



Published in final edited form as:

*J Anxiety Disord.* 2010 June ; 24(5): 480–486. doi:10.1016/j.janxdis.2010.03.004.

## What Predicts the Trajectory of Rumination?: A Prospective Evaluation

DeMond M. Grant<sup>\*</sup> and J. Gayle Beck

Department of Psychology, University at Buffalo – SUNY, Buffalo, NY 14260, USA

### Abstract

The current report aimed to document individual differences that predict the trajectory of post-event rumination following an evaluative event. In this study, 127 undergraduate students were assessed over a 5-day period preceding and following a midterm exam. Participants completed measures of anticipatory processing, trait test anxiety, trait tendency to ruminate, negative affect, and post-event rumination. Hierarchical linear modeling was used to examine predictors of post-evaluative rumination. Results suggested that individuals who reported high levels of anticipatory processing and trait test anxiety tended to experience prolonged amounts of rumination following the exam, even when controlling for negative affect, relative to those who scored low on these measures. These results suggest that specific individual difference factors impact the amount and trajectory of rumination beyond levels of general negative affect. Implications for understanding risk factors for heightened rumination are discussed, with particular attention to the larger rumination literature.

### Keywords

Post-event rumination; Anticipatory processing; Test anxiety; Negative affect

---

Recently, there has been an increase in research examining repetitive, self-focused thoughts (e.g., Mor & Winquist, 2002). This literature has documented that negative self-focused thoughts may lead to increases in negative affect, which in turn leads to increases in repetitive thoughts (e.g., Mor & Winquist, 2002). One of the most well researched self-focused thought processes is rumination, which is defined as a recurrent and excessive focus on perceived negative aspects of a past event. Rumination has been postulated to be a mechanism in the maintenance of both depressive and anxiety disorders (e.g., Clark & Wells, 1995; Nolen-Hoeksema, 1991). However, at present little is known about which individual difference factors may lead to post-event rumination following stressful events. The goal of the current report is to address this gap by examining how rumination unfolds over time following an evaluative event.

Several theoretical perspectives have been developed on rumination (e.g., Martin, Shrira, & Startup, 1999; Matthews & Wells, 1999; Watkins, 2004). Generally, these theories suggest

---

© 2010 Elsevier Ltd. All rights reserved.

\*Corresponding author, Present Address: DeMond M. Grant, Ph.D., Department of Psychology, Oklahoma State University, Stillwater, OK 74078, Telephone: 405 774 6983, Fax: 405 774 8067, demond.grant@okstate.edu.

DeMond Grant is now at the Department of Psychology, Oklahoma State University, and J. Gayle Beck is now at the Department of Psychology, University of Memphis.

**Publisher's Disclaimer:** This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

that during stressful situations, individuals engage in certain cognitive or behavioral strategies to regulate their mood (e.g., Carver & Scheier, 1988; Martin & Tesser, 1989, 1996). Although problem-focused strategies, such as cognitive reappraisal, lead to increases in positive emotion (Gross & John, 2003), emotion-focused strategies like rumination lead to increased negative affect (e.g., Martin & Tesser, 1989, 1996). Considerable research has documented the negative effects of ruminative thought among dysphoric individuals, suggesting that depressive rumination increases negative mood, hinders problem-solving, and impairs concentration (e.g., Morrow & Nolen-Hoeksema, 1990; Lyubomirsky & Nolen-Hoeksema, 1995; Lyubomirsky, Tucker, Caldwell, & Berg, 1999). With a few notable exceptions (e.g., Fresco et al., 2002; Muris, Roelofs, Meesters, & Boomsma, 2004; Nolen-Hoeksema, 2000), the role of rumination among anxious individuals has received little attention. Given that rumination has been shown to contribute to depressive mood states, it is timely to explore its role in anxiety-related processes. In particular, elucidating how rumination unfolds following evaluative events can inform our theories of the development of anxious symptomatology.

To date, our current framework for understanding the role of rumination in anxiety comes from theories of social anxiety disorder (Clark & Wells, 1995). Clark and Wells (1995) posited that among individuals with high levels of social anxiety, post-event rumination occurs after ambiguous social or performance situations and is characterized by a review of the negative thoughts and feelings that the individual experienced during the situation. This excessive focus on perceived negative reactions strengthens the individual's beliefs about their negative performance. Several studies testing this theory have found correlations between anxiety-provoking situations and post-event rumination among unselected samples (Fehm, Schneider, & Hoyer, 2007; Kocovski & Rector, 2007; Rachman, Gruter-Andrew, & Shafran, 2000; Vassilopoulos, 2004). Studies using laboratory tasks (i.e., an impromptu speech or a social interaction with a confederate) have found that individuals who report higher levels of social fears also report higher amounts of negative post-event rumination following these tasks (i.e., Abbott & Rapee, 2004; Dannahy & Stopa, 2007; Edwards, Rapee, & Franklin, 2003; Perini, Abbott, & Rapee, 2007). In a naturalistic study, Lundh and Sperling (2002) examined rumination following social-evaluative events using a diary method over a two-day period. Results found that although post-event rumination decreased among all individuals, those with elevated levels of social anxiety were more likely to report elevated levels of post-event rumination following social-evaluation.

