rejection impacts emotional regulation. Studying perceived peer rejection in daily life and the direct impact it has on emotions can elucidate mechanisms that contribute to the emergence of adolescent depressive symptoms. Therefore, ecological monetary assessments were used to study associations between adolescents' daily emotional reactivity and recovery to perceived peer rejection, as well as the role of depressive symptoms in moderating emotion dynamics in the day-to-day lives of youth. Results revealed that adolescents with elevated depressive symptoms were particularly reactive to daily peer rejection. These adolescents showed higher levels of negative emotions, and lower levels of positive emotions when experiencing perceived peer rejection. However, recovery from perceived peer rejection was not more difficult for adolescents with elevated levels of depressive symptoms. Adolescence is known as a developmental period that is characterized by changes in peer relationships, emotional regulation, and an increased vulnerability to develop depressive symptoms. This study generates a better understanding of how depressive symptoms amplify the emotional impact of perceived peer rejection in adolescents' day-to-day lives. Evident from this study is the need for more empirical studies that examine the emotional impact of perceived peer rejection in adolescents' daily lives. This would increase our knowledge of daily emotion dynamics in adolescents and help improve and tailor existing services for adolescents experiencing depressive symptoms.

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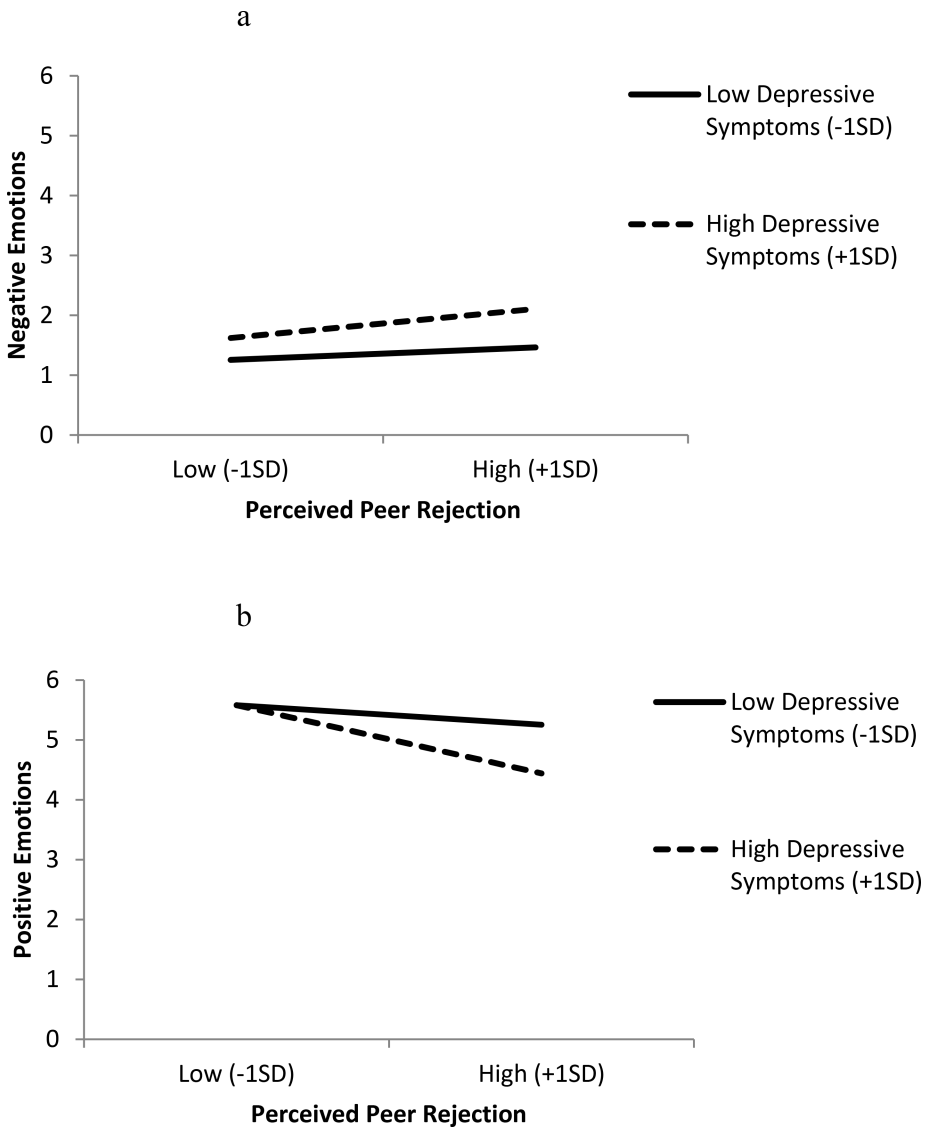

Figure 1.

