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The Everyday Dynamics of Rumination and Worry: Precipitant Events and Affective Consequences

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Abstract

Rumination and worry are two perseverative, negatively valenced thought processes that characterize depressive and anxiety disorders. Despite significant research interest, little is known about the everyday precipitants and consequences of rumination and worry. Using an experience sampling methodology, we examined and compared rumination and worry with respect to their relations to daily events and affective experience. Participants diagnosed with Major Depressive Disorder (MDD), Generalized Anxiety Disorder (GAD), co-occurring MDD-GAD, or no diagnosis carried an electronic device for one week and reported on rumination, worry, significant events, positive affect, and negative affect. Across the clinical groups, occurrences of everyday events predicted subsequent increases in rumination, but not worry. Further, higher momentary levels of rumination, but not worry, predicted subsequent decreases in positive affect and increases in negative affect. Thus, rumination was more susceptible to daily events and produced stronger affective changes over time. We discuss implications for theory and clinical intervention.

Keywords

rumination; worry; life stress; affect; experience sampling method

A growing literature is documenting that rumination and worry are perseverative, negative thought processes that cut across mood and anxiety disorders (e.g., Drost, van der Does, van Hemert, Penninx, & Spinhoven, 2014; Ehring & Watkins, 2008; Gruber, Eidelman, & Harvey, 2008; McEvoy, Watson, Watkins, & Nathan, 2013; Ruscio et al., 2015; Ruscio, Seitchik, Gentes, Jones, & Hallion, 2011; Yook, Kim, Suh, & Lee, 2010). Indeed, the constructs of rumination and worry are included in the National Institute of Mental Health Research Domain Criteria (NIMH RDoC), which support transdiagnostic research. Previous investigators have examined the overlapping and distinctive characteristics of rumination and worry, such as their associated thought content (e.g., Ehring & Watkins, 2008; Kircanski, Thompson, Sorenson, Sherdell, & Gotlib, 2015; McLaughlin, Borkovec, & Sibrava, 2007; Papageorgiou & Wells, 1999; Watkins, Moulds, & Mackintosh, 2005). Far fewer studies have probed the shared and unique *precipitants* and *consequences* of these

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thought processes. Given that rumination and worry are increasing foci of psychological treatments for emotional disorders (reviewed in Querstret & Cropley, 2013), a greater understanding of their proximal causes and effects has clear implications for treatment targets and outcomes. Such understanding requires explication of the naturalistic dynamics of rumination and worry. In the present study, we used an experience sampling methodology (ESM) to examine and compare rumination and worry in their temporal relations to everyday events as key precipitants, and to affective experiences as key consequences.

Both rumination and worry involve repetitive, negatively valenced thinking (Ehring & Watkins, 2008). Rumination is theorized to focus on the past and one's own distress (Nolen-Hoeksema, 1991); worry is posited to focus on the future and on potential negative outcomes (Borkovec, Robinson, Pruzinsky, & DePree, 1983). These proposed characteristics of rumination and worry have been supported by the findings of laboratory research. Historically, much of this work has used self-report or experimental methods to examine rumination in the context of Major Depressive Disorder (MDD) and worry in the context of Generalized Anxiety Disorder (GAD) (reviewed in Borkovec, Alcaine, & Behar, 2004, and Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). In a recent study, we extended these findings by utilizing ESM to examine individuals' naturalistic experiences of rumination and worry. Notably, persons diagnosed with MDD only, GAD only, and co-occurring MDD-GAD were highly consistent with one another in the features that they reported of rumination and worry in daily life, underscoring that these constructs are transdiagnostic as opposed to disorder specific (Kircanski et al., 2015).

Beyond characterizing the content and frequency of perseverative thinking, research also has begun to examine the precipitants of rumination and worry, particularly life events and stressors. Most prior studies have focused on major life events (reviewed in Brosschot, Gerin, & Thayer, 2006, Nolen-Hoeksema et al., 2008, and Smith & Alloy, 2009). For example, in several longitudinal investigations, higher levels of rumination surrounding major stressors (e.g., trauma, death of a loved one) were demonstrated to increase the likelihood of experiencing subsequent depression and anxiety (e.g., Abela & Hankin, 2011; Michl, McLaughlin, Shepherd, & Nolen-Hoeksema, 2013; Nolen-Hoeksema & Morrow, 1991; Nolen-Hoeksema, Parker, & Larson, 1994). By definition, worry centers on life domains or events (e.g., work, finances) (American Psychiatric Association [APA], 2000), indicating an association between these constructs. Although worry is considered to be future-oriented, events that have occurred (e.g., an evaluation at work) may prompt worry about their future occurrences or implications (e.g., whether one will be fired; Nolen-Hoeksema et al., 2008). Surprisingly little research, however, has examined event-related worry in the same manner as rumination. A small body of work has examined rumination or worry in response to everyday, as opposed to major, life events. Ruscio and colleagues (2015) found that individuals with MDD, GAD, and co-occurring MDD-GAD all reported higher levels of rumination following experiences that they had rated as at least moderately stressful than did individuals with no psychiatric diagnosis (see also Moberly & Watkins, 2008b). In addition, Pieper and colleagues (2007) conducted concurrent ESM and ambulatory physiological monitoring, and found that worry surrounding daily stressors prolonged cardiac activation. To date, no ESM study of everyday events has integrated

assessments of rumination and worry, an approach that is necessary in order to directly compare their precipitating conditions.

With respect to everyday consequences of rumination and worry, affective experience has long been considered an important outcome of perseverative thinking (Borkovec et al., 1983; Nolen-Hoeksema, 1991). In this context, ESM studies with both clinical (e.g., Ruscio et al., 2015) and community (e.g., Moberly & Watkins, 2008a, 2008b) samples have documented deleterious effects of momentary rumination on subsequent levels of positive and negative affect. This work is consistent with Alloy and colleagues' (2000) model of stress-reactive rumination, which posits that rumination precedes increases in negative affect and depressed mood. Although the naturalistic influence of worry on affect has not yet been examined using ESM, there is reason to believe that worry may differ from rumination in its affective consequences. While the tripartite model of depression and anxiety (Clark & Watson, 1991) suggests that rumination and worry are both associated with increased negative affect, findings are mixed regarding the effects of experimentally induced worry on subsequent affect (e.g., Llera & Newman, 2010; McLaughlin et al., 2007). Conceptually, whereas rumination involves a focus on one's negative feelings and problems, worry has been posited to function to cognitively avoid highly aversive material (reviewed in Nolen-Hoeksema et al., 2008). Moreover, recent theory suggests that worry serves to sustain chronic, low-level negative affect in order to prevent experiencing a subsequent strong emotional shift from a neutral or positive state to a negative state. Indeed, experiencing such an emotional contrast is aversive to individuals with GAD (Llera & Newman, 2014; Newman & Llera, 2011). Therefore, it is plausible that worry serves to sustain, rather than to change, levels of negative and positive affect in the service of avoiding emotional contrast. Accordingly, we predicted that momentary worry would not significantly change subsequent levels of negative and positive affect.