Thus, growing evidence supports the association between social-evaluative events and post-event rumination. However, a study by McEvoy and Kingsep (2006) suggests that post-event rumination may not be associated with social anxiety per se, but instead may be associated with state anxiety levels (McEvoy & Kingsep, 2006). This finding highlights an important feature of the larger literature on rumination; at present, the extent that rumination is uniquely associated with anxiety and/or depression is unclear. In particular, it is possible that rumination is associated with general negative affect following stressful or evaluative events (Thomsen, 2006). Because rumination is associated with several forms of psychopathology (e.g., Nolen-Hoeksema, 2000), research is needed to document specific individual difference factors that lead to the development of rumination, over and above its association with negative affect. Moreover, many previous studies compare participants' levels of rumination following a variety of stressful events rather than one specific event which is experienced by all participants (e.g., Fehm et al., 2007; Kocovski & Rector, 2007; McEvoy & Kingsep, 2006; Rachman et al., 2000). This methodological approach could lead to a response bias based on how recent or how negatively perceived the events in question were rated. Use of prospective designs to examine how rumination occurs following a specific stressor could advance our knowledge in this area. Thus, the current study utilized a prospective design, testing participants over a five day period preceding and following a mid-term exam, in order to examine individual-level predictors of the trajectory of rumination.

To select factors that would serve to predict post-event rumination, we drew on theoretical perspectives from both the anxiety and depression literatures. Because previous research has rarely included prospective designs, we wanted to carefully select predictors, while remaining mindful of constraints from sample size. Research by Nolen-Hoeksema and colleagues has found that certain individuals, referred to as trait ruminators, consistently respond to stressful events with rumination (e.g., Nolen-Hoeksema & Davis, 1999; Nolen-Hoeksema, Morrow, & Fredrickson, 1993). A trait ruminative style refers to a tendency to think repetitively and passively about negative emotions, distress, and the meaning of these affective states (Nolen-Hoeksema, 2000). Trait rumination has been shown to predict the onset of depression and anxiety, as well as the chronicity of depressive symptoms in community-dwelling adults (Nolen-Hoeksema, 2000). In an effort to link the current study with the available literature on rumination in general, trait rumination was included as a possible predictor. Second, three studies to date have shown that individuals with high levels of trait anxiety are more likely to ruminate following stressful events (Nolen-Hoeksema, 2000; Rachman et al., 2000; Zeidner, 1998). These studies have focused on diverse samples, including community adults ranging in age between 25 and 75 (Nolen-Hoeksema, 2000), high school students (Zeidner, 1998) and undergraduates (Rachman et al., 2000; Zeidner, 1998), within a variety of contexts. Because trait anxiety appears to be a robust predictor of post-event rumination, it also was selected as a possible predictor. Finally, cognitive models of anxiety suggest that anticipatory processing, during which individuals review what they believe will happen during an upcoming social-evaluative event, also should lead to higher levels of rumination subsequent to the event (Clark & Wells, 1995). Although no studies have examined whether anticipatory processing is related to post-event rumination, from a theoretical perspective anticipatory processing emerges as an important potential predictor. Exploration of whether trait rumination, trait anxiety, and anticipatory processing predict different trajectories of rumination will increase our understanding of the individual differences that prolong rumination and as a result, anxious symptomatology.

The current study examined the trajectory of rumination following a mid-term exam, as it is a common anxiety provoking situation that research has suggested elicits similar coping strategies as those employed for major life stressors (Zeidner, 1996). This design allowed for a prospective examination using the same anxiety-related event for all participants in a natural setting. The first assessment occurred the night before the exam when participants completed measures of trait test anxiety, trait tendency to ruminate, and the amount of anticipatory processing about the test. During the next four nights, participants reported the amount of time they spent ruminating about their exam performance. Because rumination has been shown to be associated with several forms of negative affect, participants also completed a measure of negative affect at each measurement. Two hypotheses were examined. First, it was hypothesized that rumination would decrease linearly over time. Second, it was hypothesized that individuals who reported higher levels of trait test anxiety, trait tendency to ruminate, and anticipatory processing would exhibit slower decreases in rumination over the course of the 4 days post-exam compared to those with low levels on these variables even when controlling for negative affect.

## 1. Method

### 1.1. Participants

Participants were recruited from advanced undergraduate psychology courses offered at the University at Buffalo. Announcements were made within these courses inviting students to participate in a study about college midterm exams and stress as a means of obtaining extra credit. All course instructors offered alternative opportunities for students to receive extra credit. Interested participants contacted the laboratory and were provided with information

about participation. Although students were allowed to choose which midterm they would use to complete the study, they only could complete the study once. Additionally, participants were not allowed to complete the study using their final exam in the course.

One-hundred and thirty-four participants contacted the research team and completed at least one experimental session. Four participants were excluded because they did not complete the first experimental session, and 3 participants were excluded because they only attended the first session, leaving a total of 127 participants (97 females). The average age of the participants was 22.6 ( $SD = 4.3$ ). Ninety (70.9%) were Caucasian, 13 (10.2%) were African-American, 15 (11.8%) were Asian, 5 (3.9%) were Latino(a), and 4 (3.1%) identified as other ethnicities. The average college GPA was 3.2 ( $SD = 0.5$ ).

Participants completed questionnaires at five time points. At Time 1, questionnaires measured trait test anxiety, trait tendency to ruminate, and the amount of anticipatory processing. For all subsequent time points (i.e., Time 2 through Time 5), participants completed measures of post-event rumination and negative affect. Questionnaires were administered on-line using Survey Monkey. All participants received email reminders to complete their surveys each night. Throughout the course of the study, participants were unaware of the grade that they actually earned on the exam, as they received their grade one week after they completed the exam. All procedures were approved by the Institutional Review Board of the University at Buffalo, SUNY.

