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Rumination as a Mediator and Moderator of the Relationship between Unpleasant Events and Unhappy Mood: A Daily Diary Study

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Abstract

Research is lacking on whether and how stressful events trigger ruminative episodes and whether and how rumination, in turn, exerts a perpetuating influence on negative mood on a daily basis. To answer these questions, an experience sampling study was conducted with 101 undergraduate students who reported momentary unpleasant events, rumination, and unhappy mood once a day for 30 days. Our findings showed, as expected, that daily rumination mediated the relationship between daily unpleasant events and daily unhappy mood. A significant daily moderation finding was also obtained: rumination exacerbated reports of unhappy mood under low levels of unpleasant events. Day to day stability was noted for momentary rumination and unhappy mood, and these two variables also exhibited a weak bidirectional relationship over contiguous days. And finally, a moderated mediation analysis showed that individuals who reported high trait rumination evidenced a stronger indirect effect in the daily mediation pattern. The new findings suggest that: 1) rumination functions as a daily mediator and moderator of the basic stress to depression relationship; 2) rumination perpetuates negative mood over time; and 3) rumination is a stronger predictor of negative mood from day to day than stressful events. These findings illuminate how psychopathological interpretations of day to day life experiences can lead to negative mood states in a community sample.

Keywords: Unpleasant events; Rumination; Unhappiness; Experience sampling methodology; Mediation; Moderation

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Rumination: Mediator, Moderator, or Both?

Rumination, the act of repetitively focusing on one's negative emotional state as well as the causes and consequences of that negative state, has been found to not only exacerbate and prolong negative affect, but also to increase the risk of onset and duration of depressive episodes (e.g., Abela & Hankin, 2011; Joorman & Siemer, 2011; Nolen-Hoeksema, 1987, 1991; Nolen-Hoeksema, Wisco & Lyubomirsky, 2008) [1-5]. Rumination has also been associated with suicidal ideation, anxiety symptoms, bulimic behaviour, substance abuse, increased heart rate, elevated cortisol levels, hypertension, and heightened immune system responses (Brosschot, Gerin & Thayer, 2006; Nolen-Hoeksema, 2000; Nolen-Hoeksema, Stice, Wade & Bohon, 2007) [6-8]. Most

of the research on rumination has focused on simple two-variable relationships. For example, an extensive line of research has demonstrated significant relationships between rumination and depression in adult and adolescent samples (e.g., Abela & Hankin, 2011; Nolen-Hoeksema & Morrow, 1991; Nolen-Hoeksema, Parker & Larson, 1994) [1, 9, 10]. Early studies investigating people who experienced natural disaster (Nolen-Hoeksema & Morrow, 1991) [9] or bereavement (Nolen-Hoeksema et al., 1994) [10] reported that individuals who reported higher levels of rumination experienced more severe and longer durations of negative mood. As helpful as this research has been, an important question can be asked here: what triggers rumination? If rumination can be conceptualised as a maladaptive coping strategy (Jose & Brown, 2008; Nolen-Hoeksema & Girgus, 1994) [11, 12] that is employed by some individuals to ineffectively cope with stressful events,

then we can posit a mediation triangle in which stress functions as the independent variable, rumination operates as the mediator, and negative mood stands as the outcome variable. Following the methods of Folkman, Lazarus, Dunkel-Schetter, DeLongis and Gruen (1986) [13] and others (e.g., Michl, McLaughlin, Shepherd & Nolen-Hoeksema, 2013) [14], we chose in the present study to examine whether rumination functioned as a mediating mechanism between stressful life events and negative affect.

Another important empirical question to ask is whether rumination moderates the relationship between life events and negative affect. Nolen-Hoeksema and Girgus (1994) [12] have suggested a stress-diathesis model of depression, in which the interactions between stress and predisposing risk factors such as rumination and low levels of perceived control, could maintain or increase levels of negative affect. Similarly, Cole and Turner (1993) [15] proposed testing a stress-diathesis model of depression using moderation, in which rumination was treated as a moderator of the relationship between negative life events and depression. Delving into the literature on rumination as a moderator, the findings are mixed. While Weir and Jose (2008) did not find that rumination moderated the relationship between stress and depressive symptoms, Kraaij et al. (2003) [16] reported that rumination significantly moderated the relationship between stress and depression in an adolescent sample. In their multiwave longitudinal study involving 382 adolescents aged 11 to 15 years, Abela and Hankin (2011) [1] found a significant moderation effect for rumination, indicating that adolescents with higher levels of rumination reported higher levels of depressive symptoms after experiencing high levels of unpleasant events.

The Use of Diary Methodology to Study Within-Person Covariation

Much of the work examining rumination and negative affect has assessed between-person or group comparisons in single occasion or cross-sectional datasets; however, these analyses fail to capture the experiences of individual persons over time (Aan het Rot, Hogenelst & Schoevers, 2012; Cervone, 2005) [17]. Bolger, Davis and Rafaeli (2003) [18] have proposed that a daily diary methodology is a useful way to capture the nature of within-person covariation, given that the daily diary methodology allows for within-person analyses of intra-individual associations (i.e., between-person analyses of differences between groups in these intra-individual patterns). Since rumination is described as a dynamic process that changes over time, a daily diary study methodology would seem to be especially appropriate for the moment-to-moment examination of ruminative responses as they happen in everyday emotional contexts and settings (Moberly & Watkins 2008a; Shiffman & Stone, 2008) [19, 20].

