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Cognitive Reappraisal Attenuates the Association between Depressive Symptoms and Emotional Response to Stress During Adolescence

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Abstract

Depression is associated with increased emotional response to stress. This is especially the case during the developmental period of adolescence. Cognitive reappraisal is an effective emotion regulation strategy that has been shown to reduce the impact of emotional response on psychopathology. However, less is known about whether cognitive reappraisal impacts the relationship between depressive symptoms and emotional responses, and whether its effects are specific to emotional reactivity or emotional recovery. The current study examined whether cognitive reappraisal moderated the relationship between depressive symptoms and trait or state measures of emotional reactivity and recovery. A community sample of 127 adolescents (M -age = 15.28; 49% female, 47% Caucasian), at an age of risk for depression, completed self-report measures of trait emotional responding and depressive symptoms. In addition, they completed an in vivo social stress task and were assessed on state emotional reactivity and recovery from the stressor. Findings suggested that cognitive reappraisal was associated with an attenuated impact of depressive symptoms on trait and state emotional recovery. These results provide evidence that cognitive reappraisal may be an effective strategy for improving some aspects of emotional responding in relation to depressive symptoms among adolescents.

Keywords

Emotional Reactivity; Emotional Recovery; Cognitive Reappraisal; Depressive Symptoms; Adolescence

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Depression is a common, recurrent, and debilitating disorder that impacts individuals and society as a whole (Kessler et al., 2003; 2005). The economic burden of depression in the U.S. has risen over 20% in the past decade and currently costs roughly \$210 billion annually (Greenberg et al., 2015). The one-year prevalence rates of depression are low in childhood, but dramatically surge, as much as six-fold, from early to late adolescence (Hankin et al., 1998, Kessler et al., 2003). Concurrently, experiences of stress increase during this developmental period (Ge et al., 1994). Importantly, depressive symptoms during adolescence predict Major Depressive Disorder (MDD) in adulthood (Pine et al., 1999). However, not all youth with depressive symptoms develop a mood disorder, likely due to variability in youths' abilities to regulate their emotions to stressors (Kovacs, Joormann, & Gotlib, 2008; Eisenberg et al., 2010). MDD may arise from an interaction of stressors, emotional responses to those events, and poor cognitive coping methods (Calvete, Orue, & Hankin, 2013). The current study addressed this topic and examined whether cognitive reappraisal, the tendency to change one's initial appraisal of a situation to alter the elicited emotional and physiological experience to lead to a more adaptive response (Gross 1998b), reduces the impact of depressive symptoms on emotional responses to stress.

Developmental models of psychopathology indicate a strong association between one's emotional response to stressors and maladaptive outcomes, such as MDD (Kovacs et al., 2008; Eisenberg et al., 2010). Numerous studies suggest that depression is linked with emotional reactivity (Carver, Johnson, & Joormann, 2013; Hankin, Wetter, & Flory, 2012; Shapero, Abramson, & Alloy, 2016; Stange et al., 2016; van Rijsbergen et al., 2013) and that ineffective means of managing emotions may lead to psychopathology (Aldao, Nolen-Hoeksema, & Schweizer, 2010). In parallel, individuals with psychopathology may experience heightened sensitivity and intensity of emotional reactions to stressful events and require more time to return from an escalated level (i.e., peak activation) to their regular level of emotional functioning (i.e., baseline; Davidson, 1998; Rothbart & Derryberry, 1981). This is particularly important during the developmental transition of adolescence, as this is a time of significant normative increases in emotional reactivity and sensitivity to stress (Diener, Sandyk, & Larson, 1985; Yap et al., 2007) and adolescents with more depressive symptoms report more intense and labile emotions (Silk, Steinberg, & Morris, 2003). Thus, the development and use of emotion regulation strategies is particularly needed to mitigate maladaptive responses to depressive symptoms during adolescence (Compas et al., 2017). However, little research has examined how emotion regulation strategies impact the relationship between depressive symptoms and emotional responses.

The ability to regulate emotions is complex and involves monitoring, evaluating, and modifying emotional reactions (Thompson, 1994). In the process model of emotion regulation, Gross (1998a) made a distinction between regulation that occurs prior to the full emotional response (antecedent-focused regulation) and regulation that occurs after the emotional response is underway (response-focused regulation). Numerous studies have found that cognitive reappraisal, an antecedent-focused regulation strategy, is effective at regulating emotions and reducing experiences of psychopathology (Aldao et al., 2010; D'Avanzato et al., 2013; Moore, Zoellner, & Mollenholt, 2008). Specifically, cognitive reappraisal has been shown to moderate the relationship between stressful events and depression in both adult (Troy, Wilhelm, Shallcross, & Mauss, 2010) and youth samples

(Kraaij et al., 2003), supporting that cognitive reappraisal may impact the relationship between depressive symptoms and emotional responding, and overall plays an adaptive function.

