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Rumination interacts with life stress to predict depressive symptoms: An ecological momentary assessment study

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ABSTRACT

Rumination is a well-established vulnerability factor for depression that may exert deleterious effects both independently and in interaction with stress. The current study examined momentary ruminative self-focus (MRS) and stress-reactive rumination (SRR) as predictors of depressive symptoms utilizing a smartphone ecological momentary assessment (EMA) design. 121 undergraduates responded to four text message alerts per day for one week in which they indicated the occurrence of life stress, rumination, and depressed mood. SRR, but not MRS, independently predicted increases in depressive symptoms. MRS interacted with depressive symptoms to predict increases in symptoms at the subsequent timepoint, supporting the deleterious effects of depressive rumination on future mood state. Interactions emerged between stress and both MRS and SRR, such that experiencing higher levels of stressors and rumination at an observation predicted greater increases in depressive symptoms. To our knowledge, this study is the first to demonstrate that state rumination moderates the effect of stress in predicting depressive symptoms using EMA methodology. Results suggest that rumination levels in response to stress vary within individuals and can have an important effect on depressed mood. Findings may have important clinical implications, as lessening individuals' tendency to engage in rumination following stress may help to alleviate depressive symptoms.

Major depressive disorder (MDD) is the most common psychiatric disorder, associated with major personal, societal, and economic costs (Birnbaum et al., 2010; Kessler, Merikangas, & Wang, 2007). Rumination, characterized by repetitive, passive thoughts about the symptoms, causes, and future repercussions of one's depression, is thought to perpetuate depressed mood, as outlined in the response styles theory of depression (Nolen-Hoeksema, 1991). Indeed, a wealth of research has established trait rumination's role as a major risk factor for MDD that is predictive of the onset, length, and number of depressive episodes experienced (Wisco & Nolen-Hoeksema, 2008). However, the influence of rumination at the state level is less clear. The current study utilized ecological momentary assessment (EMA) methodology to better understand the role of state rumination and stress as predictors of depressive symptoms over time.

Rumination may contribute to depression in interaction with the experience of life stress, in line with the well-supported vulnerability-stress model of depression (Abramson et al., 2002; Hammen, 2005). Indeed, in an influential early study conducted within a nonclinical sample, students scoring higher in initial levels of trait rumination demonstrated greater increases in depressive symptoms following the experience of a major stressor, the 1989 Lomo Prieta earthquake (Nolen-Hoeksema & Morrow, 1991). This relationship also has been supported in nonclinical experimental paradigms, in which individuals who either scored higher on self-report measures of rumination (Feldner, Leen-Feldner, Zvolensky, & Lejuez, 2006) or underwent a rumination induction (Watkins, Moberly, & Moulds, 2008) demonstrated greater increases in depressive symptoms following an in-lab stressor.

An extension of this literature has examined rumination occurring after the experience of stress, referred to as stress-reactive rumination (SRR; Robinson & Alloy, 2003). Individuals engaging in SRR make negative inferences about the events that they have experienced and ruminate about these beliefs, such as that the event's occurrence was entirely their fault. Those displaying higher trait levels of SRR, as measured by the Stress-Reactive Rumination Scale (SRRS; Robinson & Alloy, 2003), are more likely to experience major depressive disorder over time,

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suggesting that SRR serves as an important vulnerability for MDD (Alloy et al., 2000; Robinson & Alloy, 2003).

Given that SRR occurs in response to life stress, it is vital to study its frequency following the experience of actual stressors. A daily diary study of undergraduates found that although SRR did not independently predict depressive symptoms, there was a significant positive interaction between SRR and number of stressors per day in predicting same-day depressive symptoms, consistent with a vulnerability-stress framework (Genet & Siemer, 2012). Ecological momentary assessment (EMA) designs, in which the occurrence of rumination and stress are measured multiple times per day, have found that momentary rumination mediated the role of life stress in prospectively predicting depressive symptoms in both nonclinical (Moberly & Watkins, 2008a) and clinical samples (Ruscio et al., 2015). Although neither study found *momentary*, state-level rumination to moderate the role of stress in predicting depression, such a relationship was reported between *trait* rumination and daily stress, providing support for response styles theory (Moberly & Watkins, 2008a).

