Characterizing the Ruminative Process in Young Adolescents

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Abstract

Objective—Rumination involves repeatedly and passively dwelling on negative feelings and brooding about their causes and consequences. Prior work has found that rumination predicts many forms of psychopathology including anxiety, binge eating, binge drinking, self-injury, and especially depression (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). In the present study, we attempt to characterize the ruminative process in real time in young adolescents, specifically by examining factors that predict rumination following an interpersonal stressor.

Method—A community sample of 105 youth ages 9-14 (70% girls; 66% Caucasian) completed questionnaires regarding depressive symptoms and trait rumination along with an assessment of selective attention using an emotional faces dot-probe task. Participants then underwent an interpersonal stressor and audio rumination induction in the laboratory during which time thoughts were sampled regularly and coded.

Results—Results indicate that negative self-referential thought is a common response to the stressor and is predicted by trait rumination scores. While most participants were able to disengage from this type of thinking, 10.5% persisted through (i.e., ruminated) until the end of the study. These individuals were characterized by higher depressive symptoms and an attentional bias away from happy (relative to neutral) faces.

Conclusions—Differences in attentional processes may characterize rumination in youth. Implications for the measurement of rumination as well as treatment are discussed.

Keywords

rumination; attention bias; adolescence

Rumination (also known as depressive rumination or brooding) is one of several forms of repetitive thinking (Watkins, 2008). According to the Response Styles Theory, "rumination is a mode of responding to distress that involves repetitively and passively focusing on symptoms of distress and on the possible causes and consequences of these symptoms" (Nolen-Hoeksema, Wisco, & Lyubormirsky, 2008, p. 400). Research suggests that it is a particularly detrimental form of repetitive thought, as it has been found to predict anxiety, binge eating, binge drinking, self-injury, and especially depression (Nolen-Hoeksema et al.). Despite the evidence that rumination is a vulnerability factor for the development of psychopathology, aspects of the ruminative process may be a common and normative response to distress; however, risk for psychopathology may be conferred by the inability to control or shut off this process. The current study is designed to examine rumination in real time and test whether biases in selective attention may characterize the ruminative process.

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Rumination and Depressed Mood

The vast majority of research on rumination has focused on its role in vulnerability to depressive symptoms and disorder. Rumination appears to be a stable trait (e.g., Roberts, Gilboa, & Gotlib, 1998). Studies using self-report measures of trait rumination show that it is associated with self-reported depression as well as clinical diagnosis, concurrently and prospectively (see Nolen-Hoeksema, 2008 for a review). Although relatively more studies have focused on adults, a meta-analysis of studies with youth also shows an effect of rumination on depression (Rood, Roelofs, Bogels, Nolen-Hoeksema, & Schouten, 2009). Laboratory studies have also shown an effect of rumination on mood. These studies involve a rumination induction, which typically consists of 8 minutes of focusing on feelings along with their causes and consequences (Nolen-Hoeksema & Morrow, 1993). Several studies have found that a rumination induction results in increases in negative affect, but only among participants with higher depressive symptoms to begin with (i.e., for dysphoric individuals, ruminating for 8 minutes worsens mood; Nolen-Hoeksema et al., 2008).

From Negative Self-Referential Thought to Pathological Rumination

Rumination involves repeated processing of negative self-referential thoughts. Aspects of the ruminative process may be normative, and even adaptive, but at some point, the repetitive nature of the process becomes pathological. We believe that negative self-referential thinking is a fairly common response to a self-relevant negative event that is not necessarily pathological or itself a vulnerability to depression. This type of thinking (e.g., *Why did this happen to me? Why am I feeling so bad?*) may help individuals to process, reflect upon, and understand difficult interpersonal situations and prevent future mistakes (e.g., Lyubomirsky & Nolen-Hoeksema, 1993; Papageorgiou & Wells, 2001). Consistent with this view, attention to problems is an important component of successful self-regulation (Carver & Scheier, 1998) and to normative social development. By orienting attention to potential problems or environmental threats, some degree of negative self-focus may facilitate problem-solving (Andrews & Thompson, 2009; Martin & Tesser, 1996; Watkins, 2010). Yet, experimental studies suggest that rumination also impairs problem-solving, especially for interpersonal problems (Donaldson & Lam, 2004; Lyubomirsiy & Nolen-Hoeksema, 1995; Lyubomirsky, Tucker, Caldwell, & Berg, 1999; Watkins & Baracaia, 2002), so what may start out as a normative process can also lead to dysfunction.

Some researchers have suggested that there are different subtypes of rumination that may lead to different outcomes. For example, the reflective aspect of rumination may be benign or even adaptive, while the brooding aspect is related to depressive symptoms and difficulties (Burwell & Shirk, 2007; Joormann, Dkane & Gotlib, 2006; Treynor, Gonzalez, & Nolen-Hoeksema, 2003). Others have distinguished between concrete (focusing on the experience) and abstract (focusing on the cause, meaning, and consequence) forms of rumination and find that the abstract form is maladaptive (Watkins & Teasdale, 2004; Watkins, 2010). It is possible that these definitional distinctions could explain why rumination may seem to have both adaptive and maladaptive components. For the present study, we focus specifically on rumination as defined by Watkins (2008) and Nolen-Hoeksema and colleagues (2008) as a repetitive focus on symptoms of distress along with their causes and consequences. It is important to note that this definition of rumination (i.e., the focus on "distress") includes ruminating on both negative mood (as is often measured in studies of trait rumination) as well as ruminating on negative events (which is more often examined in studies of state rumination). The tendency to ruminate on negative mood is highly correlated with the tendency to ruminate on stressful events (assessed via self-report; Robinson & Alloy, 2003).