Several studies have used a diary methodology to examine the relationships among life stress, rumination, and negative affect. Nolen-Hoeksema, Morrow, and Fredrickson (1993) [21] assessed participants' daily reports of depressed mood and ruminative responses across 30 days. Consistent with their hypothesis, rumination predicted the duration of depressed mood. However, the diary reports were averaged across all days, and findings were based on between-person rather than within-person

associations. They did not take full advantage of the nature of this diary-based dataset, as we tried to do in the present study. Moberly and Watkins's (2008a) [19] study represents the first study that effectively examined momentary rumination and negative affect in daily life. Their findings suggested that momentary rumination was highly associated with negative affect, and that high levels of depressive symptoms exacerbated the relationship between rumination and negative mood. While Moberly and Watkins's (2008a) [19] study yielded several new results, the week-long sampling period employed in their study was relatively short and might not have adequately captured the full picture of participants' day-to-day emotions and regulation strategies. The present study obtained samples once a day for a 30-day period. Another paper by Moberly and Watkins in the same year (2008b) [22] reported that momentary rumination significantly mediated the relationship between prior negative events and daily negative affect. Also, using a retrospective daily diary design, Genet and Siemer (2012) [23] also found that rumination significantly mediated the effects of unpleasant daily events on negative mood.

Few studies, however, have examined the *moderation* model of the impact of momentary rumination and unpleasant life events on mood, namely does the use of daily rumination *exacerbate* the effects of unpleasant daily events on mood? In their retrospective diary study, Genet and Siemer (2012) [23] provided support for the moderation hypothesis: daily use of rumination exacerbated reports of unhappy mood under the condition of high levels of unpleasant events, and the moderation effect was maintained even when individual differences in the depressive symptoms and trait rumination were controlled. Moberly and Watkins (2008b) [22] examined whether trait rumination would moderate the impact of negative events on negative affect, and they found that participants who reported high levels of rumination evidenced greater negative affect than those who reported low levels of rumination.

The Present Study

In the current study, we aimed to build on and extend these previous findings with rumination by employing an experience sampling design (ESM). ESM involves obtaining self-reports from individuals at multiple random time points during their everyday life (Hektner, Schmidt & Csikszentmihalyi, 2007; Mehl & Conner, 2012) [24, 25]. A particular strength of ESM is that reporting biases inherent in retrospective studies (e.g., selective memory and social desirability) are minimised by getting participants to record their unpleasant daily hassles, ruminative thinking, and negative affect in real time at a randomly selected moment, rather than at the end of each day (i.e., retrospective recall). In addition, we operationalised rumination both as a stable, trait-like tendency and as momentary state-like emotion regulation behaviour. By doing so, we were able to investigate whether trait rumination exerted a moderating impact on momentary emotion regulation processes occurring at the daily level. Using this methodology, we proposed six hypotheses for the present research:

1. In line with previous research, we expected that momentary reports of unpleasant events, rumination, and unhappy mood would all be significantly and positively associated with each other.

2. A previously unexamined question in the literature is whether momentary reports of these variables would exhibit more or less stability from day to day. We predicted that momentary reports of rumination and unhappy mood would manifest reasonable stability from a given day to the next day as these constructs have been found to exhibit trait-like characteristics, but reports of unpleasant events, due to their uncontrollable and exogenous nature, were not expected to manifest stability from day to day.
3. In addition, several cross-lagged relationships were expected in these day-to-day analyses. First, rumination on a given day was expected to predict higher reports of residualised unhappy mood on the subsequent day as rumination has been shown to exert a perpetuating influence on depressive symptoms over time (Nolen-Hoeksema, 1991) [9]. We thought that it was also likely that unpleasant events might trigger higher levels of a residualised ruminative response on the following day.
4. The central prediction of the current study, which would replicate previous reports, was that momentary rumination would mediate the relationship between momentary reports of unpleasant events on momentary unhappy mood (using the analytic method recommended by Bauer, Preacher and Gil (2006); Hayes (2013) and Jose (2013)) [26, 27, 28].
5. We also expected to find day-level moderation effects for momentary rumination on the relationship between unpleasant events and unhappy mood. Specifically, consistent with findings by Genet and Siemer (2012) [23] and Moberly and Watkins (2008b) [22], we predicted that momentary rumination would exacerbate the relationship between negative events and unhappy mood.
6. And last, we proposed another novel hypothesis, namely, we expected to find Level 2 moderation by trait rumination of the mediation relationship presumed to exist among the three Level 1 variables (i.e., Hypothesis 4). We hypothesized that individuals reporting higher trait rumination would manifest a stronger mediation relationship on the daily level (this type of analysis is known as ‘moderated mediation’; Hayes (2013) and Jose (2013)) [27, 28].

Method

Participants

One hundred and one participants (29 males and 72 females) whose age ranged from 17 to 53 years old ($M = 21.50$ years; $SD = 5.91$) participated in the study. The majority of the participants were European New Zealanders, and the sample also included small numbers (< 10%) of Maori, Pacific Islander, Asian New Zealanders, and those who classified their ethnicity as ‘Other’. The participants were recruited via flyers and posters around the university campus and through Student Job Search, a local recruitment agency specifically catering to students. Following APA rules of ethical research conduct, written informed consent was obtained prior to the study, and participants were reimbursed

NZ\$50 worth of vouchers upon the completion of the study requirements.