The aim of the present study was to assess and compare the everyday dynamics of rumination and worry to inform theory and clinical application. We utilized ESM data from the same sample reported in Kircanski et al. (2015), which included clinical participants diagnosed with MDD, GAD, and co-occurring MDD-GAD. In that study, we found that mean levels of both momentary rumination and momentary worry did not differ among the three diagnostic groups. Based on those strong transdiagnostic findings and results of other ESM research (e.g., Ruscio et al., 2015), and to increase statistical power for the analysis of events in the comparison of rumination and worry, we examined the clinical participants (i.e., the MDD, GAD, and MDD-GAD participants) as a single combined group. We expected to identify both common and unique dynamics of rumination and worry. First, we hypothesized that levels of rumination and worry both would increase following everyday events, particularly events that were rated as more stressful. We also examined additional aspects of everyday events, including the extent to which the events were considered important, controllable, and expected. Second, we hypothesized that higher levels of rumination at a given time point would be associated with decreases in positive affect and increases in negative affect at the subsequent time point. In contrast, levels of worry were hypothesized to exhibit no such affective consequences.

Method

Participants and Procedure

Adult women ages 18 to 50 years completed the study. The sample included only women both to strengthen statistical power and because prevalence of rates MDD, GAD, and co-occurring MDD-GAD are twice as high in women as in men (Kendler, Gardner, Gatz, & Pedersen, 2007). Participants were recruited through online advertisements and local psychiatric clinics. An initial telephone interview was used to screen participants for inclusion and exclusion criteria. Exclusion criteria were: not fluent in English; history of learning disabilities, severe head trauma, psychotic symptoms, or bipolar disorder; and current alcohol or substance abuse or dependence as defined by the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; APA, 1994). Individuals identified as likely to meet inclusion criteria participated in a diagnostic interview, the *Structured Clinical Interview for DSM-IV Axis I Disorders* (SCID-I; First, Spitzer, Gibbon, & Williams, 1996) based on *DSM-IV-TR* (APA, 2000) criteria, administered in the laboratory by a highly-trained interviewer. Participants in the MDD group ($n = 16$) met diagnostic criteria for current MDD, and did not have a diagnosis of GAD currently or within the past 24 months. Participants in the GAD group ($n = 15$) met diagnostic criteria for current GAD, and did not have a diagnosis of MDD currently or within the past 24 months. Participants in the co-occurring MDD-GAD group ($n = 20$) met diagnostic criteria for both current MDD and current GAD. Although *DSM-IV* lists a criterion in which GAD caseness is not met when this disorder occurs only in the context of MDD, the empirical literature and a *DSM-5* work group have indicated multiple problems with this criterion (e.g., Andrews et al., 2010; Lawrence, Liverant, Rosellini, & Brown, 2009); therefore, the hierarchy rule was not applied. For the present study, we examined the clinical participants in a single combined group ($n = 51$). Participants in the CTL group ($n = 19$) did not meet criteria for any current or lifetime Axis I disorder. The sample size for the study was consistent with the initial report (Kircanski et al., 2015), which used power calculations to determine sample size. Diagnostic evaluations were audio recorded. Twenty-five percent of audio recordings were randomly selected across eligible and ineligible participants in order for a different, blinded interviewer to re-rate current diagnoses of MDD and GAD. Inter-rater reliability was excellent for classifying the presence/absence both of MDD ($k = 1.00$) and of GAD ($k = 0.87$).

Participants returned to the laboratory for a second time to complete self-report measures and tasks. Participants were given a hand-held electronic device (Palm Pilot Z22) and were trained to use the device and ESM items, including completing a practice ESM prompt in the laboratory with experimenter guidance. Participants also received take-home instructions that included the descriptions of the ESM items. The Palm units were programmed using ESP 4.0 software (Barrett & Feldman-Barrett, 2000), tailored to prompt participants eight times per day during a 12-hour period between 8 a.m. and 10 p.m. (based on participants' waking times and bedtimes) for seven to eight consecutive days. Prompt occurrences were randomized within 90-minute intervals ($M = 96$ min, $SD = 37$ min). If participants did not begin responding to a prompt within five minutes, data for that prompt was recorded as missing. Participants were given additional compensation if they responded to 90% or more

of the prompts. Consistent with the previous ESM report in this sample (Kircanski et al., 2015) and other ESM studies (e.g., Bylsma, Taylor-Clift, & Rottenberg, 2011), one participant who did not respond to at least five prompts was excluded from the dataset. The ESM protocol was approved by the Stanford University Institutional Review Board.

ESM Measures

For the present study, we examined ESM items corresponding to rumination and worry, significant events (occurrence, stressfulness, importance, controllability, and expectedness), and positive and negative affect. Other ESM items were included in the larger protocol, but were not the focus of the current study.

Rumination and Worry

At each prompt, participants reported on their momentary levels of rumination and worry using two separate items with 100-point visual analog scales (1 = *not at all*, 100 = *very much so*). *Rumination:* "At the time of the beep, I was dwelling on my feelings and problems." *Worry:* "At the time of the beep, I was worried about things that could happen." These items were based on prior ESM studies (e.g., Hartley et al., 2014; Moberly & Watkins, 2008a) and were pilot-tested for feasibility and clarity. In the current sample, both items were reliable within persons (intraclass correlation [ICC] for rumination: 0.35; ICC for worry: 0.43), and demonstrated good convergent and discriminant validity with questionnaire assessments of rumination and worry in the laboratory (Kircanski et al., 2015).

Significant Events

At each prompt, participants were asked if they had experienced a significant event since the previous prompt. If participants endorsed "yes," they received a series of subsequent items corresponding to several dimensions of the event, all of which used five-point Likert scales. For the present analyses, participants rated the subjective stressfulness of the event (*Event stressfulness:* 1 = *not at all stressful*; 5 = *extremely stressful*). In addition, participants rated the subjective importance of the event (*Event importance:* 1 = *a little bit important*; 5 = *extremely important*), subjective controllability of the event (*Event controllability:* 1 = *very uncontrollable*; 5 = *very controllable*), and subjective expectedness of the event (*Event expectedness:* 1 = *very unexpected*; 5 = *very expected*). For each event, participants also were asked to categorize the domain, valence, and frequency; however, due to very low rates of each specific event type, these data were not examined in relation to rumination and worry.

Given the unpredictable nature of many everyday events, we expected ratings of these dimensions to vary within participants across prompts. Nevertheless, for the purpose of establishing the statistical reliability of these items, ICCs were computed for event stressfulness, importance, controllability, and expectedness, as the proportion of inter-subject variability to total variability using restricted maximum likelihood estimates. The ICC represents the mean correlation between ratings of an item at two prompts for a given participant. The statistical significance of each ICC value was evaluated using a Wald test, H_0: ICC = 0 (Snijders & Bosker, 2011). ICCs were significantly greater than zero for event stressfulness, ICC = 0.32, $Z = 3.15$, $p < .005$, event importance, ICC = 0.27, $Z = 3.08$, $p <$.

005, event controllability, ICC = 0.16, $Z = 2.22$, $p = .03$, and event expectedness, ICC = 0.24, $Z = 2.92$, $p < .005$, indicating appropriate reliability or within-subject nesting of observations.