## 1.2 Measures

**1.2.1. Cognitive Test Anxiety Scale (CTAS; Cassady & Johnson, 2002)**—This is a 27-item measure developed to assess the tendency to exhibit anxious cognitions before, during, and after an exam. Examples of items include “During tests, I have the feeling that I am not doing well” and “I am not good at taking tests.” Respondents are asked to determine how typical these phrases are of them on a 4 point Likert scale, with 1 corresponding to “Not at all typical of me” and 4 corresponding to “Very much like me.” Previous research has provided normative information for student samples, suggesting that total scores of 27 to 61 indicate low test anxiety, scores from 62 to 71 indicate moderate test anxiety, and scores of 72 or greater indicate high test anxiety (Cassady & Johnson, 2002). This measure has been demonstrated to have high levels of internal consistency and construct validity (Cassady, 2001; Cassady & Johnson, 2002). Internal consistency (coefficient alpha) in the present study was .93.

**1.2.2. Ruminative Response Scale of the Response Styles Questionnaire (RSQ; Nolen-Hoeksema & Morrow, 1991)**—This is a 22-item instrument used to measure the tendency for individuals to respond to stressful situations with rumination. For the current study, the 5-item brooding subscale developed by Treynor, Gonzalez, and Nolen-Hoeksema (2003) was used to assess trait tendency to ruminate, as data have suggested that this subscale reflects the maladaptive component of rumination without being confounded by depressive symptoms (e.g., Treynor et al., 2003). The questionnaire presents respondents with several items, such as “think about a recent situation, wishing it had gone better” and “think ‘why can’t I handle things better?’” In the original measure, participants are asked to indicate how often they engage in each item when they feel depressed, with a rating of 1 corresponding to ‘almost never’ and a rating of 4 corresponding to ‘almost always.’ For the present study, the directions were modified to assess participants’ general tendency to use these responses following “stressful situations.” Joorman, Dkane, and Gotlib (2006) reported a mean of 44.5 for the total score among patients diagnosed with social phobia. This measure has been shown to have good internal consistency and test-retest reliability (Nolen-Hoeksema & Morrow, 1991; Nolen-Hoeksema, 2000). Coefficient alpha in the present study was .90.

**1.2.3. Thoughts Questionnaire, Anticipatory and Post (TQ-Ant, TQ-Post; Abbott & Rapee, 2004; Perini et al., 2007)**—These measures were used to assess anticipatory processing and post-event rumination, respectively. These 24-item instruments were modified from the post-event processing questionnaire used in Edwards et al. (2003), developed to measure the frequency of anticipatory processing and post-event rumination before and after a stressor, respectively. Both measures have two subscales, one which assesses positive anticipatory processing and rumination, and a second that measures negative anticipatory processing and rumination. The current study only used the negative subscale and modified the items to reflect the amount of anticipatory and post-event rumination about a test during the past 24 hours. Examples of items include “I could have done much better” and “I made a fool of myself.” Respondents indicated how often they have thought of each item with respect to their exam, with a rating of 0 corresponding to ‘never’ and a rating of 4 corresponding to ‘very often.’ These measures have been used to assess rumination about a specific social/performance task and have shown excellent internal consistency ( $\alpha = .95$ ) and construct validity in two studies (Abbott & Rapee, 2004; Perini et al., 2007). Among samples diagnosed with an anxiety disorder, reported means have ranged from 15.5 to 17.4 (Abbott & Rapee, 2004; Perini et al., 2007). In the current study, coefficient alpha was .95 for the TQ-Ant. For the TQ-Post, coefficient alphas ranged between .96 and .97 across Times 2, 3, 4, and 5.

**1.2.4. Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988)**—Affect was measured using the PANAS, a well established instrument with two 10-item mood scales measuring positive and negative affect. These scales are comprised of items that describe feelings associated with positive (e.g., excited, proud, enthusiastic) and negative (e.g., upset, scared, guilty) affect, which are rated on a five-point scale with respect to how the participant feels “at this present moment.” For the present report, we only used the negative affect subscale. Convergent and discriminant validity, as well as internal consistency and test-retest stability, has been demonstrated (Watson et al., 1988). Internal consistency (coefficient alpha) in this sample ranged from .92 to .95 at Times 2, 3, 4, and 5.

**1.2.5. Additional Variables**—At Time 1, participants also were asked to report the number of hours they studied for the exam, with an average of 4.8 (SD = 5.0). Additionally, the course instructors provided the research team with each participant’s grade on their exam. No hypotheses were posited for these variables as these data were used as covariates for the main hypotheses.

### 1.3 Statistical Analyses

The data exhibited a nested structure, wherein days were nested within individuals. Therefore, hierarchical linear modeling (HLM; Raudenbush, & Bryk, 2002) was used to analyze the data, which partitions the total variance into variance at the repeated measures level (Level 1) and variance at the person level (Level 2). This allows for individuals’ change in post-event rumination to be modeled at Level 1 and person level characteristics to be modeled at Level 2. Skew and kurtosis values all were within normal limits (i.e., skew values less than 3.0 and kurtosis values less than 8.0; Kline, 2005), suggesting the data exhibited normality, and no outliers were detected. The software package HLM 6 (Raudenbush, Bryk, Cheong, & Congdon, 2004) was used to analyze the data.