The measurement and timing of emotional responses to stress are important to delineate. The measurement of emotional responses can differ between general emotional tendencies, which can be considered trait responses, and specific responses to stressful events (Tracy, Klonsky, & Proudfit, 2014). Trait tendencies of emotional responses, or ‘emotional vulnerability’ have been posited in several theoretical models of psychopathology and have been associated with past research on temperament (e.g., Derryberry & Rothbart, 1988). Although distinct from temperament, trait-like tendencies to respond to individual experiences in an emotional manner have been found across psychopathology (e.g., Nock et al., 2009). For example, youth with the tendency to express negative emotions had greater increases in negative responses to stressful events compared to those with a lower tendency to express negative emotions (Charbonneau, Mezulis, & Hyde, 2009). A recent meta-analysis examined the extent to which negative emotionality was associated with emotional responses across different systems (e.g., self-report, behavioral, and physiological) and found that those who had higher trait-like emotional reactivity had heightened emotional responses across all types of measurement (Bylsma et al., 2008). In addition, studies of state measures of emotional responses to stress frequently have used stress paradigms to elicit a response and measured levels of distress by self-report or through various biological measurements (Gunnar et al., 2009). This research consistently highlights an association between state emotional responses and psychopathology (Zorn et al., 2017).

Additionally, research on emotional responses highlights the importance of examining the time-course of reactions to stress, as there are distinct differences based on reactivity versus recovery. Reactivity and recovery from stress can be measured either as a trait tendency or as a state response in stress paradigms. Emotional reactivity can be posited as a trait-like general increased tendency to respond affectively to a wide array of events, or as the immediate state increase in the level of distress felt in response to a stressor (Lopez-Duran et al., 2015). In contrast, emotional recovery has been studied as the ability to return to a baseline level of emotionality after arousal, which can be studied as negative affective persistence to events, or as the level of distress after a stressor has ceased. For example, a recent study that differentiated between stress reactivity and stress recovery found that affective symptoms of depression were associated with increased stress reactivity and fast recovery following a social stress task, whereas neurovegetative symptoms of depression were associated with blunted reactivity and slower recovery following the social stress task among adolescents (Morris et al., 2017). In addition, a recent examination found that depressive symptoms were associated with a more sustained emotional activation to stress, but were not associated with a greater intensity of activation (Lopez-Duran et al., 2015). This indicates that different measurements of emotional responding may be integral in understanding individual differences in responses to stress in relation to internalizing psychopathology.

When regulating stress responses, cognitive reappraisal has been linked to reduced state emotional reactivity in adults (Gaab et al., 2003). However, less is known about the impact

of trait cognitive reappraisal on the association between depressive symptoms and emotional stress responses. Knowing that youth with depressive symptoms are more likely to report higher levels of stress reactivity, cognitive reappraisal may be one mechanism that may attenuate this relationship. That is, the tendency to re-interpret stressful events, may buffer the influence of depressive symptoms on emotional responding. Further, the differences between emotional reactivity and recovery have been understudied. Doing so may provide insight into the specific timing by which cognitive reappraisal may be most effective.

Current Study

Elevated depressive symptoms during adolescence predict the onset of depression in adulthood (e.g., Pine et al., 1999) underscoring the importance of understanding the impact of these symptoms during this pivotal developmental time. Examining whether cognitive reappraisal influences the association between depressive symptoms and emotional responding will inform intervention models to prevent the onset of depression or subsequent functional impairments due to dysregulated emotional responding to stressful events. Therefore, the current study tested whether trait cognitive reappraisal would moderate the relationship between depressive symptoms and adolescents' emotional responses, including trait and state emotional responses to an in vivo social stress task. Although prior research highlights cognitive reappraisal as an antecedent-focused process, we posit that this emotion regulation strategy also would attenuate emotional reactivity across time among those with depressive symptoms. We hypothesized that: 1) trait and state measures of elevated emotional responses will be associated with elevated symptoms of depression and lower trait use of cognitive reappraisal; 2) trait cognitive reappraisal would attenuate the relationship between depressive symptoms and elevated *trait* emotional reactivity and recovery, such that higher levels of depressive symptoms would be more strongly associated with elevated levels of trait emotional sensitivity and emotional persistence among adolescents who engage in less reappraisal than those who engage in more reappraisal; and 3) trait cognitive reappraisal would attenuate the relationship between depressive symptoms and elevated *state* emotional responses, such that higher levels of depressive symptoms would be more strongly associated with elevated self-reported state emotional distress reactivity and emotional distress recovery among adolescents who engage in less reappraisal, compared to those who engage in more reappraisal.