Positive and Negative Affect

At each prompt, participants reported on their momentary levels of positive affect (PA) and negative affect (NA). Specifically, participants rated the degree to which they felt each of five positive emotions (calm, contented, interested, happy, excited) and five negative emotions (bored, sad, irritable, nervous, angry) using a five-point Likert scale (1 = *not at all*; 5 = *extremely*). These items were selected based on prior work, including the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) and Ekman's basic emotions (e.g., (Ekman, Friesen, & Ellsworth, 1972), and were designed to encompass both low- and high-arousal emotions. Ratings for the five positive emotions at each prompt were averaged to compute level of PA, and ratings for the five negative emotions at each prompt were averaged to compute level of NA. ICCs were significantly greater than zero for both PA, ICC = 0.47, $Z = 5.67$, $p < .001$, and NA, ICC = 0.47, $Z = 5.70$, $p < .001$.

Self-Report Questionnaires

Participants completed several self-report questionnaires prior to beginning the ESM protocol. Participants completed the Beck Depression Inventory (BDI-II; Beck, Steer, & Brown, 1996) to assess the severity of MDD symptoms, and the Generalized Anxiety Disorder Questionnaire-IV (GAD-Q-IV; Newman et al., 2002) to assess the severity of GAD symptoms. Both of these measures have strong psychometric properties (e.g., Dozois, Dobson, & Ahnberg, 1998; Robinson, Klenck, & Norton, 2010). In the current sample, internal consistency reliability was strong among the items of the BDI-II ($\alpha = .96$) and among the dimensional items of the GAD-Q-IV ($\alpha = .81$), with the dichotomous items summed to create a continuous item (see (Rodebaugh, Holaway, & Heimberg, 2008). Participants also completed the Ruminative Response Scale (RRS; Treynor, Gonzalez, & Nolen-Hoeksema, 2003) to assess trait rumination, and the Penn State Worry Questionnaire (PSWQ; Meyer, Miller, Metzger, & Borkovec, 1990) to assess trait worry. The RRS Brooding Subscale was selected to measure maladaptive rumination (Susan Nolen-Hoeksema et al., 2008; Treynor et al., 2003). Psychometric properties are excellent for both the RRS Brooding Subscale and the PSWQ (e.g., Molina & Borkovec, 1994; Treynor et al., 2003). In the current sample, internal consistency reliability was strong among the items of the RRS Brooding Subscale ($\alpha = .87$) and of the PSWQ ($\alpha = .94$).

Statistical Analyses

Multilevel modeling was used to test the study hypotheses, based on the nested structure of the ESM data (prompts nested within persons). Multilevel modeling enables simultaneous estimation of both within- and between-person effects and variable time intervals between prompts, and allows for missing data (Snijders & Bosker, 2011). HLM 6.08 software was used (Raudenbush, Bryk, & Congdon, 2004). All analyses were limited to within-day predictions. All models were random effects models in which the intercepts and slopes were allowed to vary. Robust standard errors were used. In all equations below, i denotes prompts and j denotes participants. As noted earlier, the primary models were conducted using the

combined clinical participants (i.e., the MDD, GAD, and MDD-GAD participants combined) as the reference group. Accordingly, the CTL group was entered as the contrast group (clinical group = 0; CTL group = 1).[1]

Results

Participant Characteristics

Characteristics of the clinical and CTL groups are presented in Table 1. The groups did not differ in age, $t(68) = 0.67$, $p = .50$, proportion of college-educated participants, $\chi^2(1, N = 70) = 0.02$, $p = .89$, distribution by race/ethnicity, $\chi^2(5, N = 70) = 6.91$, $p = .23$, or percentage of prompts completed, $t(68) = 0.16$, $p = .88$. Significant group comparisons on the BDI-II, GAD-Q-IV, RRS Brooding Subscale, PSWQ, and *DSM* Global Axis of Functioning (GAF) are denoted in Table 1 (see Kircanski et al. [2015] for specific demographic and clinical characteristics of the MDD, GAD, and MDD-GAD groups).

Descriptive Associations Among Variables

While not the focus of the primary analyses, descriptive data in the clinical group on significant concurrent associations within prompts indicated that momentary levels of rumination and worry were associated with each other, $p < .001$. Covarying concurrent worry, higher rumination was predicted (within-prompt) by higher NA, $p < .001$, and lower PA, $p < .001$, and for prompts in which preceding events were reported, higher ratings of event stressfulness, $p < .001$, and lower ratings of event importance, $p < .05$. Covarying concurrent rumination, higher worry was predicted (within-prompt) by higher NA, $p < .001$, and lower PA, $p < .01$. No other within-prompt associations with rumination or worry were significant.

Significant Events as Precipitants of Rumination and Worry

Event Occurrence—A total of 366 events were reported by 61 participants (6 clinical and 3 CTL participants did not report any events). On average, events were reported on 15.38% of prompts. An initial multilevel model indicated that the clinical group (i.e., the MDD, GAD, and MDD-GAD participants combined) reported events more frequently than did the CTL group (clinical group: $M = 17.89\%$, $SE = 0.03\%$; CTL group: $M = 8.73\%$, $SE = 0.02\%$), $t(68) = -2.67$, $p = .01$.[2]

For the primary analyses, we examined significant events and their dimensions as precipitants of rumination and worry. First, we conducted two multilevel analyses predicting

[1]We conducted exploratory models comparing the clinical diagnoses to each other (e.g., MDD vs. GAD). With two exceptions, the results indicated no significant differences among the clinical diagnoses. First, participants with GAD reported an increase in rumination following events that were rated as less controllable, whereas participants with co-occurring MDD-GAD were significantly less likely to do so, and did not show any such association (GAD group: $b = -7.89$, $SE = 2.62$; MDD-GAD group: $b = 1.91$, $SE = 1.54$; $t(41) = 3.23$, $p < .01$). Second, participants with MDD reported an increase in worry following events that were rated as more controllable, whereas participants with co-occurring MDD-GAD were less likely to do so, and did not show any such association (MDD group: $b = 7.88$, $SE = 2.55$; MDD-GAD group: $b = -2.81$, $SE = 2.90$; $t(41) = -2.77$, $p < .01$).

[2]While we did not examine rumination and worry in relation to event valence due to the low rates of each specific event type, we should note that of all events reported, the clinical group categorized proportionally fewer events as positive than did the CTL group (clinical group: $M = 37.48\%$, $SE = 0.04\%$; CTL group: $M = 59.33\%$, $SE = 0.10\%$; $t(59) = 2.08$ $p = .04$), and marginally more events as negative than did the CTL group (clinical group: $M = 43.76\%$, $SE = 0.05\%$; CTL group: $M = 25.61\%$, $SE = 0.10\%$; $t(59) = -1.98$, $p = .05$).

momentary levels of rumination and worry, respectively, at a given prompt (t) as a function of the occurrence of a significant event since the previous prompt (reported at t; dummy coded: 0 = no, 1 = yes). The two analyses controlled for levels of rumination and worry, respectively, at the previous prompt (t-1); thus, results reflect changes in levels of rumination and worry following the occurrence of an event (consistent with the procedures of previous ESM studies examining reactivity to events; e.g., Thompson et al., 2012). In addition, given that across participants levels of rumination and worry were associated within prompts, we covaried concurrent level of worry in the analysis of rumination, and we covaried concurrent level of rumination in the analysis of worry, in order to examine the specific relation between event occurrence and each of these processes.[3]

Level 1 Models (prompt level; separate equations used for rumination and worry):

$$\textbf{Rumination}_{ij(t)} = \beta_{0j} + \beta_{1j}\,(\text{occurrence of significant event}_t) + \beta_{2j}\,(\text{rumination}_{t-1}) + \beta_{3j}\,(\text{worry}_t) + r_{ij}$$

$$\textbf{Worry}_{ij(t)} = \beta_{0j} + \beta_{1j}\,(\text{occurrence of significant event}_t) + \beta_{2j}\,(\text{worry}_{t-1}) + \beta_{3j}\,(\text{rumination}_t) + r_{ij}$$

At Level 2, we conducted the models using the clinical group as the reference group and the CTL group as the contrast group.