With HLM, the data are explained with growth parameters, which include intercept and trend (i.e., linear, quadratic) parameters to model change over time. First, an unconditional model was estimated to determine the amount of between-person variance in the data. Next, models were estimated to determine the form of change in rumination that best fits the data (Raudenbush, & Bryk, 2002). Because the questionnaires were completed over four days and thus represent repeated measures, analyses were included to determine whether a linear effect



or a quadratic effect best explained the change in rumination over time. Random coefficients were added to the three growth parameters at Level 2, to determine if there were significant individual differences in rate of change. For example, the Level 1 model that included the linear growth parameter was:

$$Y_{ti} = \pi_{0i} + \pi_{1i}(\text{Linear trend}) + e_{ti}$$

where  $Y_{ti}$  is the amount of post-event rumination,  $\pi_{0i}$  is the intercept or mean level of rumination, and  $\pi_{1i}$  is the linear growth parameter. At Level 2, random effects were added for both the intercept and the linear trend:

$$\begin{aligned}\pi_{0i} &= \beta_{00} + r_{0i} \\ \pi_{1i} &= \beta_{10} + r_{1i}\end{aligned}$$

After fitting both a linear and a quadratic model to the dependent variable, the chi-square deviance statistic was used to determine whether adding each of these coefficients offered a statistically better fit to the data. Next, negative affect was added to the model as a time-varying covariate, in order to control for its associations with post-event rumination. Finally, models were estimated to determine which person-level variables (i.e., trait test anxiety, trait rumination, anticipatory processing) predicted mean level and change in post-event rumination over time. To do this, a conditional model was estimated, in which Level 2 variables were used to predict the growth parameters at Level 1. Finally, number of hours studied for the exam and their final grade were added to the Level 2 model as covariates.

## 2. Results

Table 1 presents the means and standard deviations for post-event rumination, negative affect, anticipatory processing, trait test anxiety, and trait tendency to ruminate. First, the unconditional model was estimated in order to partition the total variance into within-person and between-person components. This was computed using a one way analysis of variance with a random factor. The within-person variance was estimated as 33.91 and the between-person variance was estimated as 90.35. The intra-class correlation, which represents the proportion of variance between persons, was .90. These statistics suggest that a significant amount of the variance existed at the between-person level, warranting further analyses.

Next, a model was estimated which included a linear effect of time. Both the intercept ( $\pi_{0i} = 14.18, p < .001$ ) and the linear slope ( $\pi_{1i} = -2.19, p < .001$ ) were significant, suggesting that both growth parameters are necessary to explain variability in post-event rumination. Reliability estimates were .89 for the intercept and .56 for the linear slope, suggesting good and low discrimination for the growth parameters, respectively. The negative slope suggested that rumination decreased linearly as days passed since the exam. The random effects for both the intercept ( $\chi^2(122) = 1166.65, p < .001$ ) and slope ( $\chi^2(122) = 245.22, p < .001$ ) also were significant, suggesting that there were significant individual differences in both the mean rate of rumination and the change in rumination over time.

Next, a random quadratic effect was added to the model. The reliability estimate of the quadratic effect was .33, suggesting that most of the variability in this effect was at the measurement level rather than the individual level. However, both the fixed quadratic effect ( $\pi_{2i} = .86, p < .001$ ) and the random effect ( $\chi^2(115) = 177.66, p < .001$ ) were significant, suggesting that this parameter also explained a significant amount of variance in post-event rumination. In addition, the chi-square deviance test ( $\chi^2(4) = 57.47, p < .01$ ) was significant, offering further support

that including a random quadratic slope explained significantly more variability in post-event rumination than a model without the quadratic slope.

After specifying the growth model, negative affect was added as a time-varying covariate. The results found a significant effect of negative affect ( $\pi_{3i} = .49, t(449) = 7.9, p < .001$ ), suggesting that negative affect decreased over time as post-event rumination decreased.

Next, the three person-level variables were entered into the Level 2 model to predict the three growth parameters and the time-varying covariate. Results are presented in Table 2. As can be seen, anticipatory processing predicted the mean level in post-event rumination, and both the linear and quadratic forms of change in post-event rumination, suggesting that there were cross-level interactions between the amount of anticipatory processing reported at Time 1 and the three growth parameters. Results of these interactions are displayed graphically in Figure 1. Individuals with higher levels of anticipatory processing displayed the most deceleration in post-event rumination from Time 2 to Time 3, and reported increases in post-event rumination from Time 4 to Time 5. In contrast, individuals who reported low levels of anticipatory processing displayed a fairly steady decrease in post-event rumination across the four time points. In addition, trait test anxiety marginally predicted the linear and quadratic slope parameters. Individuals with high levels of trait test anxiety were characterized by a fairly linear decrease in post-event rumination over the four days, whereas individuals with low levels of trait test anxiety displayed a quadratic trend, with the most deceleration in post-event rumination occurring from Time 2 to Time 3, and a slight increase from Time 4 to Time 5. Trait tendency to ruminate was not significantly associated with any of the growth parameters. Secondary analyses including both number of hours studied and actual performance on the exam did not change the pattern of results.

### 3. Discussion

The present study prospectively examined the trajectory of post-event rumination following a midterm exam in an effort to document individual difference factors that influence this process. Results provide some interesting insights into specific predictors of rumination following an evaluation-based stressor. First, the results suggested that among all participants, rumination about the exam decreased quadratically over the four day period, with fastest deceleration occurring in the two days immediately following the test. This suggests that on average, individuals will experience a moderate amount of rumination following an evaluative event. However, this pattern was qualified by individual differences, specifically anticipatory processing and trait test anxiety. Anticipatory processing predicted both the initial level and the quadratic pattern of change in rumination over time, even when controlling for negative affect. Follow-up analyses suggested that individuals who reported higher levels of anticipatory processing about their test reported a higher initial amount of post-event rumination during the study, which decreased over the next three days, with a slight increase at the last time point. It is possible that such an increase occurred because students were aware that they would receive their exam grade within the next two days. Individuals who reported low levels of anticipatory processing, on the other hand, displayed low levels of post-exam rumination and exhibited little change over time. Thus, these results support predictions from cognitive theories, specifically that anticipatory processing prolongs rumination; importantly, the current results indicate that this association is not accounted for by levels of negative affect but rather, reflects more specific processes.