Method

Participants

Participants included individuals recruited to participate in a large prospective study examining the development of depressive disorders in adolescents (Adolescent Cognition and Emotion [ACE] Project), which was approved by the Temple University Institutional Review Board. Participants were originally recruited from private and public middle schools in the Philadelphia area and through advertisements in local newspapers. Inclusion criteria for the Project ACE longitudinal study were: 1) being 12 or 13 years old, 2) self-identifying as Caucasian/White, African-American/Black, or Biracial, and 3) having a female caregiver who could participate in the study. Exclusion criteria were: 1) inability to read or speak

English, 2) presence of a severe cognitive or learning disability, cognitive impairment, psychotic disorder, developmental disorder, or any other psychiatric or medical problem that would not allow the adolescents or their female caregivers to complete the study. Informed consent or assent was obtained from female caregiver and adolescent participants, respectively, included in the study. See Alloy et al. (2012) for a thorough description of the broader study.

Participants in the current study were drawn from this longitudinal study. At a single visit during the prospective study, participants were informed of the additional social stress task, and asked to sign an additional informed consent or assent. The current study included 127 adolescents ($M = 15.28$ years, $SD = 1$ year; 49% female; 48% African-American/Biracial, 47% Caucasian) who completed the in vivo social stress task. Participants in the current study did not differ based on gender ($t = 1.072$, $p > .05$), race ($t = 0.016$, $p > .05$), or income ($\chi^2 = 10.39$, $p > .05$) from the larger sample. All measures were completed during one in-lab session that lasted approximately three hours.

Procedure

Participants were first administered questionnaires (approximately 20 minutes), then were given the social stress task (approximately 8 minutes), and the remainder of the session was spent completing questionnaires. All questionnaires were administered in random order, but the social stress task always took place approximately 20 minutes into the session.

Social Stress Task.—A modified adolescent version of the Trier Social Stress Test (TSST; Kirschbaum, Pirke, & Hellhammer, 1993) was used as a method to elicit a stress response (Gunnar, Talge, & Herrera, 2009). More specifically, this stressor is designed to elicit social-evaluative threat that occurs when an important aspect of the self-identity is or could be negatively evaluated or judged by others (Dickerson & Kemeny, 2004). Adolescents were asked to give a speech under the impression that they were interviewing for a summer job and that they would be evaluated based on their performance. They received a 5 min silent preparation time alone in the room. Participants then were asked to stand, face a camera, and were prompted to speak for 2 minutes. The speech was video recorded and an interviewer observed the delivery of the speech with a neutral facial expression. After the speech, they were given an unexpected difficult mental arithmetic task (e.g., counting backwards at 7-digit increments) and were corrected when they made errors. The mental arithmetic task lasted for 1 minute. For additional information on the modified TSST, see Shapero et al. (2017).

Measures

State Emotional Response.—Participants were asked to rate their subjective distress on a 10-point visual analog scale with zero equaling no distress and 10 indicating extremely distressed. Self-reported distress is commonly used as a manipulation check for stress response during the TSST (Campbell & Ehler, 2012). Responses to the social stress task were assessed at 3 time points. Self-reported distress was measured after the baseline period was over, just before the social stress task instructions were read (T1 - *Baseline*),

immediately following the stress task (T2 - *Emotional Reactivity*), and 30 min after the stress task (T3 - *Emotional Recovery*).