Level 2 Models (participant level):

$$\beta_{0j} = \gamma_{00} + \gamma_{01}\,(\text{CTL group}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}\,(\text{CTL group}) + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}\,(\text{CTL group}) + u_{2j}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31}\,(\text{CTL group}) + u_{3j}$$

Complete results are presented in Table 2. As hypothesized, in the clinical group momentary level of rumination increased following the occurrence of a significant event, $p = .01$. Contrary to hypotheses, however, in the clinical group momentary level of worry did not change following the occurrence of a significant event, $p = .88$. Although not the focus of the study, contrasts between the clinical and CTL groups are presented in Table 2. With respect to the significant contrasts, a follow-up model with the groups reverse-coded indicated that in the CTL group, following the occurrence of a significant event, level of rumination did not significantly change, $p = .16$, but level of worry increased, $p < .01$.

Event Dimensions—Prompts with no events were removed during the analyses of event dimensions, because these prompts did not include any data for the event dimension predictors. Initial multilevel models indicated that overall, the clinical group (i.e., the MDD, GAD, and MDD-GAD participants combined) reported that events were more stressful than

[3]To be comprehensive, we also conducted all models of precipitating events and affective consequences excluding concurrent level of worry in the analyses of rumination, and excluding concurrent level of rumination in the analyses of worry. All results remained the same with one exception: in the clinical group, when excluding rumination as a covariate, momentary level of worry increased more strongly in response to events that were rated as more stressful, $p < .01$. These results indicate that there is an association between stressful events and worry only when concurrent rumination is excluded. That is, the link between event stressfulness and worry is explained (statistically) by concurrent worry and rumination.

did the CTL group (clinical group: $M = 3.36$, $SE = 0.13$; CTL group: $M = 2.23$, $SE = 0.21$), $t(59) = -4.58$, $p < .001$. The clinical and CTL groups did not differ in reported event importance (clinical group: $M = 3.55$, $SE = 0.13\%$; CTL group: $M = 3.22$, $SE = 0.25$), $t(59) = -1.17$, $p = .25$, controllability (clinical group: $M = 2.88$, $SE = 0.11$; CTL group: $M = 3.21$, $SE = 0.23$), $t(59) = 1.30$, $p = .20$, or expectedness (clinical group: $M = 2.93$, $SE = 0.12$; CTL group: $M = 3.38$, $SE = 0.28$), $t(59) = 1.51$, $p = .14$.

To examine the effects of event dimensions on rumination and worry, we conducted two multilevel analyses predicting momentary levels of rumination and worry, respectively, at a given prompt (t) as a function of the stressfulness, importance, controllability, and expectedness of the event that occurred since the previous prompt (reported at t). Again, the two analyses controlled for levels of rumination and worry, respectively, at the previous prompt (t-1), and we covaried concurrent level of worry in the analysis of rumination and concurrent level of rumination in the analysis of worry.

Level 1 Model for rumination (prompt level; same equation used for worry):

$$\textbf{Rumination}_{ij(t)} = \beta_{0j} + \beta_{1j}\,(\text{event stressfulness}_t) + \beta_{2j}\,(\text{event importance}_t) + \beta_{3j}\,(\text{event controllability}_t) + \beta_{4j}\,(\text{event expectedness}_t) + \beta_{5j}\,(\text{rumination}_{t\text{-}1}) + \beta_{6j}\,(\text{worry}_t) + r_{ij}$$

The Level 2 models were parallel in form to those reported earlier, using the clinical group as the reference group and the CTL group as the contrast group.

Complete results are presented in Table 3. With respect to rumination, as hypothesized, in the clinical group momentary level of rumination increased more strongly in response to events that were rated as more stressful, $p < .001$. However, level of rumination also increased more strongly in response to events that were rated as *less* important, $p = .02$. Level of rumination did not change as a function of reported event controllability, $p = .64$, or expectedness, $p = .45$. With respect to worry, contrary to hypotheses, in the clinical group momentary level of worry did not change as a function of reported event stressfulness, $p = .28$, importance, $p = .58$, controllability, $p = .56$, or expectedness, $p = .34$. Contrasts between the clinical and CTL groups are presented in Table 3. With respect to the significant contrasts, a follow-up model with the groups reverse-coded indicated that in the CTL group, level of rumination did not change as a function of reported event stressfulness, $p = .30$.

Positive and Negative Affect as Consequences of Rumination and Worry

Initial multilevel models indicated that the clinical group reported lower mean PA than did the CTL group (clinical group: $M = 2.26$, $SE = 0.07$; CTL group: $M = 2.89$, $SE = 0.12$), $t(68) = 4.63$, $p < .001$, and higher mean NA than did the CTL group (clinical group: $M = 1.83$, $SE = 0.06$; CTL group: $M = 1.19$, $SE = 0.03$), $t(68) = -8.99$, $p < .001$.

Positive Affect—For the primary analyses, we examined changes in PA and NA as consequences of rumination and worry. First, we conducted a multilevel analysis predicting momentary level of PA at a given prompt (t) as a function of levels of rumination and worry at the previous prompt (t-1). The analysis controlled for level of PA at the previous prompt (t-1); thus, results reflect the change in level of PA following rumination and worry

(consistent with the procedures of previous ESM studies examining the effects of rumination on affect; e.g., Pe, Raes, & Kuppens, 2013; Pe et al., 2013).

Level 1 Model (prompt level):

$$\mathbf{PA}_{ij(t)} = \beta_{0j} + \beta_{1j}\,(\text{rumination}_{t-1}) + \beta_{2j}\,(\text{worry}_{t-1}) + \beta_{3j}\,(\text{PA}_{t-1}) + r_{ij}$$

At Level 2, we conducted the model using the clinical group as the reference group and the CTL group as the contrast group.

Complete results are presented in Table 4. With respect to rumination, as hypothesized, in the clinical group higher levels of rumination at a given prompt predicted greater decreases in PA at the subsequent prompt, $p = .049$. Also as hypothesized, higher levels of worry at a given prompt did *not* produce changes in PA at the subsequent prompt, $p = .35$. Contrasts between the clinical and CTL groups, none of which were significant, are presented in Table 4.

Negative Affect—Parallel to the analysis of PA, we conducted a multilevel analysis predicting momentary level of NA at a given prompt (t) as a function of levels of rumination and worry at the previous prompt (t-1). Similarly, the analysis controlled for level of NA at the previous prompt (t-1).