In addition, there was a marginal effect of trait test anxiety. Specifically, individuals high in trait test anxiety exhibited linear decreases in rumination over the four day period, whereas those low in trait test anxiety exhibited faster deceleration in rumination during the study. Although the slight increase in post-event rumination experienced by those low in trait test

anxiety from Time 4 to Time 5 was unexpected, these individuals overall still reported a low level of rumination throughout the course of the study. Thus, trait test anxiety also appears to exhibit an influence on the trajectory of post-event rumination over time, albeit to a lesser extent than anticipatory processing. This finding augments our understanding of factors that occur during anxiogenic stressors and how these factors may shape the trajectory of rumination following the event. It also offers support that rumination may be associated with trait anxiety levels, above and beyond negative affect (Muris, Fokke, & Kwik, 2009).

These results add to the burgeoning literature examining repetitive thought both prior to and following stressful situations. Most of the repetitive thought literature has examined similarities and differences associated with worry and rumination. Although both are repetitive and intrusive (e.g., Fresco et al., 2002), worry is characterized by future threat or danger and low perceived coping effectiveness, whereas rumination is characterized by themes of past loss, failure, and disengagement from problems (Borkovec et al., 1983; Hoehn-Saric, Lee, McLeod, & Wong, 2005; Hong, 2007). It has been suggested that anticipatory processing is a form of worry, is characterized by negative images of the individual's performance, predictions of possible failure, and increases anxiety symptoms (Hinrichson & Clark, 2003; Vassilopoulos, 2004, 2005). At present little is known about similarities and differences between anticipatory processing and other repetitive thought processes. However, results of the current study suggest that continued study of repetitive thought processes is informative, because anticipatory processing prior to a stressful event may prolong an individual's ruminations for several days following the event. Thus, negative repetitive thought before a stressful event appears to not only increase symptoms of anxiety and depression, but also increase post-event rumination, likely leading to a cycle of cognitive dysfunction.

In addition to providing a prospective examination of rumination and the factors that influence this process, these findings have implications for theories of rumination. Specifically, it appears that both the amount of anticipatory processing and the level of trait test anxiety influence the trajectory of rumination following a stressful-evaluative event. Based on theories of self-regulation, it is possible that these individual difference characteristics may limit an individual's ability to regulate their mood following stressful situations. For example, Zeidner (1996) found that students who used problem-focused emotion regulation strategies experienced lower levels of anxiety during an exam compared to those who engaged in emotion-focused coping. Thus, use of emotion-focused coping strategies prior to an event, including anticipatory processing, may lead to increased anxiety during the actual event and set the stage for dysfunctional coping strategies, such as rumination, after the event. It will be important for future studies to continue to document how various types of coping strategies influence anxiety and depression following stressors.

Some limitations of the current report deserve mention. First, because this study involved a student sample, it is possible that these results do not generalize to individuals with clinically significant anxiety symptoms. However, because research has demonstrated that clinically significant levels of evaluation anxiety tend to develop between early and late adolescence (Manuzza, Fyer, Liebowitz, & Klein, 1990; Turner, Beidel, Dancu, & Keys, 1986; Zeidner, 1996), the current sample do inform understanding of processes occurring during the critical age when evaluation fears begin to cause significant impairment. Moreover, the means reported for levels of post-event rumination approximated levels reported by clinical samples (e.g., Abbott & Rapee, 2004; Perini et al., 2007), particularly at Time 1 and Time 2. Given this, it is plausible that trait tendency to ruminate might emerge as a significant predictor among a clinical population (e.g., Ehlers, Mayou, & Bryant, 1998). Future studies will need to examine clinical samples following stressful or evaluative events to determine specific factors that maintain diagnostic levels of anxiety and depression.



A second limitation is reliance on a one week assessment interval, which is a relatively short time period. Future studies on rumination may wish to consider the use of longer measurement intervals, with a particular eye towards processes such as the emergence of symptoms or impairment and distress due to rumination. Because the literature on rumination in response to anxiogenic events is relatively new, it will be important to delineate how rumination contributes to the development of symptomatology and impairment. Clark and Wells (1995) highlight the importance of examining rumination in situations that naturally elicit post-event rumination. As an initial step, the current study used a prospective design with a common stressful event, which appears to be an important methodological contribution. Third, the current study only focused on one specific event for the purpose of controlling for possible confounds. It is likely that individuals who are prone to ruminate may experience several rumination-inducing events over the course of any given day. Ideally, future research can assess both evaluative situations and general tendencies to rumination in order to increase our understanding of how this process influences the development of psychopathology. Finally, because study of anticipatory processing and post-event rumination is still relatively new, there is not much data examining the psychometric properties of the measures used in this study. In order for this literature to advance, increased validation of measures of anticipatory processing and post-event rumination will be important.

The current study contributes to the growing literature examining post-event rumination and helps to elaborate current theories of rumination (Clark & Wells, 1995; Nolen-Hoeksema, 1991). Specifically, these results support both anticipatory processing and trait test anxiety levels as predictors of the development and change of post-event rumination following an evaluative event. Moreover, these findings support the hypothesized link between anticipatory processing and post-event rumination and suggest that these processes do not simply reflect general levels of negative affect. Although there has been a growing literature documenting both the similarities and differences between repetitive thought styles and how these thought styles influence each other, more research is needed to document how repetitive thoughts influence the development of anxiety and depressive symptoms. Increasing our understanding in this arena can help us to explain the mechanisms which create and maintain psychological disorders.