Trait Emotional Response.—The Emotion Reactivity Scale (ERS; Nock, Wedig, Holmberg, & Hooley, 2008) was used to measure trait levels of self-reported emotional responses. The ERS consists of 21 items used to assess one's emotional sensitivity, intensity, and persistence. To gather a measure of trait stress reactivity and recovery, the current study included the ten-item sensitivity (e.g., "I tend to get emotional very easily") and four-item persistence (e.g., "When I am angry/upset, it takes me longer than most people to calm down") subscales. Participants rated each item using a 5-point Likert scale (0 = *not at all like me*; 4 = *completely like me*); all items in each subscale were summed with higher scores indicating higher levels of self-reported emotional reactivity and recovery, respectively (Sensitivity $M = 12.40$; $SD = 9.16$; Persistence $M = 5.62$; $SD = 3.46$). Each domain of the ERS has demonstrated good convergent and discriminant construct validity, and criterion-related validity (Nock et al., 2008). Internal consistency was $\alpha = .90$ and $.81$, respectively, for the current study.

Cognitive Reappraisal.—The Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) is a 10-item self-report measure of an individual's use of two emotion regulation strategies: expressive suppression and cognitive reappraisal. The current study only used the cognitive reappraisal domain, which assesses the tendency to control emotions by changing the way one thinks about the situation and is measured using six items (e.g., "When I want to feel less negative emotion, I change the way I'm thinking about the situation"). Participants rated each item using a 7-point Likert scale (1 = *strongly disagree*; 7 = *strongly agree*); all items were summed with higher scores indicating greater use of the strategy. The ERQ has demonstrated high internal consistency and test-retest reliability (Gross & John, 2003), with internal consistency of $\alpha = .74$ for the current study.

Depressive Symptoms.—The self-report version of the Children's Depression Inventory (CDI; Kovacs, 1985) consists of 27 items reflecting affective, behavioral, and cognitive symptoms of depression. Adolescents read a series of three statements (e.g., "I am sad once in a while," "I am sad many times," "I am sad all of the time") and choose the statement that best describes them in the past two weeks. Scores ranged from 0 to 40 in the current sample, with higher scores indicating more depressive symptoms. Internal consistency, retest reliability, and convergent and discriminant validity are well established (Klein, Dougherty, & Olino, 2005), with an internal consistency of $\alpha = .87$ for the current sample.

Data Analysis

Preliminary analyses revealed that depressive symptoms exhibited significant skew and were square-root transformed prior to further analysis to satisfy assumptions of normality consistent with prior work (e.g., Gibb et al., 2006), see Supplemental Material. All other variables satisfied assumptions of normality. Covariate analyses were conducted to examine demographic and individual characteristics that may influence the measures of trait or state stress response. These included analyses of age, sex, race, SES, and pubertal development. An independent sample t-test revealed that girls had significantly higher trait emotional

reactivity – both emotional sensitivity ($t = 3.27, p < .01$) and emotional persistence ($t = 2.87, p < .01$) than boys. No other demographic and individual characteristics impacted the outcome measures of stress response.

To test the hypotheses that trait and state measures of elevated emotional response will be associated with elevated depressive symptoms and lower trait cognitive reappraisal, we conducted linear regression models, controlling for sex differences. To test the hypotheses (2 and 3) that reappraisal would attenuate the association between depressive symptoms and trait and state emotional responses, we also conducted hierarchical linear regressions. After entering sex as a covariate, we entered the main effects of depressive symptoms and reappraisal, followed by their interaction term. Significant interactions were probed at one standard deviation above and below the mean of reappraisal (Aiken & West, 1991).

Results

Descriptive Statistics

Adolescents in this sample generally had normative levels of depressive symptoms ($M = 6.79$); however, 15% had scores above the clinical threshold for symptoms ($CDI > 13$; Kovacs, 1985), which is consistent with community epidemiological surveys (Kessler, Avenevoli, & Merikangas, 2001). Descriptive statistics and correlations between study variables are displayed in Table 1. As expected, correlations within each measurement domain of emotional responses were moderate (trait emotional responses and state emotional responses to stress). Supporting the hypothesis that adolescents' depressive symptoms would be associated with elevated emotional responses, depressive symptoms were positively and significantly correlated with trait emotional responses (sensitivity and persistence on the ERS), and with state emotional responses (self-reported distress) at all three time points. Additionally, trait measures of emotional responses were positively associated with state measures of emotional responses.