Level 1 Model (prompt level):

$$\mathbf{NA}_{ij(t)} = \beta_{0j} + \beta_{1j}\,(\text{rumination}_{t-1}) + \beta_{2j}\,(\text{worry}_{t-1}) + \beta_{3j}\,(\text{NA}_{t-1}) + r_{ij}$$

At Level 2, we conducted the model using the clinical group as the reference group and the CTL group as the contrast group.

Complete results are presented in Table 4. With respect to rumination, as hypothesized, in the clinical group higher levels of rumination at a given prompt predicted greater increases in NA at the subsequent prompt, $p = .04$. Also as hypothesized, higher levels of worry at a given prompt did *not* produce changes in NA at the subsequent prompt, $p = .32$. Contrasts between the clinical and CTL groups are presented in Table 4. With respect to the significant contrasts, a follow-up model with the groups reverse-coded indicated that in the CTL group, higher levels of worry predicted greater decreases in NA at the subsequent prompt, $p = .03$.

Discussion

The goal of the present study was to compare the everyday dynamics of rumination and worry, specifically with respect to their precipitants and consequences. All of the primary analyses included naturalistic temporal effects from one sampling occasion to the next. Consistent with the NIMH RDoC framework (Insel et al., 2010; Sanislow et al., 2010), we used a transdiagnostic approach to examine rumination and worry across participants diagnosed with MDD, GAD, and co-occurring MDD-GAD, grounded in knowledge that all of these clinical groups engage in problematic perseverative negative thinking (e.g., Kircanski et al., 2015; McEvoy et al., 2013; Ruscio et al., 2015; Yook et al., 2010). In these clinical participants, we found that occurrences of significant events increased levels of rumination, but not of worry. In addition, higher momentary levels of rumination, but not of

worry, predicted decreases in positive affect and increases in negative affect at the subsequent prompt. These results indicate that level of rumination is more susceptible to everyday events and produces stronger affective changes than does worry. Below, we discuss the implications of these findings for theory and clinical intervention.

This is the first ESM investigation to integrate assessments of both rumination and worry in relation to everyday events. Intriguingly, the clinical participants' simple report of an event having occurred since the previous prompt, regardless of its characteristics, significantly increased their level of rumination. In the analysis of event dimensions, greater subjective stressfulness of an event was shown to predict a stronger increase in rumination for clinical participants. This finding supports theory linking rumination to life stress (e.g., Nolen-Hoeksema et al., 1994), here at the daily level as opposed to major life events (see also Moberly & Watkins, 2008b, and Ruscio et al., 2015). Importantly, however, the subjective controllability and expectedness of events were not associated with changes in rumination; in fact, contrary to intuition, events that were rated as less subjectively important were associated with stronger increases in rumination. One potential explanation that might be useful in attempting to understand this latter finding is provided by control theories (see Carver & Scheier, 1982, and Martin & Tesser, 1996, elaborated by Watkins, 2008). These theories propose that stressors (e.g., a failure experience) activate discrepancies between individuals' actual and desired states, and that rumination serves to resolve such discrepancies, sometimes by downgrading the subjective importance of the events (e.g., telling oneself that the domain in which failure occurred is not important) (see Michl et al., 2013). Thus, in the current study, higher levels of rumination may have been serving the function of downgrading the subjective importance of everyday events (however, see Moberly & Watkins, 2010). Alternatively, it is possible that individuals are more likely to perceive themselves to be dwelling or ruminating excessively following events for which perseverative thinking does not seem justifiable (i.e., unimportant events). In contrast, repeatedly thinking about highly important events may be viewed by individuals as more reasonable and, therefore, may be experienced less as dwelling.

Descriptive results indicated that the clinical participants were more likely to report events, and specifically more stressful and negative events, than were control participants. These findings are consistent with previous research examining the heightened experience of stressful events in depression and anxiety (reviewed in Nolen-Hoeksema et al., 2008, and Smith & Alloy, 2009), including ESM studies (e.g., Thompson et al., 2012), and may help to account for clinical participants' greater tendency to ruminate in response to events. However, given that clinical participants' simple report of an event having occurred served to increase their rumination, investigators and clinicians should note that rumination in MDD and GAD may be susceptible to a wide variety of daily events, not only to negative, unexpected, or uncontrollable events as are typically considered.

Contrary to predictions, for the clinical participants, level of worry did not change significantly as a function of the occurrence or dimensions of everyday events. Therefore, although the content of worry centers on life domains and stressors (APA, 2000), the precise level of worry at a given point in time may be more internally generated than tied to the experience of external life events. Taken together with the findings for everyday events and

rumination, these results suggest that interventions targeting rumination and worry might focus differently on daily events as augmenting factors. For example, whereas interventions to reduce rumination might involve the deliberate practice of skills following daily events, clinical reduction of worry may focus more on self-generated dynamics (e.g., mindfulness skills for spontaneous rises in worry). Of course, rumination and worry may be addressed collectively in treatments that broadly target perseverative negative thought (see Querstret & Cropley, 2013). Even in such treatments, however, it is likely to be particularly valuable to assess the diverse everyday situations in which rumination is generated.

Rumination also exhibited stronger prospective affective consequences than did worry, indicating that rumination carries the emotional 'weight' of perseverative negative thought. Findings that rumination was associated with a decrease in positive affect and increase in negative affect were consistent with results reported in previous studies (e.g., Moberly & Watkins, 2008a, 2008b; Ruscio et al., 2015), and underscore the deleterious impact of rumination on subsequent positive and negative affect (Alloy et al., 2000). Based on emotional contrast avoidance theory (Llera & Newman, 2014; Newman & Llera, 2011), we had predicted that worry would sustain but not significantly change subsequent levels of negative and positive affect. Thus, despite the overlapping features of rumination and worry, they appear to have distinct effects on subsequent naturalistic emotions. Importantly, descriptive associations indicated that within prompts for clinical participants, higher levels of both rumination and worry were associated with decreased positive affect and increased negative affect. That is, while worry was concurrently associated with emotional distress, worry did not drive subsequent changes in positive or negative affect as did rumination. These results have implications for overarching theories of perseverative negative thought (e.g., Ehring & Watkins, 2008), by emphasizing the need to incorporate both the shared and unique aspects of rumination and worry. Moreover, the current findings suggest that when targeting rumination clinically, one goal may be for individuals to experience *less* subsequent change in affect over time. Conversely, targeting worry may involve having individuals experience *greater* shifts away from positive emotion and toward negative emotion as individuals learn to tolerate such affective contrasts (Llera & Newman, 2014; Newman & Llera, 2011).

We should note that, in healthy control participants, level of rumination was not affected by event occurrence and stressfulness as was the case in clinical participants. In contrast, however, in control participants level of worry increased following event occurrence and predicted decreases in NA, indicating that it is normative for worry to be tied to daily events and may function adaptively in this group. Levels of rumination were similarly related to affective experience in clinical and control participants. Here, however, we should reiterate that overall levels of rumination and worry in the control group were significantly lower than were those in the clinical group (see Kircanski et al., 2015). In addition, as we described earlier, the control group reported fewer significant events, higher positive affect, and lower negative affect than did the clinical group. Therefore, the dynamics of rumination and worry still would be expected to disproportionately affect individuals with MDD, GAD, and co-occurring MDD-GAD.