## Acknowledgments

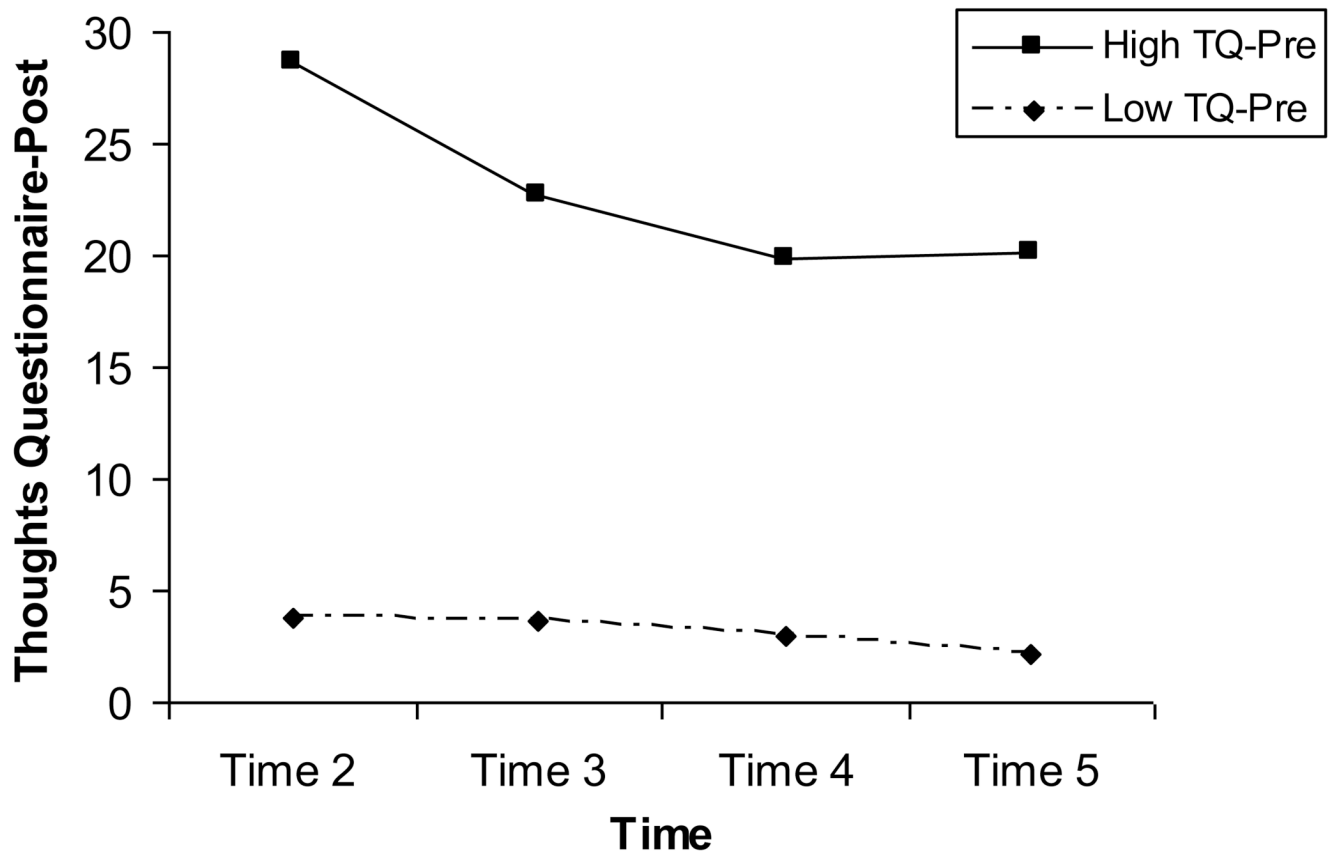
This project was supported in part by National Research Service Award MH 075130 from the National Institute of Mental Health. Portions of these data were presented at the 2007 meeting of the Association for Behavioral and Cognitive Therapies, Philadelphia. The authors would like to thank Vitaly Kramer and Shira Bennett for their assistance with data management, and the UB students who generously gave their time to participate in this project.

## References

- Abbott MJ, Rapee RM. Post-event rumination and negative self-appraisal in social phobia before and after treatment. *Journal of Abnormal Psychology* 2004;113:136–144. [PubMed: 14992666]
- Borkovec TD, Robinson E, Pruzinsky T, Depree JA. Preliminary exploration of worry: Some characteristics and processes. *Behaviour Research and Therapy* 1983;21:9–16. [PubMed: 6830571]
- Brozovich F, Heimberg RG. An analysis of post-event processing in social anxiety disorder. *Clinical Psychology Review* 2008;28:891–903. [PubMed: 18294745]
- Carver CS, Scheier MF. A control-process perspective on anxiety. *Anxiety Research* 1988;1:17–22.
- Cassady JC. Self-reported GPA and SAT: A methodological note. *Practical Assessment, Research, and Evaluation*, 7. 2001 Retrieved October 22, 2008 from <http://PAREonline.net/getvn.asp?v=7&n=12>.
- Cassady JC, Johnson RE. Cognitive test anxiety and academic performance. *Contemporary Educational Psychology* 2002;27:270–295.