A central tenant of the response styles theory (Nolen-Hoeksema, 1991) is that vulnerability for psychopathology most likely lies not in the engagement of negative self-referential thinking, but rather the inability to disengage from it. Based on this research, we expected to find that most individuals engage in negative self-referential thought and then stop, whereas a smaller number of individuals become stuck in this process.

Expanding Measurement of Rumination

To examine ruminative processing in real time, we built upon the prior research of Moberly and Watkins (2008), who examined rumination in an experience sampling study of college students. Their study measured state rumination by asking participants the degree to which they were currently focusing on their feelings and problems (two separate items that were combined) using Likert-type scales. Results indicated that trait rumination was correlated with state rumination and that state rumination predicted subsequent increases in negative affect, largely consistent with previous research on trait rumination. Moberly and Watkins' study was critical in demonstrating that rumination has an effect on mood in a more ecologically valid context. Their measurement of state rumination may have been confounded by mood because dysphoric participants' ratings of the degree to which they were focusing on their feelings and problems could be over-inflated (for a review, see Kihlstrom, Eich, Sandbrand, & Tobias, 2000). Additionally, rumination was assessed as a momentary process, limiting an understanding of some of its temporal properties (e.g., duration). We attempted to overcome these limitations in the present study by sampling thoughts at multiple times following a distressing event and having them coded by independent raters.

Rumination and Selective Attention

One way to unpack the process of a complex construct like rumination is to focus on more discrete underlying mechanisms (Pollak, 2005), and one mechanism that is particularly relevant is attention. Rumination seems to involve a narrowing of attention much like tunnel vision. For example, the longer one ruminates, the more fully absorbed one becomes in negative affect resulting in difficulty focusing on other things. This process may continue until something interrupts the process either endogenously (e.g., reappraisal, intentional distraction, active problem-solving) or exogenously (e.g., distraction by positive stimuli). Much of the prior research on the attentional processes associated with rumination has focused on adults and examined difficulty with disengagement of attention, especially from negative information (Daches, Mor, Winquist, & Gilboa-Schechtman, 2010; Linville, 1996; Joormann, 2006; Jormann & Gotlib, 2010). In the present study, we were interested in examining whether selective attention may be associated with rumination among youth.

Selective attention to negative stimuli may orient ruminators toward information that initiates and promotes the ruminative cycle. In this way, a negativity bias may kindle and fuel the ruminative process. Research on individuals with depression and at risk for depression (e.g., Gibb, Benas, Grassia, & McGeary, 2009; Joormann, Talbot & Gotlib, 2007) has demonstrated selective attention to mood congruent stimuli (e.g., selective attention to sad words or faces; Mathews & MacLeod, 2005), and rumination could be responsible for these findings (Donaldson, Lam, & Mathews, 2007). Although selective attention to negative stimuli could be an antecedent of rumination, selective attention for negative information may also be common among ruminators because this type of information has been primed via rumination (Donaldson et al., 2007).

Attention biases may relate to how easy or difficult it is to stop negative self-focused thinking once started. Non-ruminators may be easily distracted from their distress by paying attention to positive stimuli. In fact, such a positivity bias has been demonstrated in research

with typical (i.e., not at-risk) youth (Joormann et al., 2007). Previous research has identified difficulties processing positive information among depressed individuals and children at-risk for depression (Joormann & Gotlib, 2006, Joormann et al., 2007), and depressive symptoms have been associated with a bias away from happy faces (Bradley, Mogg, Falla, & Hamilton, 1998). Perhaps rumination is also responsible for these findings, in that individuals prone to ruminate may disregard positive information in the environment that would otherwise be able to help distract from their negative cognitions and pull them out of the ruminative cycle.

Our guiding theory is that selective attention is one of the basic mechanisms underlying the ruminative process. For example, attentional biases to emotional information maintain ruminative processes, and rumination, in turn, may also strengthen, reinforce, or narrow attentional biases. In sum, distinct selective attentional patterns for emotional stimuli may characterize rumination. Either selective attention to negative emotional stimuli, a lack of bias toward positive emotional stimuli, or both may account for the perseverative nature of rumination. We examine these possibilities in the current experiment. We use emotional faces because these stimuli elicit attention biases in children at risk for depression (Joormann et al., 2007), and we use a 1500 ms stimulus duration based on literature suggesting that depression-relevant biases typically emerge at relatively longer durations of 1 to 1.5 seconds (Mogg & Bradley, 2005).

The Present Study

We designed this experiment to examine the ruminative process in real time and predict which youth would engage in persistent rumination following a self-relevant negative event. We expected that negative self-referential thinking would be a common response to a self-relevant negative event and would not be associated with biases in selective attention. While we expected that most youth would quickly move on from this type of thinking, we also expected that some individuals would continue to persist with negative self-referential thinking. These individuals would be considered ruminators, and we tested to see if they had distinct selective attention patterns for emotional stimuli. Finally, we explored two ancillary issues. First, we examined whether individual differences such as sex, age, and depressive symptom levels influenced our findings, based on prior research suggesting these factors are associated with rumination (Rood et al., 2009). Second, we examined whether trait rumination predicted state rumination.