There are several limitations of the present study warranting discussion. First, we studied women in this investigation, based on their higher prevalence of MDD and GAD (Kendler et al., 2007) and in order to enhance statistical power. Future studies should examine the generalizability of these findings to men. Second, a previous ESM protocol in our laboratory had a slightly higher overall prompt response rate than that in the current study (Thompson et al., 2012). Other research groups, however, have reported lower ESM response rates in clinical groups than we did in the present study (Hartley et al., 2014). In future investigations, a reduced overall number or frequency of ESM items, or a titrated compensation schedule, may help to increase response rates. Third, significant events were endorsed at relatively low rates in both the clinical and control groups, which may have limited our power to detect effects. The ESM approach we took in this study differed from that taken by (Ruscio and colleagues 2015), who at every prompt asked participants to identify and rate the most stressful experience that had occurred since the previous prompt. While this latter approach likely increased power through frequency of assessment, it was not confined to events *per se*, given the wording of the item. In future ESM studies of everyday events, it may be fruitful to use a combined assessment approach in which significant events are first queried, followed by having participants identify the most subjectively stressful experience since the previous prompt. Fourth, we did not assess the ongoing activities in which participants were engaged and that contextualized their perseverative thinking and affective experience. Further research using ESM should directly investigate the activities or contexts in which rumination and worry are activated, perhaps in a person-specific manner in order to identify individualized treatment targets (Fisher, 2015).

In sum, in the first ESM study to directly compare the everyday dynamics of rumination and worry, we found distinct relations with both daily events and affective experience. Despite the shared characteristics of rumination and worry, these two forms of repetitive negative thought appear to have unique precipitants and consequences in daily life. In the broader psychopathology literature, a movement toward transdiagnostic constructs encourages further investigation of rumination and worry across a wide range of affected clinical populations. Future research should continue to elucidate the shared and unique aspects of rumination and worry, with a significant focus on biological correlates and optimal treatment strategies.

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References

Abela JRZ, & Hankin BL (2011). Rumination as a vulnerability factor to depression during the transition from early to middle adolescence: A multiwave longitudinal study. Journal of Abnormal Psychology, 120(2), 259–271. [PubMed: 21553940]

Alloy LB, Abramson LY, Hogan ME, Whitehouse WG, Rose DT, Robinson MS, ... & Lapkin JB (2000). The Temple-Wisconsin Cognitive Vulnerability to Depression Project: Lifetime history of

axis I psychopathology in individuals at high and low cognitive risk for depression. Journal of Abnormal Psychology, 109(3), 403–418. [PubMed: 11016110]

American Psychiatric Association. (1994). Diagnostic and Statistical Manual of Mental Disorders (4th ed.). Washington, DC: American Psychiatric Association.

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders (5th ed.). Washington, DC: American Psychiatric Publishing.

Andrews G, Hobbs MJ, Borkovec TD, Beesdo K, Craske MG, Heimberg RG, … Stanley MA (2010). Generalized worry disorder: A review of DSM-IV generalized anxiety disorder and options for DSM-V. Depression and Anxiety, 27(2), 134–147. [PubMed: 20058241]

Barrett DJ, & Feldman-Barrett L (2000). The experience sampling program (ESP). Available at http://www.experience-sampling.org/.

Beck AT, Steer RA, & Brown GK (1996). Manual for the Beck Depression Inventory-II. San Antonio, TX: Psychological Corporation.

Borkovec TD, Alcaine OM, & Behar E (2004). Avoidance theory of worry and generalized anxiety disorder In Heimberg RG, Turk CL, & Mennin DS (Eds.), Generalized anxiety disorder: Advances in research and practice (pp. 77–108). NY: Guilford Press.

Borkovec TD, Robinson E, Pruzinsky T, & DePree JA (1983). Preliminary exploration of worry: Some characteristics and processes. Behaviour Research and Therapy, 21(1), 9–16. [PubMed: 6830571]

Brosschot JF, Gerin W, & Thayer JF (2006). The perseverative cognition hypothesis: A review of worry, prolonged stress-related physiological activation, and health. Journal of Psychosomatic Research, 60(2), 113–124. [PubMed: 16439263]

Bylsma LM, Taylor-Clift A, & Rottenberg J (2011). Emotional reactivity to daily events in major and minor depression. Journal of Abnormal Psychology, 120(1), 155–167. [PubMed: 21319928]

Carver CS, & Scheier MF (1982). Control theory: A useful conceptual framework for personality-social, clinical, and health psychology. Psychological Bulletin, 92(1), 111–135. [PubMed: 7134324]

Clark LA, & Watson D (1991). Tripartite model of anxiety and depression: Psychometric evidence and taxonomic implications. Journal of Abnormal Psychology, 100(3), 316–336. [PubMed: 1918611]

Drost J, van der Does W, van Hemert AM, Penninx BWJH, & Spinhoven P (2014). Repetitive negative thinking as a transdiagnostic factor in depression and anxiety: A conceptual replication. Behaviour Research and Therapy, 63, 177–183. [PubMed: 25461794]

Ehring T, & Watkins ER (2008). Repetitive negative thinking as a transdiagnostic process. International Journal of Cognitive Therapy, 1(3), 192–205.

Ekman P, Friesen WV, & Ellsworth P (1972). Emotion in the human face: Guidelines for research and an integration of findings. New York: Pergamon Press.

First MB, Spitzer R, Gibbon M, & Williams J (1996). Structured Clinical Interview for DSM-IV Axis I Disorders-Clinician Version (SCID-CV). Washington, DC: American Psychiatric Press.

Fisher AJ (2015). Toward a dynamic model of psychological assessment: Implications for personalized care. Journal of Consulting and Clinical Psychology, 83(4), 825–836. [PubMed: 26009781]

Gruber J, Eidelman P, & Harvey AG (2008). Transdiagnostic emotion regulation processes in bipolar disorder and insomnia. Behaviour Research and Therapy, 46(9), 1096–1100. [PubMed: 18684436]

Hartley S, Haddock G, Vasconcelos E Sa D, Emsley R, & Barrowclough C (2014). An experience sampling study of worry and rumination in psychosis. Psychological Medicine, 44(8), 1605–1614. [PubMed: 23953654]

Insel T, Cuthbert B, Garvey M, Heinssen R, Pine DS, Quinn K, … Wang P (2010). Research domain criteria (RDoC): Toward a new classification framework for research on mental disorders. The American Journal of Psychiatry, 167(7), 748–751. [PubMed: 20595427]

Kendler KS, Gardner CO, Gatz M, & Pedersen NL (2007). The sources of co-morbidity between major depression and generalized anxiety disorder in a Swedish national twin sample. Psychological Medicine, 37(3), 453–462. [PubMed: 17121688]

Kircanski K, Thompson RJ, Sorenson JE, Sherdell L, & Gotlib IH (2015). Rumination and worry in daily life: Examining the naturalistic validity of theoretical constructs. Clinical Psychological Science, 3(6), 926–939. [PubMed: 26783506]

Lawrence AE, Liverant GI, Rosellini AJ, & Brown TA (2009). Generalized anxiety disorder within the course of major depressive disorder: Examining the utility of the DSM-IV hierarchy rule. Depression and Anxiety, 26(10), 909–916. [PubMed: 19798759]