Daily Mood Diary Measures

Momentary unpleasant events

Three dimensions were measured for unpleasant events: frequency, intensity, and impact. The questions asked were “How many unpleasant events happened to you in the last hour?”, “How intense were the unpleasant events?”, and “How much impact did the unpleasant events have?” For the frequency and impact questions, response options ranged from 0 (*none*) to 4 (*a lot*). Intensity was also measured with a five-point Likert scale, but with slightly different labels: 0 (*not*) to 4 (*very*). A composite variable “*unpleasant events*” was created to encompass the event frequency, intensity, and impact information by linearly combining these three items. To obtain a measure of internal consistency reliability, we computed occasion-specific Cronbach’s alphas (one for each of the 30 days), and found the median alpha to be .87 with a minimum of .79 and a maximum of .93. The size of these reliabilities justified averaging across these three items at each time point, and subsequently in this paper we use the term “momentary unpleasant events” for this composite variable.

Momentary rumination

Three items modelled on brooding rumination items from Nolen-Hoeksema et al.’s (1993) [21] Response Style Questionnaire were used to measure state rumination. The items used were “I thought that I wasn’t doing a good job of dealing with these events”, “I thought that I was hopeless in trying to cope”, and “I blamed myself for not doing a better job of coping”. All items were rated on a five-point Likert scale (0 = “*disagree*” and 4 = “*agree*”). As above with unpleasant events, to obtain a measure of internal consistency reliability for rumination, we computed occasion-specific Cronbach’s alphas for the 30 days, and obtained a median alpha of .91 with a minimum of .77 and a maximum of .99. As with unpleasant events, we averaged across these three rumination items at each time point, and in this paper we refer to this composite variable as “momentary rumination.”

Momentary unhappy mood

Participants responded to three items that sought to capture a sense of unhappiness: “I felt unhappy”, “I felt like my life was going badly”, and “I felt bad” on a 5-point Likert scale with 0 = not at all and 4 = a lot. Again, to obtain a measure of internal consistency reliability for unhappy mood, we computed occasion-specific Cronbach’s alphas for the 30 days, and obtained a median alpha of .92 with a minimum of .81 and a maximum of .97. As with the other daily variables, we averaged across these three outcome items at each time point, and in this paper we refer to this composite variable as “momentary unhappy mood.”

Trait Measures

Participants were asked to complete the set of questionnaires twice, once before the diary study commenced and then once again after the mood diary study finished thirty days later. For the

purpose of this study, participants' self-reported scores on the rumination and depression scales were averaged across the pre-test and post-test to yield an average score.

Trait depression

A shortened version (12 items) of the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock & Erbaugh, 1961) [29] was used to assess depressive symptoms. The items were rated on a scale from 0 to 3, with higher scores indicating higher level of depressive symptoms. The shortened BDI scale yielded Cronbach's alphas of .88 and .89 at the two time points. This average score was used as a Level 2 covariate of the Level 1 moderation analysis reported below.

Trait rumination

A shortened version (11 items) of the rumination response subscale of the Response Styles Questionnaire (RSQ; Nolen-Hoeksema, 1991) [9] was used. The RSQ was designed to measure an individual's frequency of rumination about their depressive symptoms or the causes and results of the depressed mood. The scale as it was used in the present study included mostly depression-related rumination items, e.g., "Think 'I won't be able to do my job if I don't snap out of this'", two reflection rumination items, e.g., "Go away by yourself and think about why you feel this way", and two brooding rumination items, e.g., "Think 'what am I doing to deserve this?'". Participants rated their responses on a 5-point Likert scale (1 = *never* to 5 = *always*) with higher scores indicating higher levels of rumination. In adult samples, the RSQ has demonstrated good internal reliability as well as good predictive validity of depressive symptoms (Nolen-Hoeksema, 2000) [7]. Following the advice of Treynor, Gonzalez and Nolen-Hoeksema (2003) [30], efforts were made here to isolate the brooding and reflective rumination items and use these groupings as separate subscales, but at both time points two items proved to be too few to establish statistical reliability. Instead, the entire scale was utilised, and in this sample, the shortened scale yielded high internal reliability at both time points ($\alpha = .87, .88$).

Procedure

Prior to the study, participants attended an information session in which they were provided with the web addresses to access the online mood diary as well as the pre-test and post-test assessments of trait rumination. After completing the pre-test, participants completed the on-line mood diary once a day for 30 consecutive days. Participants were prompted to fill out their mood diary by a short text message sent to their cellphones by a research assistant on a random time schedule between 8 a.m. and 8 p.m. once a day. The on-line daily mood diary recorded the date and time participants provided their responses, and this data informed us whether the participants entered their data in a timely fashion. About 90% of entries were made within ten minutes of the text message being sent. The overall response rates were 92.6% (2805 diary entries were completed out of a possible 3030), and on average, participants completed 27.8 out of 30 diary entries. At the end of the 30 days of diary entry, participants completed the on-line measure of trait rumination

again. After performing this last action, participants were then compensated for their time of participation and debriefed.