Because rumination is a vulnerability factor for the development of depression, we tested young adolescents. Compared to younger children, individuals in this developmental period are likely to show individual differences in trait rumination (Rood et al., 2009) but not yet likely to have developed depression (Hankin et al., 1998). Thus, understanding rumination among this developmental group has important potential for informing prevention efforts.

We also developed a new paradigm that allowed us to elicit negative self-referential thinking in an ecologically valid manner (i.e., use of a self-relevant stressor) and allow for objective and dynamic measurement of negative self-referential thinking in real time. Measurement of blood pressure and negative affect were included in order to validate the stress involved in this task. We followed the stressor with a rumination induction in attempt to induce or maintain negative self-relevant thought. Our central prediction was that the group of youth who were unable to disengage from negative self-relevant thinking following the stressor (i.e., the ruminators) would exhibit atypical selective attentional patterns (i.e., selective attention to negative stimuli and/or lack of bias toward positive emotional stimuli).

Method

Participants

Participants included 105 youth ages 9-14 (*M* age = 11.40, *SD* = 1.46) recruited from the community via flyers and newspaper and television advertisements for a study on emotion regulation in young adolescents. Participants were included regardless of depression score (Children's Depressive Inventory scores ranged from 0 to 29, *M* = 6.24, *SD* = 6.28). Because rumination has been found to be more common in girls (e.g., Hilt, McLaughlin & Nolen-Hoeksema, 2010), we over-sampled girls (70%; *n* = 74). Racial-ethnic backgrounds of participants included 66% Caucasian (non-Hispanic), 19% African-American, 10% Asian-American, 4% Hispanic, and 1% Native American. Mean reported income by parents of study participants was in the range of $60,000 to $70,000. The study was approved by the Institutional Review Board. Informed consent (including knowledge of deception) was given by parents and assent was obtained for all participants (who were debriefed at the completion of the study). Participants were given a small prize and $10 for their participation.

Procedure

Participants completed trait rumination and depressive symptom self-report measures during the week before their lab visit (or at the end of the lab visit if they did not have time to complete ahead of time; *n* = 3; there were no differences in outcomes when these cases were excluded from analyses). The lab visit began with an emotional faces dot- probe task to assess selective attention. Following this, participants underwent the social stressor (i.e., speech/feedback task), a rumination induction, and an 8-minute delay. Participants completed a thought record at four times throughout the study to assess negative self-referential thinking (before the stressor, immediately after the stressor, after the rumination induction, and after the delay period). Additionally, we collected self-reports of negative affect and blood pressure readings before and after the stressor to assess its effectiveness. Participants did not have access to cell phones or other personal items during the study.

Self-report Measures

Trait Rumination—We assessed trait rumination using the rumination subscale from the Children's Response Style Questionnaire (CRSQ; Abela, Brozina, & Haigh, 2002). For each item, children are asked to rate how often they respond in that way when they feel sad on a 4-point Likert scale (0 = almost never, 1 = sometimes, 2 = often, 3 = almost always). The reliability and validity of the CRSQ, as well as its subscales, have been demonstrated in several studies (e.g., Abela et al. 2002; Abela, Aydin, & Auerbach, 2007). We modified the directions slightly to ask children to respond based on what they do when they feel sad *or stressed* in order to examine rumination as a response to distress, in line with current conceptualizations (Nolen-Hoeksema et al., 2008) and as has been done with other studies of youth (e.g., Burwell & Shirk, 2007). The CRSQ rumination subscale consists of 13 items that assess participants' use of self-focused thought concerning the causes and consequences of depressed mood. Sample items include: *Think about a recent situation wishing it had gone better* and *Think "Why can't I handle things better?"* The CRSQ rumination scale demonstrated good reliability in this study (α = .85).

Depressive symptoms—The Children's Depression Inventory (CDI; Kovacs, 1992) is a 27-item self-report measure of depressive symptoms that has been standardized on children and adolescents aged 7–17 years. Each item consists of three statements (e.g., *I am sad once in a while, I am sad many times, I am sad all the time*) representing different levels of severity of a specific symptom of depression (e.g., depressed mood) or a consequence of depressive symptoms (e.g., social rejection). Items are assigned a numerical value from 0

(symptom absent) to 2 (symptom present and severe), and higher scores indicate higher levels of depression. The CDI has sound psychometric properties, including internal consistency (Reynolds, 1994), test-retest reliability, and discriminant validity (Kovacs, 1992). Internal consistency for the present sample was good ($\alpha = .91$).