In addition to examining the effect of SRR on depressive symptoms, the degree to which individuals engage in ruminative, self-focused thought irrespective of proximal stressors is also worthy of study. A novel line of research has investigated the relationship between momentary ruminative self-focus (MRS) during periods of rest, in which individuals are not engaged in a specific task and their minds are able to wander, and their subsequent mood symptoms. A nonclinical study of undergraduates found that those who scored higher on a baseline scale of cognitive reactivity and engaged in more ruminative, internally-focused thought during rest, as measured by the Momentary Ruminative Self-focus Inventory (MRSI; Mor, Marchetti, & Koster, 2013) showed increased depressive symptoms (Marchetti, Koster, & De Raedt, 2013). Furthermore, nonclinical EMA studies have found that engaging in negative ruminative self-focus, irrespective of the occurrence of proximal stressors, predicts depressive symptoms both concurrently (Ottaviani, Medea, Lonigro, Tarvainen, & Couyoumdjian, 2015; Takano & Tanno, 2010) and prospectively (Moberly & Watkins, 2008b), and has been linked to increased heart rate and decreased autonomic flexibility (Ottaviani et al., 2015). Thus, these findings indicate that momentary rumination is also an important vulnerability factor for depressive symptoms independent of the experience of life stress. Indeed, given extensive research demonstrating the negative effects of ruminating about one's depression, it is likely that the effects of momentary rumination would be exacerbated when concurrently experiencing down mood (Wisco & Nolen-Hoeksema, 2008). Focused examination of the relationship between current mood state and momentary rumination in predicting subsequent depressive symptoms is needed.

Together, this research emphasizes the need to examine the relationships between rumination, life stress, and depressive symptoms as they occur in real-time utilizing EMA techniques. The use of this methodology is important for several reasons. First, EMA assessment is less likely to fall victim to recall biases in which individuals provide inaccurate retrospective reports of rumination levels or stress. Second, these designs capture stress and ruminative processes in a natural setting, versus in structured laboratory paradigms, which may not generalize to real-world experiences. Third, the use of EMA results in many data points, allowing for examination of temporal relationships as well as providing increased confidence in the reliability of the data (Armey, Schatten, Haradhvala, & Miller, 2015; Shiffman, Stone, & Hufford, 2008; Stone et al., 1998; Wenze & Miller, 2010). Furthermore, it has been demonstrated that rumination levels fluctuate over time and are modestly stable at best, suggesting that trait measures may not accurately capture the phenomenology of this construct (Moberly & Watkins, 2008a; Takano & Tanno, 2011).

1. Current study

The current study sought to build on previous findings by utilizing an EMA design to assess the role of both momentary ruminative self-focus irrespective of proximal stressors (e.g., *Right now, I am thinking about the possible meaning of the way I feel*) and stress-reactive rumination in response to stressor occurrence (e.g., *I'm thinking about how the stressful event is all my fault*) in predicting depressive symptoms over time. Participants responded to text message alerts on their smartphones four times a day for one week, in which they indicated the occurrence of life stressors, their degree of engagement in SRR directly after event occurrence, and their current mood state and level of momentary ruminative self-focus regardless of whether a stressor was reported. The SRR and MRS measures were derived from the validated SRRS and MRSI questionnaires, respectively. Trait measures of rumination and depression also were collected at a baseline session.

It was hypothesized that observation-level increases in both MRS and SRR relative to individuals' mean levels would independently predict increases in depressive symptoms, and that individuals with higher mean levels of MRS and SRR across the EMA week would display greater increases in depressive symptoms. In addition, MRS was hypothesized to interact with depressive symptoms at the same timepoint to predict increases in subsequent symptoms, given established deleterious effects of ruminating about one's depressed mood. Significant interactions were hypothesized to emerge between stressor occurrence and both state-level MRS and SRR in predicting increases in depressive symptoms over time. Finally, in accordance with response styles theory, it was hypothesized that significant interactions would emerge between trait measures of rumination collected at baseline and the experience of stress during the EMA week in predicting prospective increases in depressive symptoms.

The present EMA study is the first to examine both momentary ruminative self-focus and stress-reactive rumination within the same design, and is the first to derive its momentary rumination items directly from the SRRS and MRSI questionnaires in order to best assess these constructs. Furthermore, previous depressive symptoms serve as controls in all analyses, allowing for truly prospective tests of increases in depressive symptoms. It is important to note that previously conducted EMA and daily diary studies either did not control for depressive symptoms at the previous observation (Genet & Siemer, 2012; Moberly & Watkins, 2008a; Takano & Tanno, 2010) or their effects were no longer significant when doing so (Ruscio et al., 2015), precluding interpretations that momentary rumination predicted relative increases in depressive symptoms over time, and thus, highlighting a necessary area of further study.

The current design allows for a thorough examination of rumination's contribution to temporal changes in depressive symptoms, both independently and in interaction with current mood and stress, during participants' daily functioning outside of the laboratory. Findings from this research not only will serve to better characterize the nature of ruminative thought patterns, but also will help to identify the ways in which rumination contributes to depressed mood, allowing for more targeted interventions with the ultimate goal of alleviating depressive symptoms.

2. Method

2.1. Participants

One hundred twenty-two undergraduate and graduate students