Llera SJ, & Newman MG (2010). Effects of worry on physiological and subjective reactivity to emotional stimuli in generalized anxiety disorder and nonanxious control participants. Emotion, 10(5), 640–650. [PubMed: 21038947]

Llera SJ, & Newman MG (2014). Rethinking the role of worry in generalized anxiety disorder: Evidence supporting a model of emotional contrast avoidance. Behavior Therapy, 45(3), 283–299. [PubMed: 24680226]

Martin LL, & Tesser A (1996). Some ruminative thoughts In Wyer RS, Jr (Ed.), Advances in social cognition, Vol. 9 (pp. 1–47). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc,

McEvoy PM, Watson H, Watkins ER, & Nathan P (2013). The relationship between worry, rumination, and comorbidity: Evidence for repetitive negative thinking as a transdiagnostic construct. Journal of Affective Disorders, 151(1), 313–320. [PubMed: 23866301]

McLaughlin KA, Borkovec TD, & Sibrava NJ (2007). The effects of worry and rumination on affect states and cognitive activity. Behavior Therapy, 38(1), 23–38. [PubMed: 17292692]

Meyer TJ, Miller ML, Metzger RL, & Borkovec TD (1990). Development and validation of the Penn State Worry Questionnaire. Behaviour Research and Therapy, 28(6), 487–495. [PubMed: 2076086]

Michl LC, McLaughlin KA, Shepherd K, & Nolen-Hoeksema S (2013). Rumination as a mechanism linking stressful life events to symptoms of depression and anxiety: Longitudinal evidence in early adolescents and adults. Journal of Abnormal Psychology, 122(2), 339–352. [PubMed: 23713497]

Moberly NJ, & Watkins ER (2008a). Ruminative self-focus and negative affect: An experience sampling study. Journal of Abnormal Psychology, 117(2), 314–323. [PubMed: 18489207]

Moberly NJ, & Watkins ER (2008b). Ruminative self-focus, negative life events, and negative affect. Behaviour Research and Therapy, 46(9), 1034–1039. [PubMed: 18684437]

Moberly NJ, & Watkins ER (2010). Negative affect and ruminative self-focus during everyday goal pursuit. Cognition & Emotion, 24(4), 729–739. [PubMed: 19300531]

Molina S, & Borkovec TD (1994). The Penn State Worry Questionnaire: Psychometric properties and associated characteristics In Davey G & Tallis F (Eds.), Worrying: Perspectives on theory, assessment and treatment (pp. 265–283). New York: Wiley.

Newman MG, & Llera SJ (2011). A novel theory of experiential avoidance in generalized anxiety disorder: A review and synthesis of research supporting a contrast avoidance model of worry. Clinical Psychology Review, 31(3), 371–382. [PubMed: 21334285]

Newman MG, Zuellig AR, Kachin KE, Constantino MJ, Przeworski A, Erickson T, & Cashman-McGrath L (2002). Preliminary reliability and validity of the Generalized Anxiety Disorder Questionnaire-IV: A revised self-report diagnostic measure of generalized anxiety disorder. Behavior Therapy, 33(2), 215–233.

Nolen-Hoeksema S (1991). Responses to depression and their effects on the duration of depressive episodes. Journal of Abnormal Psychology, 100(4), 569–582. [PubMed: 1757671]

Nolen-Hoeksema S, & Morrow J (1991). A prospective study of depression and posttraumatic stress symptoms after a natural disaster: The 1989 Loma Prieta Earthquake. Journal of Personality and Social Psychology, 61(1), 115–121. [PubMed: 1890582]

Nolen-Hoeksema S, Parker LE, & Larson J (1994). Ruminative coping with depressed mood following loss. Journal of Personality and Social Psychology, 67(1), 92–104. [PubMed: 8046585]

Nolen-Hoeksema S, Wisco BE, & Lyubomirsky S (2008). Rethinking rumination. Perspectives on Psychological Science, 3(5), 400–424. [PubMed: 26158958]

Papageorgiou C, & Wells A (1999). Process and meta-cognitive dimensions of depressive and anxious thoughts and relationships with emotional intensity. Clinical Psychology & Psychotherapy, 6(2), 156–162.

Pe ML, Raes F, & Kuppens P (2013). The cognitive building blocks of emotion regulation: Ability to update working memory moderates the efficacy of rumination and reappraisal on emotion. PLOS One, 8(7), e69071. [PubMed: 23874872]

Pe ML, Raes F, Koval P, Brans K, Verduyn P, & Kuppens P (2013). Interference resolution moderates the impact of rumination and reappraisal on affective experiences in daily life. Cognition & Emotion, 27(3), 492–501. [PubMed: 22966838]

Pieper S, Brosschot JF, van der Leeden R, & Thayer JF (2007). Cardiac effects of momentary assessed worry episodes and stressful events. Psychosomatic Medicine, 69(9), 901–909. [PubMed: 17991822]

Querstret D, & Cropley M (2013). Assessing treatments used to reduce rumination and/or worry: A systematic review. Clinical Psychology Review, 33(8), 996–1009. [PubMed: 24036088]

Raudenbush SW, Bryk AS, & Congdon R (2004). HLM (Version 6) [Computer software].

Rodebaugh TL, Holaway RM, & Heimberg RG (2008). The factor structure and dimensional scoring of the generalized anxiety disorder questionnaire for DSM-IV. Assessment, 15(3), 343–350. [PubMed: 18202302]

Ruscio AM, Gentes EL, Jones JD, Hallion LS, Coleman ES, & Swendsen J (2015). Rumination predicts heightened responding to stressful life events in major depressive disorder and generalized anxiety disorder. Journal of Abnormal Psychology, 124(1), 17–26. [PubMed: 25688429]

Ruscio AM, Seitchik AE, Gentes EL, Jones JD, & Hallion LS (2011). Perseverative thought: A robust predictor of response to emotional challenge in generalized anxiety disorder and major depressive disorder. Behaviour Research and Therapy, 49(12), 867–874. [PubMed: 22030295]

Sanislow CA, Pine DS, Quinn KJ, Kozak MJ, Garvey MA, Heinssen RK, … Cuthbert BN (2010). Developing constructs for psychopathology research: Research domain criteria. Journal of Abnormal Psychology, 119(4), 631–639. [PubMed: 20939653]

Smith JM, & Alloy LB (2009). A roadmap to rumination: A review of the definition, assessment, and conceptualization of this multifaceted construct. Clinical Psychology Review, 29(2), 116–128. [PubMed: 19128864]

Snijders TAB, & Bosker R (2011). Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling (2nd ed.). Los Angeles: Sage.

Thompson RJ, Mata J, Jaeggi SM, Buschkuehl M, Jonides J, & Gotlib IH (2012). The everyday emotional experience of adults with major depressive disorder: Examining emotional instability, inertia, and reactivity. Journal of Abnormal Psychology, 121(4), 819–829. [PubMed: 22708886]

Treynor W, Gonzalez R, & Nolen-Hoeksema S (2003). Rumination reconsidered: A psychometric analysis. Cognitive Therapy and Research, 27(3), 247–259.