Assessment of Negative Self-Referential Thought

We wanted to capture general brooding along with specific thoughts about negative affect in real time using an objective method. Thus, we assessed negative self-referential thinking by asking participants to write down (i.e., type on a computer) whatever they were thinking about at the moment. Specifically, a "thought box" appeared on the computer screen with the instructions, "Type whatever you are thinking about RIGHT NOW". Each thought was coded by a rater as being indicative of negative self-referential thought or not. Thoughts were coded as negative self-referential thinking if they clearly referenced negative feelings (sadness, anxiety, fear, anger), past upsetting events/problems (e.g., *a fight with my friend*), or brooding (e.g., *why am I feeling this way?*). Thoughts were also coded as negative self-referential thinking if they clearly referenced the speech task with negative statements about the self regarding the speech or feedback (e.g., *I'm self-conscious because of what those kids said about me*). Thoughts were coded as not indicative of negative self-referential thinking if they referenced present negative bodily states (e.g., *I'm tired*), neutral or positive aspects of the study (e.g., *This is fun, I wonder when this will be over*), objects or people (e.g., *I'm thinking about my mom*), future events (e.g., *I wonder what we're having for dinner*), or positive mood states (e.g., *I'm feeling happy*).

For each data collection point (baseline, post-stressor, post-rumination induction, and end of study), all separate thoughts were given a code, and if any of the thoughts were coded as negative self-referential thinking, the data point was assigned a "1"; if no statements during the data point were coded as negative self-referential thinking, it was assigned a "0". Most data points had one thought ($M = 1.08$; $SD = .55$), comprising 1-3 sentences. The absence of any statements resulted in a missing data point (< 2% of data). Two independent raters coded these thought responses (kappas range from .81 to .92); a third rater was used to resolve any discrepancies.

Attention Assessment

Dot-Probe Task—An emotional faces dot probe task (Romens & Pollak, 2012) was used to examine attentional biases related to happy and sad faces. This task was adapted from a similar task designed for children (Joormann et al., 2007). A set of 19 faces, each expressing happy, sad, and neutral emotions, was selected from the MacArthur Network Face Stimuli Set (Tottenham, Borscheid, Ellertsen, Marcus, & Nelson, 2002). Faces with the highest reliability scores for rater identification of the correct emotional expression were chosen (Tottenham et al., 2009), including an equal number of male and female faces of different ethnicities that each had a neutral, happy, and sad expression.

Each trial began with a fixation cross for 1000ms, followed by presentation of the face pair (emotion and neutral) for 1500 ms. Face presentation duration of 1500 ms was selected based on previous findings that depression-relevant attention biases occur only for longer stimulus durations (Mogg & Bradley, 2005). After offset of the face pair, a small dot appeared in the center of the location where one of the faces had been. The dot remained on the screen until the participant responded with a key press to indicate the location of the dot. Slower reaction times to probes appearing in the location of non-emotional stimuli compared to emotional stimuli indicate a bias in attention to emotional stimuli. Each of the picture pairs (happy/neutral and sad/neutral) was presented two times per task, for a total of 96 trials. Faces appeared in the right and left positions equally, as did the dot.

The size of each picture projected on the computer screen was approximately 14 cm × 18 cm, and the pictures in each pair were approximately 22 cm apart, measured from their centers. The task was presented on a Tobii 21-in. (53.34-cm) color monitor, using E-Prime (Psychology Software Tools, 2002) software for stimulus presentation and data recording. Participants were positioned with the index finger of their left hand on the "C" key, which was labeled "L" for left, and the index finger of their right hand on the "M" key, which was labeled "R" for right. Participants were instructed to "spot the dot" and press the key labeled "L" if the dot appeared of the left side and the key labeled "R" if the dot appeared on the right side. Participants first completed 10 practice trials and were told that it was important to respond quickly and correctly.

Scoring—Only reactions times from correct responses were analyzed. Trials with reaction times less than 200 ms were excluded from analyses as they likely reflected anticipation errors. Additionally, reaction times greater or less than two standard deviations for each individual's average were excluded. Less than 5% of the data were excluded based on these criteria. Attention bias to emotion faces (sad or happy) compared to neutral faces was computed using the following equation (cf. Mogg, Bradley, & Williams, 1995):

$$\text{Attentional bias score} = 1/2[(RpLe - RpRe) + (LpRe - LpLe)]$$

where R indicates right position, L indicates left position, p indicates probe, and e indicates emotional face.

In this equation, RpLe represents the mean reaction time when the dot probe was on the right side of the screen, while the emotional face was on the left side of the screen, and so on for other combinations of probe position and emotion face position. This equation represents differential attention to the emotional faces by subtracting the mean reaction time for participants to respond to the probe when it appeared behind the emotional face from the mean reaction time for participants to respond to the probe when it appeared in a different position than the emotional face. Thus, this equation produces an attention bias score that represents the preferential attention to the emotional face. Positive values for attention bias scores indicate attention *toward* the emotional faces relative to neutral faces, while negative values indicate attention *away* from the emotional faces relative to neutral faces.