Linear regression models then were conducted to examine the associations between depressive symptoms and cognitive reappraisal with emotional responses, covarying sex. These models were run individually with trait and state emotional responses as the dependent variable and either depressive symptoms or trait cognitive reappraisal as the independent variable. These analyses indicated that depressive symptoms were significantly positively associated with trait emotional sensitivity ($B = 3.59, t = 6.96, p < .001$) and trait emotional persistence ($B = 1.36, t = 7.00, p < .001$). In contrast, these analyses found that cognitive reappraisal was not associated directly with trait emotional sensitivity ($B = -.07, t = 0.55, p = 0.58$) or trait emotional persistence ($B = -.05, t = 0.99, p = 0.33$). Depressive symptoms were not significantly associated with state emotional reactivity ($B = .10, t = 0.77, p = 0.44$), but were significantly associated with state emotional recovery ($B = .18, t = 2.26, p = .03$) when controlling for distress at Time 1. This indicates that individuals with higher depressive symptoms had higher self-reported distress at the recovery period. Cognitive reappraisal also was not significantly associated with state emotional reactivity ($B = -.00, t = 0.07, p = 0.94$), but was significantly associated with state emotional recovery ($B = -.04, t = 2.25, p = .03$) when controlling for distress at Time 1. This indicates that individuals with lower trait cognitive reappraisal had higher self-reported distress at the recovery period.¹

Does Reappraisal Attenuate the Association between Depressive Symptoms and Emotional Responses?

To test the second hypothesis that reappraisal would attenuate the association between depressive symptoms and trait emotional responses, we conducted hierarchical linear regressions using the sensitivity (trait emotional reactivity) and persistence (trait emotional recovery) subscales from the ERS (Table 2).

When predicting trait emotion sensitivity, there was a marginally significant interaction between depressive symptoms and reappraisal in the hypothesized direction (Table 2; Figure 1a), such that the association between depression and emotion sensitivity was stronger among individuals with less tendency to use reappraisal ($B = 4.36$, $t = 6.55$, $p < .0001$, 95% CI [3.04, 5.67]) than among individuals with greater use of reappraisal ($B = 2.40$, $t = 2.90$, $p < .01$, 95% CI [0.76, 4.05]). Similarly, consistent with hypotheses, there was a significant interaction between depressive symptoms and reappraisal predicting trait emotion persistence (Table 2; Figure 1b), such that the association between depression and emotion persistence was stronger among individuals with less use of reappraisal ($B = 1.73$, $t = 6.99$, $p < .0001$, 95% CI [1.25, 2.24]) than among individuals with greater use of reappraisal ($B = 0.76$, $t = 2.44$, $p = .02$, 95% CI [0.14, 1.38]).

To test the third hypothesis that reappraisal would attenuate the association between depressive symptoms and state emotional responses, we conducted hierarchical linear regressions using self-reported distress at T2- emotional reactivity and T3- emotional recovery (Table 2).

Although in the same direction as the findings for trait emotional responses, the interaction between depressive symptoms and reappraisal did not significantly predict state emotional reactivity as measured by self-reported distress at Time 2, controlling for distress at Time 1. However, the interaction between depressive symptoms and reappraisal significantly predicted state emotional recovery as measured by self-reported distress at Time 3, controlling for distress at Time 1 (Figure 1c).² The form of this interaction was such that depressive symptoms predicted significantly higher distress at Time 3 (indicative of poorer emotional recovery) among individuals with less use of reappraisal ($B = .29$, $t = 2.95$, $p < .005$, 95% CI [0.10, 0.49]), but not among individuals with greater use of reappraisal ($B = -.05$, $t = -0.38$, $p = .71$, 95% CI [-0.29, 0.20]).³

¹Given known sex differences in depression rates among youth (Breslau et al., 2017), and the finding that girls had higher trait emotional reactivity, exploratory analyses examined whether sex moderated the relationship between depression symptoms and trait emotional responding. Sex did not moderate the relationship between depressive symptoms and trait emotional sensitivity ($t = 1.44$, $p = 0.15$) or trait emotional persistence ($t = 0.85$, $p = 0.39$). Sex also did not moderate the relationship between depressive symptoms and state emotional reactivity ($t = 0.81$, $p = 0.42$) or state emotional recovery ($t = 0.33$, $p = 0.32$), when controlling for baseline levels of distress. In addition, sex did not moderate the relationship between cognitive reappraisal and trait emotional sensitivity ($t = .34$, $p = 0.73$) or trait emotional persistence ($t = .56$, $p = 0.57$). Further, sex did not moderate the relationship between depressive symptoms and state emotional reactivity ($t = 0.09$, $p = 0.93$) or state emotional recovery ($t = .10$, $p = 0.92$), when controlling for baseline levels of distress.