Figure 1a. Reactivity to perceived peer rejection; cross-level interaction with depressive symptoms moderating the association between perceived peer rejection and negative emotions. **Figure 1b.** Reactivity to perceived peer rejection; cross-level interaction with depressive symptoms moderating the association between perceived peer rejection and positive emotions.

Table 1

Means and Standard Deviations

	M	*SD*	Range	*N*
Depressive symptoms [a]	0.51	0.42	0–2.30	281
Perceived peer rejection T0	2.29	0.83	1.00–5.42	269
Negative emotions T−1	1.59	0.65	1.00–4.83	284
Negative emotions T0	1.65	0.64	1.00–4.42	286
Negative emotions T1	1.56	0.61	1.00–4.28	286
Positive emotions T−1	5.09	0.84	2.33–7.00	284
Positive emotions T0	5.03	0.83	1.00–5.02	286
Positive emotions T1	5.14	0.82	1.00–7.00	286

Note. The momentary assessment variables Perceived peer rejection, Negative emotions (T−1, T0, T+1), and Positive emotions (T−1, T0, T+1) were aggregated to represent a mean score of overall assessments.

[a]This is a between-individual variable.

Table 2

Bivariate Correlations between Model Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Gender [a]	-								
2. Age [a]	−0.09	-							
3. Depressive symptoms [a]	0.21***	−0.07	-						
4. Perceived peer rejection T0	0.12*	−0.09	0.42***	-					
5. Negative emotions T−1	0.15*	−0.01	0.46***	0.47***	-				
6. Negative emotions T0	0.17**	0.06	0.46***	0.64***	0.69***	-			
7. Negative emotions T1	0.11	0.04	0.39***	0.54***	0.60***	0.74***	-		
8. Positive emotions T−1	0.01	−0.01	−29***	−0.45***	−0.44***	−0.32***	−0.31***	-	
9. Positive emotions T0	−0.08	−0.02	−0.38***	−0.53***	−0.36***	−0.52***	−0.41***	0.75***	-
1O. Positive emotions T1	−0.04	−0.07	−0.31***	−0.39***	−0.27***	−0.35***	−0.42***	0.71***	0.78***

Note. 0 = boy; 1 = girl. The momentary assessment variables Perceived peer rejection, Negative emotions (T−1, T0, T+1), and Positive emotions (T −1, T0, T+1) were aggregated to represent a mean score of overall assessments.

[a]These are between-individual variables.

*$p < 0.05$

**$p < 0.01$

***$p < 0.001$.

Table 3

Summary of Effects for Linear Multilevel Models of Emotional Reactivity: Predicting Negative and Positive Emotions at T0 to Perceived peer rejection at T0 and Moderation of Depressive Symptoms (Controlling for Gender and Previous Emotions).

	Negative emotions		Positive emotions	
Fixed Effects	γ	SE	γ	SE
Intercept	1.61***	0.03	5.07***	0.05
Gender[a]	0.08	0.07	0.05	0.10
Emotions T−1	0.35***	0.04	0.32***	0.04
Perceived peer rejection	0.23***	0.04	−0.28***	0.05
Depressive symptoms[a]	0.65***	0.08	−0.75***	0.11
Perceived peer rejection × depressive symptoms[a]	0.19*	0.08	−0.21*	0.10
Random Effects	τ	LR Test	τ	LR Test
Intercept	0.24***	110.20	0.43***	179.20
Perceived peer rejection	0.14***	77.30	0.11**	10.90

Note. The likelihood ratio (LR) test represents the difference between the −2 log likelihood of a model that treats the effect of perceived peer rejection as random and one that does not.

[a]These are between-individual variables.

*$p < 0.05$

**$p < 0.01$

***$p < 0.00$.

Table 4

Summary of Effects for Linear Multilevel Models of Emotional Recovery: Predicting Negative and Positive Emotions at T+1 to Perceived peer rejection at T0 and Moderation of Depressive Symptoms (Controlling for Gender, Time since Event, and Previous Emotions).

	Negative emotions		Positive emotions	
Fixed Effects	γ	SE	γ	SE
Intercept	1.55***	0.03	5.15***	0.05
Gender[a]	0.01	0.07	0.05	0.09
Time	−0.00	0.00	0.00	0.00
Emotions T0	0.04	0.04	0.21***	0.03
Perceived peer rejection	0.10*	0.04	−0.07	0.04
Depressive symptoms[a]	0.51***	0.08	−0.61***	0.11
Perceived peer rejection × depressive symptoms[a]	0.01	0.00	−0.00	0.09
Random Effects	τ	LR Test	τ	LR Test
Intercept	0.19***	118.40	0.40***	157
Perceived peer rejection	0.11**	31.10	0.04	2.30

Note. The likelihood ratio (LR) test represents the difference between the −2 log likelihood of a model that treats the effect of perceived peer rejection as random and one that does not.

[a]These variables are between-individual variables.

*$p < 0.05$

**$p < 0.01$

***$p < 0.00$.