Negative Mood Induction: Interpersonal Stressor Involving Feedback on a Speech Task

Speech—We used a speech task designed to be an ecologically valid negative event that activated self-relevant negative affect and involved an interpersonal stressor (i.e., negative feedback from peers). We wanted the task to be self-relevant in order to increase its likelihood of triggering rumination (Wisco, 2009). We also wanted a task that was interpersonal in nature, because peer stress is commonly reported among adolescents, especially girls (e.g. Hankin, Mermelstein & Roesch, 2007; see Rose & Rudolph, 2006 for a review), and is a likely theme of rumination among adolescents. Participants were told that they had the opportunity to audition for a new reality television show and would be recorded giving a 3 minute speech about themselves (similar to the cover story used by Heilbron, Prinstein, & Hilt, 2009). We played a video recorded by a supposed representative from the television network to instruct them about the audition. Next, the images of four "peers" appeared on the computer screen (2 boys and 2 girls of various racial-ethnic backgrounds). Participants were told that these children had already been chosen for the show and would be judging their audition speeches to decide if the videos should be sent on to the television network. The experimenter instructed the participant that she was going to set the peer judges up with microphones and that the participant should prepare for the speech until the

experimenter returned. The experimenter returned 3 minutes later and instructed the participant to stand up in front of the video camera. The viewing screen was turned toward the participant so his/her image was visible during the speech. The experimenter instructed the participant to speak for 3 minutes. If the participant finished early, he/she was instructed to continue and talk about what makes him/her special or unique and why he/she should get picked for the show.

Feedback—At the end of 3 minutes, the participant listened to feedback from the peer judges. Although the participant was led to believe that the feedback was live and specific to his/her speech, the feedback was pre-recorded and played back over an intercom from the control room. The feedback was neutral to slightly negative (e.g., *His/Her speech was ok, He/she was average, I just don't think he/she would be good for a reality TV show*). Following the feedback, the experimenter left the room (under the guise of talking to the other children about the audition video).

Effectiveness evaluation—The goal of the speech task was to induce negative affect following a self-relevant negative event involving peers. To determine whether the task was effective, we collected self-report and physiological data to compare negative affect and blood pressure before and after the speech task. Participants reported on negative affect using visual analog scales, and they completed practice ratings with an experimenter prior to baseline ratings. Participants were presented with questions on a computer screen asking how sad, anxious, and irritated they were (interspersed with 3 positive items and 3 neutral items presented in a randomized order for each data collection point). A black line appeared below the question ranging from 0% (not at all sad/anxious/irritated) to 100% (extremely sad/anxious/irritated). Participants clicked the mouse pointer anywhere on the line to indicate their response (range = 0 to 100). Ratings for sad, anxious and irritated were averaged to form the negative affect rating. Blood pressure readings index mean arterial pressure. This is controlled by the autonomic nervous system and can reflect moment-to-moment changes. Blood pressure ratings were obtained with an ambulatory blood pressure monitor (Spacelabs Healthcare; Issaquah, WA). The blood pressure cuff was fitted around participants' upper left arm, and the monitor was attached by belt near the right hip. Participants were prompted on the computer screen to take their blood pressure. Diastolic (minimum pressure in the arteries) and systolic (peak pressure in the arteries) readings were obtained for each data point. Because of equipment malfunction, some blood pressure data points were missing for 10 participants.

Audio Rumination Induction

Following the speech and feedback ratings period, participants listened to an 8 minute audio recording that involved 23 prompts (e.g., *Think about why you are feeling the way you do*) read at a rate of 1 every 20 seconds. This rumination induction was adapted from prior rumination inductions that typically involve self-paced focus on 46 prompts written on note cards (Lyubomirsky & Nolen-Hoeksema, 1993, 1995). The prompts in the present study included half of the prompts from the Lyubomirsky and Nolen-Hoeksema studies and were chosen to be appropriate for adolescents and be face valid as representing brooding.

Debriefing

At the completion of the study, participants were told about the nature of the study (i.e., that we were interested in how kids responded when they were feeling a little upset and that the audition was not real). We allowed adolescents to play back the feedback in order to demonstrate that it was pre-recorded. Participants completed a final set of mood ratings after the debriefing to ensure that they left the study feeling good.

Data Analytic Plan

We conducted a set of analyses leading up to a test of our central prediction, that ruminators would be characterized by biases in selective attention. First, we performed a manipulation check on our stressor. Next, we examined how many participants were engaged in negative self-referential thought at each of the four sampling periods. We expected a large number of participants to engage in negative self-referential thinking following the stressor, and we examined potential predictors of this in a logistic regression equation. Finally, we defined rumination as repeated engagement in negative self-referential thinking following the stressor and expected a small number of participants to be ruminators. We ended by testing potential predictors of state rumination.

Results

Manipulation Check

Negative affect significantly increased from baseline ($M = 51.06$, $SD = 55.27$) to post-stressor ($M = 87.80$, $SD = 71.62$), $t(101) = -6.43$, $p < .001$. Similarly, diastolic blood pressure significantly increased ($M = 72.97$, $SD = 7.25$; $M = 78.52$, $SD = 8.26$), $t(88) = -6.92$, $p < .001$; as did systolic blood pressure ($M = 117.02$, $SD = 10.85$; $M = 122.61$, $SD = 13.95$), $t(91) = -4.27$, $p < .001$.

Negative Self-referential Thinking

Descriptive Statistics—Figure 1 shows the percentage of participants engaged in negative self-referential thought at each time point in the study. As expected, a large number of participants evidenced negative self-referential thinking immediately after the stressor, while a smaller number of individuals evidenced negative self-referential thinking at the end of the study (approximately 20 minutes after the stressor). Unexpectedly, the rumination induction was not effective in maintaining negative self-referential thought.