Watkins ER (2008). Constructive and unconstructive repetitive thought. Psychological Bulletin, 134(2), 163–206. [PubMed: 18298268]

Watkins E, Moulds M, & Mackintosh B (2005). Comparisons between rumination and worry in a non-clinical population. Behaviour Research and Therapy, 43(12), 1577–1585. [PubMed: 16239152]

Watson D, Clark LA, & Tellegen A (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. Journal of Personality and Social Psychology, 54(6), 1063–1070. [PubMed: 3397865]

Yook K, Kim K-H, Suh SY, & Lee KS (2010). Intolerance of uncertainty, worry, and rumination in major depressive disorder and generalized anxiety disorder. Journal of Anxiety Disorders, 24(6), 623–628. [PubMed: 20439149]

Table 1

Demographic and Clinical Characteristics of the Clinical and CTL Groups

Variable	Clinical Group *M (SD)* or %	CTL Group *M (SD)* or %
Age	32.96 (9.40)	34.68 (9.88)
% college educated	66.7%	68.4%
Race/ethnicity†		
Non-Hispanic White	58.8%	66.7%
Hispanic	7.8%	0%
African-American	3.9%	11.1%
Asian-American	17.6%	5.6%
Mixed Race/Other	11.8%	16.7%
% prompt completion	64.0%	65.1%
BDI-II *	25.08 (11.91)	1.47 (2.63)
GAD-Q-IV *	9.80 (3.06)	1.89 (2.23)
RRS Brooding† *	13.80 (3.39)	6.44 (1.20)
PSWQ *	61.25 (13.20)	40.79 (12.48)
GAF *	57.76 (6.99)	89.37 (8.75)

Note. Clinical = Major Depressive Disorder (MDD), Generalized Anxiety Disorder (GAD), and co-occurring MDD-GAD participants combined; CTL = no past or current psychiatric disorder; BDI-II = Beck Depression Inventory-II; GAD-Q-IV = Generalized Anxiety Disorder Questionnaire-IV; RRS Brooding = Ruminative Response Scale Brooding Subscale; PSWQ = Penn State Worry Questionnaire; GAF = Global Axis of Functioning. †For each variable, data were missing for one CTL participant.

*Significant group comparison, $p < .001$.

Table 2

Occurrences of Significant Events Predicting Changes in Momentary Rumination and Worry in Clinical and Control Groups

	Unstd. Coeff.	*SE*	*t*
$Rumination_t$			
Event $occurrence_t$, clinical group (γ_{10})	7.43	2.80	2.65**
CTL group contrast (γ_{11})	−11.66	4.10	−2.84**
$Rumination_{t-1}$, clinical group (γ_{20})	0.16	0.03	5.16***
CTL group contrast (γ_{21})	−0.02	0.06	−0.40
$Worry_t$, clinical group (γ_{30})	0.53	0.04	12.80***
CTL group contrast (γ_{31})	−0.01	0.08	−0.18
$Worry_t$			
Event $occurrence_t$, clinical group (γ_{10})	0.25	1.67	0.15
CTL group contrast (γ_{11})	6.57	2.71	2.43*
$Worry_{t-1}$, clinical group (γ_{20})	0.09	0.03	2.78**
CTL group contrast (γ_{21})	−0.11	0.05	−2.33*
$Rumination_t$, clinical group (γ_{30})	0.48	0.04	12.42***
CTL group contrast (γ_{31})	0.12	0.09	1.22

Note. CTL = no past or current psychiatric disorder ($n = 19$). Clinical group represents the estimate in the MDD, GAD, and MDD-GAD groups combined ($n = 51$). CTL group contrast represents the difference between the estimates in the clinical group and the CTL group. t denotes a given prompt; t-1 denotes the previous prompt. All covariates are presented. Effects are denoted only when they are statistically significant.

* $p < .05$;

** $p \leq .01$;

*** $p < .001$.

Table 3

Dimensions of Significant Events Predicting Changes in Momentary Rumination and Worry in Clinical and Control Groups

	Unstd. Coeff.	*SE*	*t*
Rumination$_t$			
Event stressfulness$_t$, clinical group (γ_{10})	7.39	1.58	4.67***
CTL group contrast (γ_{11})	−9.90	2.86	−3.46**
Event importance$_t$, clinical group (γ_{20})	−4.00	1.66	−2.41*
CTL group contrast (γ_{21})	4.25	2.33	1.82
Event controllability$_t$, clinical group (γ_{30})	−0.51	1.09	−0.47
CTL group contrast (γ_{31})	−1.23	1.85	−0.67
Event expectedness$_t$, clinical group (γ_{40})	−1.01	1.33	−0.76
CTL group contrast (γ_{41})	−1.85	1.71	−1.08
Worry$_t$			
Event stressfulness$_t$, clinical group (γ_{10})	2.10	1.91	1.10
CTL group contrast (γ_{11})	4.06	3.81	1.07
Event importance$_t$, clinical group (γ_{20})	0.70	1.25	0.56
CTL group contrast (γ_{21})	−0.21	2.97	−0.07
Event controllability$_t$, clinical group (γ_{30})	0.92	1.57	0.58
CTL group contrast (γ_{31})	0.58	3.48	0.17
Event expectedness$_t$, clinical group (γ_{40})	−1.38	1.43	−0.96
CTL group contrast (γ_{41})	1.60	1.94	0.83

Note. CTL = no past or current psychiatric disorder (n = 16). Clinical group represents the estimate in the MDD, GAD, and MDD-GAD groups combined (n = 45). CTL group contrast represents the difference between the estimates in the clinical group and the CTL group. t denotes a given prompt; t-1 denotes the previous prompt. Effects for the rumination and worry covariates are not presented; see models of event occurrence for the effects of these covariates, Table 2, which did not significantly differ from those in the current models. Effects are denoted only when they are statistically significant.

* $p < .05$;

** $p \leq .01$;

*** $p < .001$.

Table 4

Rumination and Worry Predicting Changes in Momentary Positive and Negative Affect in Clinical and Control Groups

	Unstd. Coeff.	*SE*	*t*
Positive Affect$_t$			
Rumination$_{t-1}$, clinical group (γ_{10})	−0.002	0.001	−2.01*
CTL group contrast (γ_{11})	−0.001	0.001	−0.76
Worry$_{t-1}$, clinical group (γ_{20})	−0.001	0.001	−0.94
CTL group contrast (γ_{21})	0.002	0.002	1.26
Positive affect$_{t-1}$, clinical group (γ_{30})	0.296	0.032	9.22***
CTL group contrast (γ_{31})	0.017	0.080	0.21
Negative Affect$_t$			
Rumination$_{t-1}$, clinical group (γ_{10})	0.002	0.001	2.08*
CTL group contrast (γ_{11})	−0.000	0.001	−0.00
Worry$_{t-1}$, clinical group (γ_{20})	0.001	0.001	1.01
CTL group contrast (γ_{21})	−0.002	0.001	−2.03*
Negative affect$_{t-1}$, clinical group (γ_{30})	0.188	0.042	4.53***
CTL group contrast (γ_{31})	−0.055	0.062	−0.88

Note. CTL = no past or current psychiatric disorder (n = 19). Clinical group represents the estimate in the MDD, GAD, and MDD-GAD groups combined (n = 51). CTL group contrast represents the difference between the estimates in the clinical group and the CTL group. t-1 denotes the previous prompt. All covariates are presented. Effects are denoted only when they are statistically significant.

* $p < .05$;

*** $p < .001$.