- Clark, DM.; Wells, A. A cognitive model of social phobia. In: Heimberg, RG.; Liebowitz, MR.; Hope, DA.; Schneier, FR., editors. *Social phobia: Diagnosis, assessment, and treatment*. New York: Guilford Press; 1995. p. 69-93.
- Dannahy L, Stopa L. Post-event processing in social anxiety. *Behaviour Research and Therapy* 2007;45:1207–1219. [PubMed: 17112463]
- Edwards SL, Rapee RM, Franklin J. Post-event rumination and recall bias for a social performance event in high and low socially anxious individuals. *Cognitive Therapy and Research* 2003;27:603–617.
- Ehlers A, Mayou RA, Bryant B. Psychological predictors of chronic posttraumatic stress disorder after motor vehicle accidents. *Journal of Abnormal Psychology* 1998;107:508–519. [PubMed: 9715585]
- Fehm L, Schneider G, Hoyer J. Is post-event processing specific for social anxiety? *Journal of Behavior Therapy and Experimental Psychiatry* 2007;38:11–22. [PubMed: 16730328]
- Fresco DM, Frankel AN, Mennin DS, Turk CL, Heimberg RG. Distinct and overlapping features of rumination and worry: The relationship of cognitive production to negative affective states. *Cognitive Therapy and Research* 2002;26:179–188.
- Gross JJ, John OP. Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. *Journal of Personality and Social Psychology* 2003;85:348–362. [PubMed: 12916575]
- Hinrichsen H, Clark DM. Anticipatory processing in social anxiety: Two pilot studies. *Journal of Behavior Therapy and Experimental Psychiatry* 2003;34:205–218. [PubMed: 14972668]
- Hoehn-Saric R, Lee JS, McLeod DR, Wong DF. The effect of worry on RCBF in non-anxious subjects. *Psychiatry Research: Neuroimaging* 2005;140:259–269.
- Hong RY. Worry and rumination: Differential associations with anxious and depressive symptoms and coping behavior. *Behaviour Research and Therapy* 2007;45:277–290. [PubMed: 16635479]
- Joorman J, Dkane M, Gotlib IH. Adaptive and maladaptive components of rumination? Diagnostic specificity and relation to depressive biases. *Behavior Therapy* 2006;37:269–280. [PubMed: 16942978]
- Kline, RB. *Principles and practice of Structural Equation Modeling*. New York: The Guilford Press; 2005.
- Kocovski NL, Rector NA. Predictors of post-event rumination related to social anxiety. *Cognitive Behaviour Therapy* 2007;43:1–11.
- Lundh L-G, Sperling M. Social anxiety and the post-event processing of socially distressing events. *Cognitive Behaviour Therapy* 2002;31:129–134.
- Lyubomirsky S, Nolen-Hoeksema S. Effects of self-focused rumination on negative. *Journal of Personality and Social Psychology* 1995;69:176–190. [PubMed: 7643299]
- Lyubomirsky S, Tucker KL, Caldwell ND, Berg K. Why ruminators are poor problem solvers: Clues from the phenomenology of dysphoric rumination. *Journal of Personality and Social Psychology* 1999;77:1041–1060. [PubMed: 10573879]
- Mannuzza S, Fyer AJ, Liebowitz MR, Klein DF. Delineating the boundary of social phobia: Its relationship to panic disorder and agoraphobia. *Journal of Anxiety Disorders* 1990;4:41–59.
- Martin, LL.; Shrira, I.; Startup, HM. Rumination as a function of goal progress, stop rules, and cerebral lateralization. In: Papageorgiou, C.; Wells, A., editors. *Depressive rumination: Nature, theory and treatment*. Hoboken, NJ: Wiley; 1999. p. 153-176.
- Martin, LL.; Tesser, A. Toward a motivational and structural theory of ruminative thought. In: Uleman, JS.; Bargh, JA., editors. *Unintended thought*. New York: Guilford Press; 1989. p. 306-326.
- Martin, LL.; Tesser, A. Ruminative thoughts. *Advances in social cognition*. Wyer, RS., editor. Hillsdale, NJ: Lawrence Erlbaum Associates; 1996. p. 1-47.
- Matthews, G.; Wells, A. Rumination, depression, and metacognition: The S-REF model. In: Papageorgiou, C.; Wells, A., editors. *Depressive rumination: Nature, theory and treatment*. Hoboken, NJ: Wiley; 1999. p. 125-151.
- McEvoy PM, Kingsep P. The post-event processing questionnaire in a clinical sample with social phobia. *Behaviour Research and Therapy* 2006;44:1689–1697. [PubMed: 16458852]
- Mellings TMB, Allen LE. Cognitive processes in social anxiety: The effects of self-focus, rumination, and anticipatory processing. *Behaviour Research and Therapy* 2000;38:243–257. [PubMed: 10665158]