Fifty percent of participants ($n = 52$) were engaged in negative self-referential thought after the feedback. We examined whether the audio rumination induction resulted in negative self-referential thinking among participants not already engaged in that type of thinking following the speech/feedback task. We found that four new participants engaged in negative self-referential thinking after the audio rumination induction; additionally, we found that about half of the participants (25 out of 52) who were engaged in negative self-referential thinking following the speech/feedback task were no longer engaged in this type of thinking by the end of the rumination audio induction, $\chi^2(1) = 22.86$, $p < .001$.

Central to our predictions is the idea that many individuals will have negative self-referential thoughts following a negative event but only for a short time, while others will get stuck in a ruminative cycle. We operationalized rumination as engagement in negative self-referential thinking at all three time points following the stressor. We found that 11 participants (10.5% of the total sample; 21% of the group that engaged in negative self-referential thinking following the speech task) persisted in negative self-referential thinking (i.e., ruminating), while the remaining 79% of those who engaged in negative self-referential thought after the speech task stopped, $\chi^2(1) = 13.81$, $p < .001$.

Predicting Engagement in Negative Self-Referential Thinking—We performed a logistic regression to predict engagement in negative self-referential thinking immediately following the stressor, including the following predictors: sex, age, trait rumination, depressive symptoms, and dot-probe scores for happy and sad faces. The set of six predictors was marginally significant, $\chi^2(6) = 12.52$, $p = .051$. The Hosmer-Lemshow test was not significant, $\chi^2(8) = 8.32$, $p = .403$, and no outliers were found with regression

diagnostics suggesting a good fit. Because the set of predictors was on the threshold for statistical significance, we interpreted the individual effects in the model and found that trait rumination was a significant predictor, i.e., higher trait rumination scores predicted engagement in negative self-referential thinking following the speech task. In a final model with only trait rumination as a predictor, the likelihood ratio test was significant, $\chi^2(1) = 4.82$, $p = .028$; B = .06, SE = .03, Wald = 4.49, df = 1, p = .030, Exp (B) = 1.07. The exponentiation of B can be interpreted as an odds ratio such that for each standard deviation increase in trait rumination, the odds ratio of engaging in negative self-referential thinking increases by a factor of 1.6.

Finally, we examined factors to predict state rumination (i.e., repeated engagement in negative self-referential thinking at the end of the study compared to those who were able to disengage after the speech task). We performed a logistic regression with the same predictors as above. The set of predictors was significant, $\chi^2(6) = 13.11$, $p < .05$; Hosmer-Lemshow test $\chi^2(8) = 4.13$, $p = .845$. For regression diagnostics, we requested outliers more than two standard deviations away. There were only two observations which is expected by chance. The Hosmer-Lemshow test combined with the exploration of outliers suggested the model was a good fit. Higher depressive symptoms and a bias away from happy faces significantly predicted state rumination. Thus, we ran a final model with non-significant effects removed. The likelihood ratio test was significant, $\chi^2(2) = 9.62$, $p = .008$. In this final model, with dot-probe happy scores entered first and depressive symptoms added subsequently, dot-probe happy scores remained a significant predictor, and depressive symptoms were marginally significant (see Table 1 for results)[1]. In order to interpret the effect size for the dot-probe happy score effect, the exponentiation of the B coefficient suggests that for each standard deviation increase, the odds ratio declines by a factor of .30.

Follow-up analyses to examine the attentional bias finding showed that those who disengaged from negative self-referential thinking did not display a bias on the happy vs. neutral dot-probe trials (*M* = -.75, *SD* = 40.94). Those who persisted with negative self-referential thinking (i.e., the ruminators) displayed a bias away from happy faces relative to neutral faces (*M* = -32.33, *SD* = 26.56). These scores were significantly different from each other, *t*(48) = 2.27, *p* = .028.

Discussion

The present data indicate that engagement in negative self-referential thinking is a common response to an interpersonal stressor among young adolescents. Most of the adolescents who engaged in this type of thinking following the stressor were able to disengage from it by the end of the study. Those youth who were unable to disengage (i.e., the ruminators) were the individuals who had an attentional bias prior to the negative event. Specifically, the participants who continued to ruminate were characterized by an attentional bias away from positive emotional stimuli.

Slightly more than half of the participants engaged in negative self-referential thinking immediately after the stressor. This group that engaged in this type of thinking had higher trait rumination scores than those participants that did not engage in negative self-referential thinking. Although this lends some validation to use of self-reported trait rumination (i.e., the adolescents who reported that they tend to engage in negative self-referential thinking in response to distress did just that), the trait measure of rumination did not predict which adolescents persisted in negative self-referential thinking following the negative event.

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[1] Including the four participants who began engaging in negative self-relevant thought after the rumination induction (but not immediately after the stressor) in the persistent/state rumination group does not change the results.

Rumination and Attentional Bias

Our central hypothesis involved individual differences in attention to emotional information that may characterize persistent negative self-referential thinking. We expected that selective attention to sad faces, lack of attention to happy faces, or both would characterize the group that failed to disengage from negative self-referential thinking compared to the group that engaged and then stopped. The data revealed that the group who failed to disengage from negative self-referential thinking (i.e., the state ruminators) was characterized by a bias away from happy faces (relative to neutral), and this finding held when we controlled for depressive symptom level. A similar bias was found among participants with high depressive symptoms in previous research using both a 1250 ms and 500 ms dot-probe task (Bradley, Mogg, & Millar, 2000; Bradley et al., 1998), and our finding suggests this may have been due to rumination. This finding is consistent with previous research showing that ruminators are less willing to engage in pleasant activities, even when they believe they will be enjoyable (Lyubomirsky & Nolen-Hoeksema, 1993), and suggests that ruminators may have difficulty attending to positive stimuli in the environment that could serve as distractors and help repair negative mood.