Statistical Analyses: Multilevel Modelling

In our daily diary data, the level of days (Level 1) was nested within persons (Level 2). Due to the nested two-level nature of the data, we conducted multilevel random coefficient models (MRCM) using Raudenbush, Bryk, and Congdon's (2004) [31] Hierarchical Linear Modeling software (Version 6.06). HLM addresses both levels in a hierarchically nested data set (i.e., in this case, days nested within individuals) simultaneously without violating the assumptions of independence and models them at the higher level (between persons) as a random effect using maximum likelihood estimation. Nezlek (2001) [32] for a comprehensive description of the MRCM approach for diary data.

Descriptive Statistics and Reliability of Daily Measures

Descriptive statistics and reliability coefficients of all the variables (i.e., ratio of the true to total variance of an effect) are presented in **(Table 1)**. These statistics were provided by an unconditional or null model of each variable (i.e., no terms other than intercepts are included in the model) (Nezlek, 2001) [32]. The basic equation used was:

$$\text{Level 1 (within-person): } Y_{ij} = \beta_{0j} + r_{ij}$$

In which Y_{ij} refers to a daily measure of unpleasant events, rumination, or unhappy mood for participant j on day i , β_{0j} is a random coefficient representing the mean of Y for participant j , and r_{ij} refers to the error associated with each measure and the variance of r_{ij} constitutes the within-person error variance. The statistical values reported in **Table 1** indicate that all of the daily measures were reliable.

Results

Within-Person Covariation of Momentary Reports of Unpleasant Events, Rumination, and Unhappy Mood

Guided by our mediation hypothesis, the basic within-person models we constructed were:

$$\text{UnhapMood}_{ij} = \beta_{0j} + \beta_{1j}(\text{UnPleasEv}) + r_{ij}$$

$$\text{Rum}_{ij} = \beta_{0j} + \beta_{1j}(\text{UnpleasEv}) + r_{ij}$$

$$\text{UnhapMood}_{ij} = \beta_{0j} + \beta_{1j}(\text{Rum}) + r_{ij}$$

For these equations, β_{0j} represents the intercept for a participant's mean of unhappy mood (or rumination) on a given day, β_{1j} represents the maximum likelihood estimate of the population slope relating the independent variable to the dependent variable, and r_{ij} refers to error associated with the outcome measure.

Consistent with Hypothesis 1, we found that unpleasant events significantly predicted variance in daily negative affect (UnhapMood), $B = .64$, $se = .04$, $p < .001$, rumination was found to significantly predict negative affect, $B = .15$, $se = .01$, $p < .001$, and unpleasant events were significantly and positively associated with rumination, $B = .20$, $se = .009$, $p < .001$, suggesting that all

Table 1 Descriptive Statistics and Reliability of Negative Daily Measures.

Negative Daily Measures					
Level 1 Variables	Mean	Within-Person Variance	Between-Person Variance	Reliability	Intra-class Correlation
Momentary Unpleasant Events	0.87	0.87	0.41	0.83	0.32
Momentary Rumination	1.61	0.82	0.53	0.90	0.39
Momentary Unhappy Mood	1.98	1.14	0.55	0.84	0.33

Note: Reliability estimates are routinely provided by HLM, and are defined as true variance divided by total variance. Intraclass correlation = proportion of the total variance accounted for by between-individual differences (i.e., Level 2 variance). It is calculated by using the formula: Level 2 variance / (Level 1 + Level 2 variance).

three variables co-varied significantly and positively with each other within a given day.

Within-Person, Cross-Lagged Relationships between Yesterday's and Today's Reports of Unpleasant Events, Rumination, and Unhappy Mood

We conducted lagged-day analyses to establish the predictive relationships between unpleasant events, rumination, and unhappy mood from one day to the next. HLM equations were constructed to predict a given day's (Day 2) unpleasant events, rumination, and unhappy mood from the previous day's (Day 1) unpleasant events, rumination, and unhappy mood. For example, the HLM equation we used to predict Day 2's Unhappy Mood was:

$$\text{UnhapMood2}_{ij} = \beta_{0j} + \beta_{1j}(\text{UnpleasEv1}) + \beta_{2j}(\text{Rum1}) + \beta_{3j}(\text{UnhapMood1}) + r_{ij}$$

We performed three analyses on the single day-lagged data: all three Day 1 variables predicted in turn the same three variables one day later. We first examined the lagged-day stabilities of the three variables. As shown in (Table 2), unhappy mood showed significant stability over one day's time, $B = .12$, $se = .04$, $p = .004$. Rumination manifested marginally significant stability from Day 1 to Day 2, $B = .08$, $se = .05$, $p = .08$, while unpleasant events did not manifest significant stability across days, $p > .05$. Consistent with Hypothesis 2, these results suggest that rumination was weakly stable, unhappy mood was relatively stable from one day to the next, but the construct of unpleasant events was not stable, $B = .005$, $se = .03$, $p = .88$.

In these analyses, two other marginally significant cross-lagged findings were observed: Unhappy mood on Day 1 positively predicted rumination on Day 2, $B = .13$, $se = .07$, $p = .05$, and rumination on Day 1 also positively predicted unhappy mood on Day 2, $B = .03$, $se = .02$, $p = .06$. These results suggest that unhappy mood and rumination exhibited a weak bi-directional relationship over contiguous days. Hypothesis 3 stipulated that rumination would predict an increase in unhappy mood over time, and this prediction was marginally supported. However, the predicted effect of unpleasant events on one day to rumination on the next day was not obtained, $B = -.11$, $se = .10$, $p = .28$, nor did we anticipate that unhappy mood would predict an increase

in rumination over time. Thus, Hypothesis 3 was supported only to some degree.