²An alternative analysis to examine emotional recovery is to control for the degree of reactivity (change in self-reported distress from Time 1 to Time 2) as opposed to controlling for Time 1 self-reported distress. We conducted this alternative analysis and found that the interaction between depressive symptoms and reappraisal was marginally significant in predicting state emotional recovery using this approach ($t = 1.87$, $p = .06$). Consistent with the previous model, the form of this interaction was such that depressive symptoms predicted significantly higher distress at Time 3 (indicative of poorer emotional recovery) among individuals with less use of reappraisal ($\beta = .49$, $t = 3.92$, $p < .005$, 95% CI [0.24, 0.74]), but not among individuals with greater use of reappraisal ($\beta = .10$, $t = 0.63$, $p = .52$, 95% CI [-0.22, 0.41]).

Discussion

The goal of the current study was to examine whether cognitive reappraisal was associated with attenuated emotional responses among adolescents with depressive symptoms. We examined this hypothesis across measures of emotional responding, including trait and state measurement. Findings indicated that trait and state emotional responding were associated with one another and with symptoms of depression. In addition, adolescents with higher levels of depressive symptoms had better trait and state emotional recovery from a stressor if they had an increased tendency to use cognitive reappraisal. Although reappraisal is theorized to be an antecedent-focused strategy, these findings build upon prior research that indicates that cognitive reappraisal is helpful in reducing the impact of emotional responses prior to the full emotional experience by indicating that reappraisal may enhance the regulation of emotions throughout a stressful event, even after emotions have occurred. For adolescents with depressive symptoms, reappraisal may be continually helpful in reducing overall trait persistence of emotions, as well as state levels of emotional reactivity in response to stressful events. Indeed, although relationships were correlational in nature, for adolescents with higher levels of depressive symptoms, reappraisal appeared to attenuate emotional reactivity to levels that were comparable to adolescents who had lower levels of depressive symptoms. These results were consistent for boys and girls. This highlights the potential utility of reappraisal for improving emotional reactions for adolescents with symptoms of depression. In contrast, reappraisal may be less helpful for youth with lower depressive symptoms, perhaps because they may be less reactive initially.

According to the process model of emotion regulation, cognitive reappraisal occurs early in the emotion-generative process by decreasing initial responses to events, when studied in adulthood (Gross, 2001). However, a recent review indicates that the generic timing of the implementation of strategies provides only indirect evidence that cognitive reappraisal is solely helpful prior to the first emotion-generative cycle and suggests that emotions arise at multiple cycles throughout the process (Sheppes & Gross, 2011). Taken further, Sheppes and Gross's (2011) process-specific timing hypothesis suggests that emotional processes are dynamic and when reappraisal is implemented for an extended duration, it may be effective in reducing emotional intensity.

In contrast to expectations, the current study largely did not show that cognitive reappraisal reduced the association of depressive symptoms with measures of emotional reactivity, with the exception of attenuation in emotional sensitivity, but instead, only significantly increased measures of recovery. This suggests that it may be more difficult for adolescents with depressive symptoms to prevent their initial emotional reactions using their tendency to reappraise, and instead, reappraisal may be helpful after the emotions have occurred. In line with this, when examining state emotional recovery, taking into account the level of change in emotional reactivity instead of initial levels of distress led the interaction between depressive symptoms and reappraisal to become marginally significant. Therefore, it could

³Given possible differences in emotion regulation styles and emotional responses (Garnefski et al., 2004; Neumann et al., 2010), we explored whether reappraisal's attenuation of associations between depression symptoms and emotional responding may further depend on sex. Three-way interactions were examined, and indicated that there were no significant sex differences in the aforementioned moderation analyses.

be the case that recovery from a stressor is impacted by lower initial emotional responding. Emotional reactivity and regulation during adolescence remains less examined than in adulthood, and there may be age-related differences given that adolescence is a time of increased stress and a period during which emotion regulation strategies are still developing (Silvers et al., 2012). Additionally, a lack of concordance between reappraisal and different measures of emotional responses have been found in adults (Butler, Gross, & Barnard, 2014; Evers et al., 2014). That is, the effect of cognitive reappraisal on emotional responses may differ based on the methods used, suggesting the importance of ascertaining information across methods and levels of analysis.