This finding extends the work on attention in rumination, which has largely focused on attentional inhibition, to include other selective attention processes (also see Donaldson et al., 2007). In studies of selective attention, a positivity bias exists in control participants, suggesting that it is normal to preferentially attend to positive information (e.g., happy faces) (e.g., Joormann,et al., 2007). This bias may be one mechanism that allows individuals to disengage from negative self-referential thought. Individuals with high depressive symptoms or who are at-risk for depression do not demonstrate this positivity bias (e.g., Joormann et al., 2007; Bradley et al., 1998). The present study shows that ruminators seem to lack this positivity bias. It is possible that this attention bias precedes the development of rumination and/or that the ruminative process narrows attention so that positive information is less likely to be attended to, maintaining a repetitive negative thought process.

We were surprised that the ruminators in our sample did not show biases for sad faces. Such biases for depressed individuals are frequently reported in the literature (Gotlib & Krasnoperova, 1998; Wisco, 2009). Our sample of youth was not clinically depressed. It may be the case that although rumination predicts depression, the emergence of depressive disorders may involve distinct cognitive characteristics such as attention to negative information (Gibb et al., 2009). It is important to note that because we did not find an attentional bias for sad faces, the bias away from happy faces likely does not represent difficulty disengaging from negative stimuli, but rather a distinct attentional process. It is also noteworthy that attentional biases for emotional faces did not predict engagement in negative self-referential thought immediately following the stressor, suggesting that those individuals who engage in this type of thinking only briefly following a stressor may have more flexible attentional mechanisms. To fully understand the role of attention in rumination, causal mechanisms will need to be clarified by closely examining the temporal associations among the development of attentional biases, rumination, and psychopathology.

The results of the present experiment contribute to a growing body of work supporting the idea that negative self-referential thought itself may not be harmful, but the inability to disengage from the process may be what is pathological (Daches et al., 2010; Joormann, 2006; Joormann & Gotlib, 2010; Phillippot & Brutoux, 2008; Siegle, Steinhauer, Thase, Stenger, & Carter, 2002; Watkins & Brown, 2002). We found that the failure-to-disengage group had higher concurrent depressive symptoms than the group who disengaged from negative self-referential thought. Next steps in testing and elaborating this idea include examining clinical symptom and diagnostic data prospectively to evaluate the predictive value of the failure-to-disengage/state rumination group and closely examining the strategies

(e.g., distraction, active problem-solving, reappraisal, etc.) that helped some of the negative self-referential thinkers disengage from the process.

To our knowledge, this is the first report of state rumination in the laboratory following a distressing event in a sample of youth. Based on past research examining trait rumination in youth (e.g., Hilt et al., 2010; Rood et al., 2009), we expected that age and sex may be related to rumination. However, age and sex were not significant predictors of short-term negative self-referential thinking or persistent state rumination. The lack of sex difference is consistent with a few other studies of community samples of children in this age range (e.g., Broderick & Korteland, 2004). We also expected that trait rumination would be a significant predictor of state rumination. Some previous research demonstrating an association between trait and state rumination has used similar measurement of the two constructs (e.g., self-report using Likert scales; Moberly & Watkins, 2008). In the present study, we used self-report of trait rumination using Likert scales and coded thoughts for state rumination, which likely limited shared method variance. It will be important for future research to examine the correspondence between trait and state measures of rumination. A lack of correspondence could suggest that one or both measurements lack validity or that they tap into different underlying constructs.

Strengths and Limitations

Strengths of the present study involve our dynamic measurement of the ruminative process. We used thought coding in order to apply a more objective lens to identifying rumination. Of course, this technique still relies on participants' willingness to accurately disclose their thoughts; however our approach overcomes some of the challenges outlined by Moberly and Watkins (2008) including their difficulty with tapping into the self-critical aspects of rumination (e.g., Thinking *Why am I feeling this way?*) and capturing the repetitive nature of rumination. Our use of an ecologically valid social stressor to induce negative mood followed by an audio rumination induction in a controlled laboratory setting allowed us to unpack the process of rumination in real time. By measuring negative self-referential thinking multiple times in short succession during our paradigm, we were able to investigate differences between individuals who engage in this type of thinking briefly and then disengage and those who seem to get stuck in the ruminative process.

Although we attempted to maximize ecological validity by employing a self-relevant, interpersonal stressor to induce rumination, our inclusion of the audio rumination induction detracted from the ecological validity of the study. We do not know if the adolescents who persisted at negative self-referential thinking would have done so naturally without the rumination induction. Additionally, the audio rumination induction did not maintain or induce negative self-referential thinking in many participants. Rumination inductions have been used to successfully increase negative affect in youth in prior studies (e.g., Park, Goodyer, & Teasdale, 2004), however the audio format is novel, and this delivery mode may not have been as effective. It is also possible that the rumination induction was not particularly effective because we utilized a community sample of youth, and rumination inductions often only work for dysphoric participants (i.e., those with high depressive symptoms; Nolen-Hoeksema et al., 2008).