Another set of HLM equations, similar to the analyses described above, were constructed to examine whether these three variables exhibited stability over two days' time. Rumination manifested significant stability from Day 1 to Day 3, $B = .10$, $se = .04$, $p = .006$, and a similar level of stability was observed for unhappy mood, $B = .12$, $se = .04$, $p = .004$. These results suggest that rumination and unhappiness, measured on a daily basis, displayed greater stability than reports of unpleasant events.

Rumination as a Mediator between Unpleasant Events and Unhappy Mood

It is possible to examine a Level 1 variable as a potential mediator between a Level 1 predictor and a Level 1 outcome in multilevel modelling (Jose, 2013) [28]. Next we investigated Hypothesis 4, namely the expectation that rumination would function as a mediator between unpleasant events and unhappy mood on a daily basis (all Level 1 variables). When the relationships between three variables all residing at Level 1 (what is termed a 1-1-1 mediation model) are examined, the predictive effects can all be treated as random rather than fixed (MacKinnon, 2008) [33]. Multilevel analysis allows for accurate estimation of the day-level effects by appropriately handling the dependencies or similarities among responses from days within individuals. We adopted Bauer, Preacher and Gil's (2006) [26] approach to assess random effects at Level 1. The first step involved determining whether all three Level 1 variables, namely daily unpleasant events, daily rumination, and daily unhappy mood, were significantly related to each other. Separate regressions were conducted to verify the relationships among the three Level 1 variables (see the results above under within-person covariation of unpleasant events, rumination, and unhappy mood).

Adopting the method proposed by Bauer et al. (2006) [26], the random indirect effect was estimated to be 0.05 and the random total effect was estimated to be 0.27; thus, the indirect effect accounted for about 19% of the total effect. Our proposed mediation pattern was found to be statistically significant because the 95% confidence interval did not encompass the value of zero

Table 2 Lagged Day Analyses.

Outcomes	Predictors (Day 1)	b	se	p	Predictors (Day 2)	b	se	p
UNPLE2	UNPLE1	0.02	0.04	ns	UNPLE2	---	---	---
	RUM1	0.02	0.01	ns	RUM2	0.08	0.01	< .001***
	UNHAP1	0.03	0.03	ns	UNHAP2	0.44	0.03	< .001***
UNPLE3	UNPLE1	0.03	0.03	ns	UNPLE2	0.01	0.04	ns
	RUM1	0.02	0.01	ns	RUM2	0.01	0.01	ns
	UNHAP1	0.01	0.02	ns	UNHAP2	0.02	0.03	ns
RUM2	UNPLE1	-0.08	0.11	ns	UNPLE2	0.80	0.12	< .001***
	RUM1	0.08	0.05	.08~	RUM2	---	---	---
	UNHAP1	0.13	0.07	.05~	UNHAP2	0.89	0.10	< .001***
RUM3	UNPLE1	-0.01	0.09	ns	UNPLE2	-0.13	0.11	ns
	RUM1	0.10	0.04	.006**	RUM2	0.07	0.04	ns
	UNHAP1	-0.02	0.07	ns	UNHAP2	0.13	0.07	.06~
UNHAP2	UNPLE1	-0.05	0.04	ns	UNPLE2	0.65	0.04	< .001***
	RUM1	0.03	0.02	.06~	RUM2	0.14	0.01	< .001***
	UNHAP1	0.12	0.04	.004**	UNHAP2	---	---	---
UNHAP3	UNPLE1	-0.05	0.04	ns	UNPLE2	-0.05	0.04	ns
	RUM1	0.03	0.02	.04*	RUM2	0.02	0.01	.08~
	UNHAP1	0.12	0.04	.004**	UNPLE2	0.10	0.04	.007**

Note: All values represent unstandardized regression coefficients. UNPLE = unpleasant events; RUM = rumination; UNHAP = unhappiness. 1 = Day 1; 2 = Day 2; and 3 = Day 3. *** $p < .001$; ** $p < .01$; * $p < .05$; ~ $p < .10$

(95% CI = .04 to .07). Hypothesis 4 was thus supported: Daily rumination was found to significantly mediate the relationship between daily unpleasant life events and daily unhappy mood.