- Mor N, Winquist J. Self-focused attention and negative affect: A meta-analysis. *Psychological Bulletin* 2002;128:638–662. [PubMed: 12081086]
- Morrow J, Nolen-Hoeksema S. Effects of responses to depression on the remediation of depressive affect. *Journal of Personality and Social Psychology* 1990;58:519–527. [PubMed: 2324941]
- Muris P, Roelofs J, Meesters C, Boomsma P. Rumination and worry in nonclinical adolescents. *Cognitive Therapy and Research* 2004;28:539–554.
- Muris P, Fokke M, Kwik D. The ruminative response style in adolescents: An examination of its specific link to symptoms of depression. *Cognitive Therapy and Research* 2009;33:21–32.
- Nolen-Hoeksema S. Responses to depression and their effects on the duration of depressive episodes. *Journal of Abnormal Psychology* 1991;100:569–582. [PubMed: 1757671]
- Nolen-Hoeksema S. The role of rumination in depressive disorders and mixed anxiety/depressive symptoms. *Journal of Abnormal Psychology* 2000;109:504–511. [PubMed: 11016119]
- Nolen-Hoeksema S, Davis. “Thanks for sharing that”: Ruminators and their social support networks. *Journal of Personality and Social Psychology* 1999;77:801–814. [PubMed: 10531672]
- Nolen-Hoeksema S, Morrow J. A prospective study of depression and posttraumatic stress symptoms after a natural disaster: The 1989 Loma Prieta Earthquake. *Journal of Personality and Social Psychology* 1991;61:115–121. [PubMed: 1890582]
- Nolen-Hoeksema S, Morrow J, Fredrickson BL. Response styles and the duration of episodes of depressed mood. *Journal of Abnormal Psychology* 1993;102:20–28. [PubMed: 8436695]
- Perini SJ, Abbott MJ, Rapee RM. Perception of performance as a mediator in the relationship between social anxiety and negative post-event rumination. *Cognitive Therapy and Research* 2007;30:645–659.
- Rachman S, Grüter-Andrew J, Shafran R. Post-event processing in social anxiety. *Behaviour Research and Therapy* 2000;38:611–617. [PubMed: 10846809]
- Raudenbush, SW.; Bryk, AS. Hierarchical linear models: Applications and data analysis methods. 2nd ed. London: Sage Publications; 2002.
- Raudenbush, S.; Bryk, A.; Cheong, YF.; Congdon, R. HLM 6: Hierarchical linear and nonlinear modeling [computer software]. Scientific Software International, Inc.; 2004.
- Sarason, IG. Introduction to the study of test anxiety. In: Saraon, IG., editor. *Test anxiety: Theory, research and applications*. Hillsdale, NJ: Lawrence Erlbaum Associates; 1980. p. 3-14.
- Thomsen DK. The association between rumination and negative affect: A review. *Cognition and Emotion* 2006;20:1216–1235.
- Treynor W, Gonzalez R, Nolen-Hoeksema S. Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research* 2003;27:247–259.
- Turner SM, Beidel DC, Dancu CY, Keys DJ. Psychopathology of social phobia and comparison to avoidant personality disorder. *Journal of Abnormal Psychology* 1986;95:389–394. [PubMed: 3805504]
- Vassilopoulos SP. Anticipatory processing in social anxiety. *Behavioural and Cognitive Psychotherapy* 2004;32:303–311.
- Vassilopoulos SP. Anticipatory processing plays a role in maintaining social anxiety. *Anxiety, Stress, and Coping* 2005;18:321–332.
- Watkins E. Adaptive and maladaptive ruminative self-focus during emotional processing. *Behaviour Research and Therapy* 2004;42:1037–1052. [PubMed: 15325900]
- Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology* 1988;54:1063–1070. [PubMed: 3397865]
- Zeidner M. How do high school and college students cope with test situations? *British Journal of Educational Psychology* 1996;66:115–128.
- Zeidner, M. *Test anxiety: The state of the art*. New York: Plenum; 1998.



**Figure 1.** Simple slopes of the cross-level interaction between the amount of anticipatory processing and quadratic change in post-event rumination.

**Table 1**

Means and Standard Deviations of the Study Variables at each Time Point.

	Time 1	Time 2	Time 3	Time 4	Time 5
Variable	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
TQ-Post		15.02 (12.3)	11.17 (11.0)	9.06 (10.1)	8.82 (10.5)
PANAS – NA		17.39 (8.0)	15.37 (6.7)	14.64 (6.7)	14.70 (7.1)
TQ-Ant	16.32 (12.3)				
CTAS	63.43 (14.9)				
RSQ-Brood	10.15 (4.1)				

*Note.* TQ-Post = Thoughts Questionnaire-Post; PANAS – NA = the negative subscale of the Positive and Negative Affect Schedule; TQ-Ant = Thoughts Questionnaire-Pre; CTAS = Cognitive Test Anxiety Scale; RSQ = the full Response Styles Questionnaire; RSQ-Brood = the brooding subscale of the Response Styles Questionnaire.



**Table 2**

Estimates of the Person-level Variables Predicting Post-event Rumination.

Fixed Effects	Coefficient	T-value	p-value
Intercept, TQ-Post	16.22	16.48	< .001
TQ-Ant	1.02	7.75	< .001
CTAS	-0.15	-1.48	<i>ns</i>
RSQ-Brood	0.41	1.36	<i>ns</i>
Linear Slope, TQ-Post	-3.64	-5.26	< .001
TQ-Ant	-0.31	-3.42	< .001
CTAS	0.13	1.89	.06
RSQ-Brood	-0.14	-0.64	<i>ns</i>
Quadratic Slope, TQ-Post	0.62	3.24	.002
TQ-Ant	0.07	2.97	.004
CTAS	-0.04	-1.89	.06
RSQ-Brood	0.04	0.68	<i>ns</i>
PANAS – NA	0.46	6.53	< .001
TQ-Ant	-0.02	-1.75	.08
CTAS	0.02	2.61	.01
RSQ-Brood	-0.01	-0.78	<i>ns</i>

*Note.* TQ-Post = Thoughts Questionnaire-Post; TQ-Ant = Thoughts Questionnaire-Anticipatory; CTAS = Cognitive Test Anxiety Scale; RSQ-Brood = the brooding subscale of the Response Styles Questionnaire; PANAS – NA = the negative subscale of the Positive and Negative Affect Schedule.