A few other study limitations are worth noting. Although we explained nearly 40% of the variance in rumination, it is possible that there are other factors we did not measure that could help distinguish between those who are able to disengage versus get stuck in a ruminative cycle. For example, Abramson and colleagues (Abramson et al., 2002) suggest that individuals with a negative cognitive style (i.e., those who make negative inferences about the causes, consequences and self following negative events) are more likely to get stuck in rumination. Additionally, we did not measure other attentional mechanisms (e.g.,

specific difficulty with inhibitory processes) related to rumination. Regarding interpretation of the dot-probe findings, it is not possible to distinguish whether the bias away from happy faces was due to slower responding to happy faces or relatively faster responding to neutral faces. Also, this task does not distinguish among subcomponent processes of selective attention (e.g., initial orienting of attention vs. dwelling of attention). Future research using methods that can examine attention with more precision (e.g., eye tracking) may help to better unpack these processes.

Implications for Measurement and Treatment

Findings from the present study suggest that engagement in negative self-referential thinking can be distinguished from difficulty disengaging from this type of thinking. Prior research has relied largely on self-report of trait rumination, which does not distinguish these processes. For example, self-report questionnaires regarding rumination typically ask *how often* a person engages in negative self-referential thinking in response to distress, not *how long* (e.g., Abela et al., 2002). Perhaps this is why trait rumination predicted engagement in negative self-referential thought following the stressor but not perseverative state rumination in the present study. Considering that the definition of rumination mentions that it is a *repetitive* focus on negative feelings, causes and consequences (Nolen-Hoeksema et al., 2008; Watkins, 2008), and that those who perseverate at rumination can be distinguished from those who temporarily engage in negative self-referential thinking, it might be helpful to add this to the measurement of rumination. For example, questions about difficulty disengaging could be added to self-report measures, and/or real time rumination could be measured dynamically as was done in the present study.

Given that rumination is associated with depression and other forms of psychopathology (Nolen-Hoeksema et al., 2008), the current findings may be applied to prevention and intervention work. The pattern of lack of attention to happy faces that characterized ruminators could be addressed through attention retraining (i.e., training individuals to attend to positive stimuli). Attention retraining can involve a variety of methodologies including dot-probe training (e.g., Schmidt, Richey, Buckner & Timpano, 2009) and mindfulness meditation training (e.g., Farb, Anderson, Mayberg, Bean, McKeon, & Segal, 2010). A recent review of the literature suggests that attention may be effectively trained to improve emotion regulation (Wadlinger & Isaacowitz, 2011).

Acknowledgments

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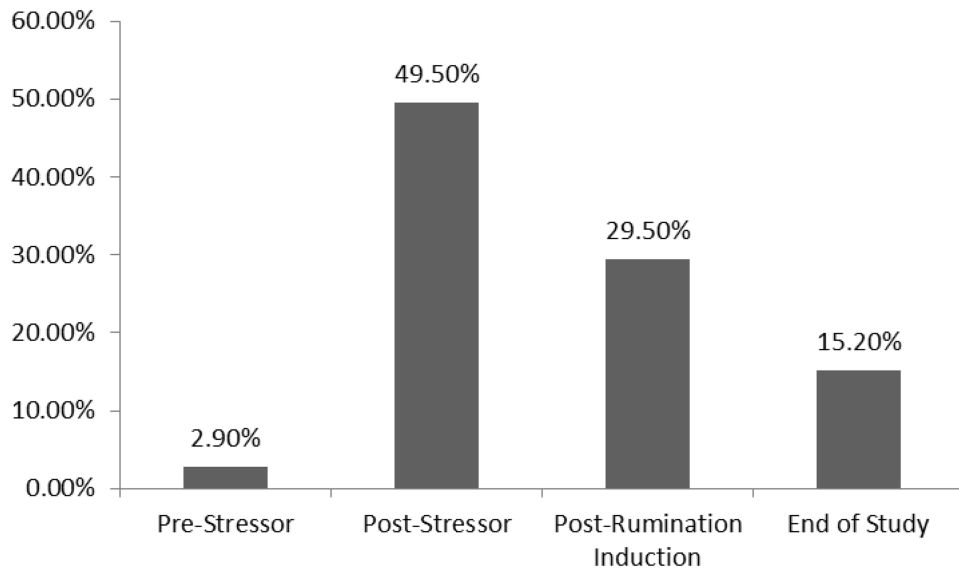
Figure 1.
Percent engaged in negative self-referential thinking at each time point.

Table 1

Logistic Regression Predicting Failure to Disengage from Negative Self-Referential Thinking (i.e., State Rumination)

Predictors	B	S.E.	Wald Test	df	p-value	Exp (B)
Model 1						
Dot-Probe Happy Score	-.02	.01	4.47	1	.034	.98
Model 2						
Dot-probe Happy Score	-.03	.01	5.59	1	.018	.97
Depressive Symptoms (CDI)	.11	.06	3.64	1	.056	1.11

Note. Exp (B) stands for exponentiation of the B coefficient which can be interpreted as an odds ratio.