This study found that girls reported higher trait emotional reactivity compared to boys. Given the known sex differences in the rates of depression (e.g., Breslau et al., 2017) and possible sex differences in emotion regulation styles and responding (Garnefski et al., 2004; Neumann et al., 2010), we explored whether sex influenced the relationship between depressive symptoms and emotional responding. The results did not find sex to be a significant moderator of these relationships. Although girls had higher trait emotional reactivity they did not report higher depressive symptoms or state emotional responses than boys which may have limited finding a moderating effect. Therefore, even though the current investigation failed to find sex as a moderator of the relationships between depressive symptoms, cognitive reappraisal, and emotional responding, future studies are needed to make stronger conclusions.

The growth and consolidation of coping strategies remains an important developmental task in order to effectively manage stressors throughout life. Overall, emotion regulation strategies, such as cognitive reappraisal, are associated with fewer symptoms of psychopathology during adolescence (Aldao et al., 2010; Compas et al., 2017). Garnefski and colleagues (2002) examined differences in coping strategies, including positive reappraisal, in relation to internalizing symptoms between adults and adolescents. They found that although both adults and adolescents reported the use of all coping strategies, adolescents reported using these strategies to a significantly lesser extent than adults, which helped to explain why adolescents reported higher symptoms (Garnefski et al., 2002). Thus, it will be important for adolescents to learn how to consistently use effective coping strategies such as cognitive reappraisal. Taken further, adolescents with higher levels of depressive symptoms report a lower tendency to use reappraisal compared to those with lower depressive symptom levels (Hughes, Gullone, & Watson, 2011). Findings from the current study bolster the evidence that cognitive reappraisal is a useful strategy to manage emotional processes and is important to develop in youth with depressive symptoms.

The stress paradigm used to elicit emotional distress focused on a particular type of stress that may be particularly relevant to depression symptoms. Dickerson and Kemeny (2004) highlight the impact of social-evaluative threat that occurs when an important aspect of the self-identity is or could be negatively judged by others, and conclude that stress paradigms that include a social evaluative component are the most stressful. The TSST is a stress paradigm that elicits social evaluative threat. This is different than other stress paradigms like tasks designed to elicit negative emotions (e.g., mood induction; fear paradigms), threats to social relationships or peer social stress (e.g., conflict-discussion), or physical stressors

(e.g., blood draws, cold pressor). Interpersonal stress and social rejection are consistently associated with depression (e.g., Hammen, 2005; Slavich & Irwin, 2014). Although the stress paradigm used in this study was not designed to elicit broader negative affect (e.g., sad mood induction), it was designed to elicit a type of stress centrally associated with depression. Therefore, the interpretation of the effects of reappraisal on regulation of social stress responses should take the type of stressor into account. That is, as opposed to the effects of reappraisal on negative affect itself or other types of stressors, the current study focused on a particular emotion (e.g., social embarrassment) that is important for adolescent depression.

The current study had several strengths and limitations. Participants represented a non-clinical diverse community sample that enhances the generalizability of these findings. However, the sample was constrained to participants who were Caucasian and African American, and excluded adolescents of other racial backgrounds. On average, these participants had normative levels of depressive symptoms; however, the proportion of adolescents who reported clinically-relevant elevated depression symptoms is consistent with epidemiological studies (Kessler et al., 2001). Because this study did not utilize a depressed sample, findings from this study may not necessarily generalize to a clinical sample. We also employed multiple measures of emotionality during a time of heightened risk for the development of depression. However, although this study included measurement of trait and state emotional reactivity and recovery, it relied on self-report questionnaires, which may be subject to reporter bias. Future research could employ clinician-rated symptoms and observational coding of distress that may help reduce the impact of subjective reporter bias. Nevertheless, self-report is a useful method for assessing constructs such as emotional reactivity and recovery, about which participants are likely to be self-aware (Haefel & Howard, 2010). In addition, we utilized a trait measure of cognitive reappraisal and not a state measure of how the adolescents tried to regulate their emotions during the stress task. Although generally correlated (McRae, 2013), trait measures of the tendency to use cognitive reappraisal differ from state measures of cognitive reappraisal abilities (Troy et al., 2010). Therefore, it would be important to assess the impact of real-time use of cognitive reappraisal on the relationship between depressive symptoms and emotional responses in future studies. The data presented also were cross-sectional and correlational in nature, which constrains causal interpretations. As depressive symptoms during adolescence have been shown to predict the onset of major depression in adulthood, future research should incorporate prospective longitudinal designs to examine whether cognitive reappraisal during adolescence may buffer against the effects of emotional responses on the development of psychopathology, perhaps particularly when adolescents encounter life stressors.