Rumination as a Moderator of the Relationship between Unpleasant Events and Unhappy Mood on a Daily Basis

Using HLM, we wished to examine our moderation hypothesis among the Level 1 variables. Specifically, we expected to find that rumination exacerbated the unpleasant events to unhappy mood relationship. We centered all the predictor variables before creating the interaction terms, and we entered trait rumination and trait depression as Level 2 covariates of the Level 1 moderation (following the approach of Genet and Siemer, 2012) [23]. We constructed the following Level 1 HLM equation to address the present question:

$$\text{UnHapMood}_{ij} = b_0j + b_1j(\text{UnpleasEv}) + b_2j(\text{Rum}) + b_3j(\text{UnpleasEv} \times \text{Rum}) + r_{ij}$$

We found a significant main effect for unpleasant events, $\beta = .81$, $se = .06$, $p < .001$, a significant main effect for rumination, $\beta = .19$, $se = .02$, $p < .001$, and a significant interaction between unpleasant events and rumination, $\beta = -.028$, $p = .01$, $p = .001$, in explaining the variance in unhappy mood. The interaction was graphed and is presented in **Figure 1**. All simple slopes were significantly different from zero: low rumination, slope = .72, $t(94) = 25.31$, $p < .001$; medium rumination, slope = .67, $t(94) = 31.56$, $p < .001$; and high rumination, slope = .62, $t(94) = 23.12$, $p < .001$. These slopes show that the relationship between unpleasant events and unhappy mood was positive and significant under all levels of rumination. Of the three groups described in the figure, high ruminators tended to be

consistently unhappy across all degrees of unpleasant events, whereas low ruminators were differentially unhappy depending on the degree of unpleasant events. Specifically, the exacerbating effect was most evident when the degree of unpleasant events was low: under these circumstances, high ruminators reported high unhappiness whereas low ruminators reported considerably less unhappiness. All three moderation groups reported about the same amount of unhappiness under the circumstance of high unpleasant events. We predicted that high ruminators would manifest stronger relationships between negative life events and unhappy mood, and this result was not obtained. However, we considered Hypothesis 5 to be partially supported because rumination exacerbated unhappy mood under the condition of low unpleasant events.

Trait Rumination at Level 2 as a Moderator on the Mediated Relationship between Unpleasant Events, Rumination, and Unhappy Mood at Level 1

Given evidence of significant mediation by rumination between unpleasant events and daily unhappy mood, the last question to be addressed was whether trait rumination (at Level 2) might have explained some of the variability in this mediation relationship. Our prediction was that the Level 2 moderator of trait rumination (W) would significantly strengthen the mediation relationships between daily unpleasant events (X) and daily rumination (M), i.e., path a, and between daily rumination (M) and daily negative effect (Y), i.e., path b (**Figure 2**). We adopted the suggestions put forward by Bauer et al. (2006) to examine whether moderated mediation would be obtained across the two levels of data. As shown in the findings under Hypothesis 4, we found evidence of significant random effects for the mediation

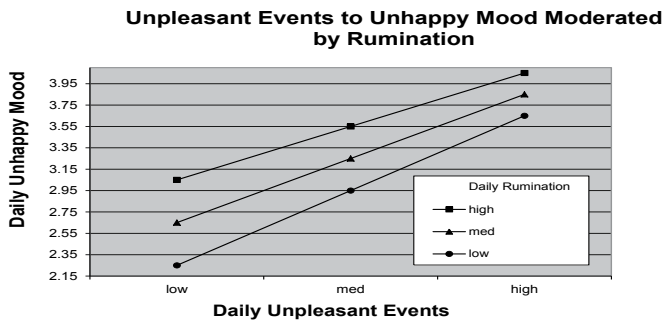


Figure 1 Daily unhappy mood as a function of daily unpleasant events and daily rumination.

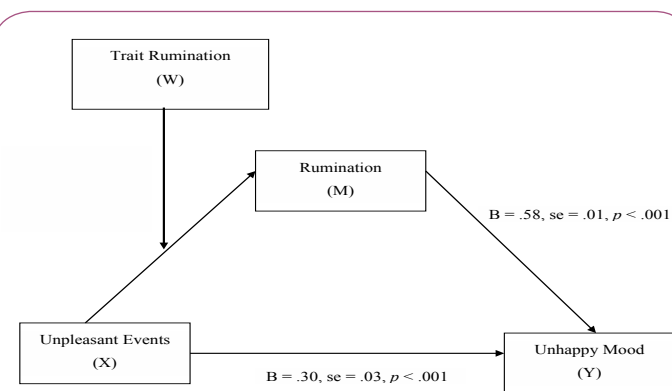


Figure 2 Depiction of Level 2 trait moderation of the Level 1 mediation.

at Level 1, and we aimed to add a Level 2 factor to the model to explain further variance. According to Bauer et al., significant prediction of either a_j or b_j by a Level 2 moderator would indicate significant moderated mediation, in which the strength of the indirect relationship of the Level 1 predictor depends on the Level 2 moderator. We added trait rumination (Level 2) to the 1-1-1 mediation model, and we found that trait rumination significantly moderated the a_j component of the mediation, $p < .01$, providing support for Hypothesis 6. Simple effect analyses revealed that the a_j of the mediation was strengthened under conditions of high levels of trait rumination (low = 1.25, $se = .14$; medium = 1.43, $se = .09$; high = 1.61, $se = .12$).

Discussion

The present study aimed to replicate and extend past empirical findings concerning how rumination is related to stressful events and negative mood. As expected, we found significant and positive associations among momentary reports of unpleasant events, rumination, and unhappy mood. An investigation of day-to-day stability of the three constructs showed that momentary reports of rumination and unhappy mood evidenced reasonable stability from one day to the next, but, as expected, unpleasant events did not demonstrate the same level of stability. Additionally, we found a significant bi-directional cross-lagged relationship between rumination and negative mood, but we did not find the anticipated link between unpleasant events to rumination over contiguous days. Two central predictions of the current study

were that momentary rumination would mediate and moderate the relationship between unpleasant life events and unhappy mood, and both of these predictions were supported. And finally, we obtained empirical support for our moderated mediation prediction such that trait rumination was found to significantly moderate the momentary mediation relationship demonstrated among daily unpleasant events, rumination, and unhappiness. We will now discuss each finding in turn within the context of existing literature.

Rumination is a well-established risk factor for emotional disorders; the precipitating factor leading to rumination, however, is less well understood. Jose and Brown (2008) [11] and Michl et al. (2013) [14] have proposed that the occurrence of stressful events could trigger an increased tendency to engage in ruminative thinking. In particular, Michl et al. have found that self-reported exposure to stressful life events predicted increased use of rumination in two separate longitudinal samples of early adolescents and adults. Experience sampling studies have also demonstrated significant relationships among momentary stressful events, rumination, and negative affect (Moberly & Watkins, 2008a; Mor et al., 2010) [19, 34]. Consistent with these studies, we found that momentary reports of unpleasant events, rumination, and unhappy mood were positively related to each other within a given day.

The direction and strength of these momentary relationships from one day to the next has not been examined previously, so to elucidate these important phenomena we chose to conduct stability and cross-lagged analyses on our day-lagged momentary unpleasant events, rumination, and unhappy mood data. Consistent with our second hypothesis, both rumination and unhappy mood were relatively stable across successive days, but unpleasant events did not manifest day-to-day stability given its uncontrollable and exogenous nature. We also found that rumination and unhappy mood, but not unpleasant events, evidenced significant stability over a two-day period, so the findings suggest relative stability of these two constructs over time. Examination of cross-lagged relationships over time allowed us to obtain a picture of how these variables affected each other from day to day. We found two marginally significant cross-lagged findings: unhappy mood on a given day positively predicted rumination one day later, and rumination on a given day positively predicted unhappy mood one day later, thus suggesting the existence of a weak bidirectional relationship over contiguous days. This pattern is consistent with Moberly and Watkins' (2008a) [19] finding of a bidirectional relationship between momentary rumination and negative mood, conforming to a downward spiral pattern in which the alternating effect of rumination and negative mood on each other is seen to degrade the person's mood. Although we predicted that the occurrence of stressful events on a given day would trigger more rumination on the following day, we obtained no empirical support for this contention. Taken together these results suggest that intrapsychic dynamics (i.e., rumination) may be more important in the perpetuation of poor mood than influences originating outside of the person (i.e., stressful events). This view would be consistent with the cognitive approach to emotional disturbance (e.g., Clark & Beck, 2010) [35] pointing to the importance of

enduring and stable response and interpretation processes, rather than transitory content of experience, in the aetiology and maintenance of psychological disturbances.

Another approach commonly used to examine the relationships among these three variables is statistical mediation. A number of studies have showed that daily or state rumination mediates the effects of unpleasant daily events on negative mood (e.g., Genet & Siemer, 2012; Hatzenbuehler, Nolen-Hoeksema & Dovidio, 2009; Moberly & Watkins, 2008b) [23, 36, 22], and we found confirmation of the same pattern in the present study. It is important to acknowledge, however, that the mediation analysis used here, as well as in previous studies, collapses across the various days' of data, and then examines amounts of shared variance among the three constructs. Although the results suggest the presence of a causal path beginning with stressful events, proceeding through ruminative thought, and ending with negative mood, in truth, this method does not well capture the day to day temporal influences among these three variables (compared to the day-lagged analyses). In a fashion, the analysis of mediation among these three Level 1 variables is similar to the analysis of three concurrent variables (sometimes called 'concurrent mediation') in a single occasion survey. Various authors (Jose, 2013; MacKinnon, 2008; Maxwell & Cole, 2007) [28, 33, 37] have warned against attributing causal influences to a concurrent mediation result, and the same caveat might apply in the present case as well.

Moderation, on the other hand, is not based on the same assumption of causal relationships among variables. To our knowledge, Genet and Siemer's (2012) [23] study was the first to show that daily use of rumination moderated the relationship between negative life events and unhappy mood, but they used a retrospective daily diary approach. Using a prospective experience sampling design, we found a significant moderation effect after covarying out individual differences in depressive symptoms and trait rumination, suggesting that high ruminators tended to be consistently unhappy across all conditions of unpleasant events while low ruminators' self-reported levels of unhappiness were more dependent on the number or degree of unpleasant events. In other words, the exacerbating effect of daily rumination was most evident under conditions of low levels of unpleasant events. This finding is inconsistent with Genet and Siemer's findings in that they found rumination to function as a traditional exacerbator, i.e., the slope for high ruminators was steeper than the slope for medium and low ruminators. In our case we found that the slope of the high rumination group was flatter than the other two groups.

How can we explain this discrepancy? We think it is important to acknowledge some important differences in the research measures used. While Genet and Siemer (2012) [23] measured use of rumination retrospectively at the end of six consecutive days, we investigated the moment-by-moment occurrence of ruminative thinking using real-time sampling once a day for 30 days. The possibility of reporting biases and distortions is widely acknowledged as a general limitation of retrospective reports (Aan het Rot et al., 2012; Levine & Safer, 2002) [17, 38]. An important advantage of the prospective experience sampling

approach used in our study is that rumination is an ongoing dynamic process that fluctuates over time, and therefore, it is important to capture how ruminative thinking unfolds over time in response to everyday events as they occur (Shiffman & Stone, 2008). Moberly and Watkins (2008a) found that reports of daily rumination tended to be higher in the morning and evening and lower at midday (a U-shaped diurnal variation pattern; Takano & Tanno, 2011) [39]. This pattern concurs with the clinical experience of depressed patients who describe their worst bouts of rumination upon waking and just before going to bed.