Taken together, findings from the current study highlight the potential usefulness of cognitive reappraisal in reducing the impact of depressive symptoms on emotional responses. Dysregulated emotional responses to stressful events may amplify the impact of the stressors and lead to further functional impairments. In addition, elevated depressive symptoms during this period of adolescence are associated with the onset of depression during adulthood (Pine et al., 1999), making symptoms an important target of early intervention strategies. Cognitive reappraisal is a helpful emotion regulation strategy during

the turbulent period of adolescence and may help to increase recovery from stressful experiences. Incorporating explicit training in cognitive reappraisal may further benefit youth who experience depressive symptoms or high levels of stress in order to help reduce the emotional impact of these experiences. However, future studies will benefit from testing this model in a clinical sample of depressed adolescents, as well as examine whether interventions to teach cognitive reappraisal can further reduce maladaptive responding to stressors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Interactions between depressive symptoms and reappraisal predicting (a) Trait emotion sensitivity on the Emotional Reactivity Scale (ERS); (b) Trait emotion persistence (ERS); and (c) State distress recovery (Time 3 distress). Note: This figure presents slopes for ± 1 SD of the mean, thus the descriptions of higher/lower & less/more are relative to the sample mean.

Table 1

Descriptive Statistics and Correlations between Study Variables

Measure	1	2	3	4	5	6	7
1 CDI	---						
2 ERQ Reappraisal	-.20 [*]	---					
3 ERS Sensitivity	.55 ^{***}	-.07	---				
4 ERS Persistence	.54 ^{***}	-.10	.71 ^{***}	---			
5 Time 1 Distress (Baseline)	.30 ^{**}	-.12	.31 ^{***}	.28 ^{**}	---		
6 Time 2 Distress (Reactivity)	.25 ^{**}	-.09	.31 ^{***}	.34 ^{***}	.64 ^{***}	---	
7 Time 3 Distress (Recovery)	.36 ^{***}	-.22 [*]	.39 ^{***}	.38 ^{***}	.67 ^{***}	.61 ^{***}	---
8 Sex	.09	-.07	.28 ^{**}	.25 ^{**}	.06	.08	.08
Min	0.00	6.00	0.00	0.00	0.00	0.00	0.00
Max	40.00	42.00	37.00	15.00	8.00	9.00	8.50
Mean	6.79	27.58	12.40	5.62	1.42	3.12	1.18
SD	6.76	6.08	9.16	3.46	1.92	2.40	1.54

* $p < .05$;** $p < .01$;*** $p < .01$.

Note. CDI = Children's Depression Inventory (non-transformed); ERQ = Emotion Regulation Questionnaire; ERS = Emotional Reactivity Scale; Distress = self-reported emotional distress; Sex: 1 = Female, 0 = Male

Table 2

Moderation Analyses Demonstrating Interactions between Depressive Symptoms and Cognitive Reappraisal Predicting Emotional Responses

Reactivity Hypotheses					Recovery Hypotheses				
Step	Variable	β	t	R^2	Step	Variable	β	t	R^2
<u>Predicting Emotion Sensitivity (ERS)</u>					<u>Predicting Emotion Persistence (ERS)</u>				
1	Sex	0.28	3.15 **	.08	1	Sex	0.25	2.84 **	.06
2	CDI	0.52	6.92 ***	.27	2	CDI	0.52	6.89 ***	.27
	Reappraisal (ERQ)	0.04	0.47			Reappraisal (ERQ)	0.01	0.10	
3	CDI $\times$ Reappraisal	-0.14	1.82	.02	3	CDI $\times$ Reappraisal	-0.19	2.45 *	.03
<u>Predicting Emotional Reactivity (Time 2)</u>					<u>Predicting Emotional Recovery (Time 3)</u>				
1	Sex	0.03	0.45	.42	1	Sex	0.05	0.67	.46
	Time 1 Distress	0.64	9.20 ***			Time 1 Distress	0.68	10.07 ***	
2	CDI	0.06	0.76	.00	2	CDI	0.14	2.01 *	.04
	Reappraisal (ERQ)	0.00	0.00			Reappraisal (ERQ)	-0.13	1.89	
3	CDI $\times$ Reappraisal	-0.11	1.46	.01	3	CDI $\times$ Reappraisal	-0.14	2.17 *	.02

* $p < .05$;

** $p < .01$;

*** $p < .01$

Note. CDI = Children's Depression Inventory; ERQ = Emotion Regulation Questionnaire; ERS = Emotional Reactivity Scale; Distress = self-reported emotional distress.