Another possibility is that our particular pattern may have resulted from a ceiling effect. The highest score someone could report for negative mood in the present study was 4.0, and (**Figure 1**) shows that all three high rumination groups under the condition of high unpleasant events were 'bumping their heads' against this ceiling. Genet and Siemer (2012) [23], in contrast, requested participants to indicate the extent to which they currently felt each of fifteen negative mood states using a seven-point rating scale (1 = *not at all* to 7 = *extremely*). Their corresponding figure indicated that the high rumination group only reached a score of about 3.0 under conditions of high stress, a pattern totally unaffected by a ceiling effect. We therefore conclude that although our specific moderation pattern varied in shape from the one obtained by Genet and Siemer, we are both likely glimpsing the same general exacerbating effect of rumination on the relationship between unpleasant events and negative mood. The ceiling effect in our data likely suppressed the exacerbating effect that Genet and Siemer noted under conditions of high stressful events, and we ended up finding the exacerbating effect under conditions of low stressful events instead. In both cases, however, we found that high rumination exerted a deleterious effect on the basic stressful events to negative mood relationship.

And last, a novel analytic approach used in the current study was the examination of whether trait rumination moderated the mediation pattern identified among the momentary variables. Moberly and Watkins (2008b) [22] performed a similar analysis by showing that trait rumination exacerbated the relationship between daily events and daily negative affect, with people who reported high levels of rumination manifesting a stronger relationship between greater negative affect and negative events. In our case, we were interested in whether trait rumination moderated the observed mediational relationship among momentary daily unpleasant events, rumination, and unhappy mood (i.e., moderated mediation). Our results provided novel evidence that the stress to rumination to depression mediation was strengthened under levels of high trait rumination, suggesting that people who are typically high ruminators are more likely to experience tighter associations among the three constructs of unpleasant life events, rumination, and unhappy mood in their daily lives.

Limitations

Although we believe that this present study advances the understanding of rumination and its impact on the stress to depression relationship, there are a number of caveats that need to be considered when interpreting our findings. One of

the limitations of the present study is we did not include the full scale of RSQ and hence, we were unable to assess the different subscales of the RSQ, namely brooding and reflection (Treyner et al., 2003) [30], and their relationships with the mood outcomes. Another limitation of our study relates to the operationalization of unhappy mood. For the current study, we focused primarily on the feeling of sadness or depression. Recent studies have shown that rumination acts as a transdiagnostic process in other negative mood states such as anxiety (McLaughlin & Nolen-Hoeksema, 2011) [40] and anger (Rusting & Nolen-Hoeksema, 1998) [41]. And third, we asked participants to think about unpleasant events that had happened in the previous one hour. This constraint probably prevented individuals from reporting unpleasant events that had happened since the last measurement point but that had occurred more than one hour before. Future studies would benefit from including an affect rating measure that encompasses high and low arousal negative affect (as in Genet & Siemer, 2012) [23], and broadening the recollection period of time to capture states and events over the previous 24 hours.

Clinical Implications

Past literature has contributed greatly to our understanding of rumination as a vulnerability factor for psychopathology. We believe that our findings extend the theoretical and clinical understanding of rumination in several ways. At the theoretical level, our significant mediation finding sheds light on the etiological pathway of rumination, suggesting that unpleasant life events may function as a risk factor for engagement in rumination. On the other hand, the day-lagged results failed to find a link between negative life events on a given day and rumination one day later. A shorter period of time between time points (e.g., as captured by Moberly and Watkins, (2008b) [22] may be the more appropriate lens to view the impact of stress upon ruminative thought. The moderation results provided strong support for the view that rumination functions as an exacerbator of the relationship between unpleasant events and unhappy mood. Knowing that rumination worsens this appraisal process has important clinical implications. Specifically, patients' relapse into depression after treatment poses a significant challenge as

current pharmacological and psychotherapeutic interventions seem insufficient to prevent these recurrent depressive episodes. Our results suggest that rumination is a promising target for intervention, and an example of a relevant intervention is metacognitive therapy (MCT; Wells, 2009) [42], a transdiagnostic approach that emphasises reducing perseverative negative thinking such as rumination and worry. Despite being a relatively new intervention, MCT has gained growing support for its efficacy in treating a number of mood disorders such as major depressive disorder and various anxiety disorders.

Conclusions

Rumination has been identified as an important risk factor for the development of emotional disorders and psychopathology (Aldao, Nolen-Hoeksema & Schweizer, 2010; Nolen-Hoeksema & Watkins, 2011) [43, 44], but surprisingly little is known about how people use this strategy in their daily lives. The present study aimed to better understand the role of momentary rumination in regulating emotions in daily life. As predicted, rumination was significantly related to stressful events and unhappy mood in concurrent analyses, and rumination mediated and moderated the relationships between negative life events and unhappy mood as well. The findings of our current study provide support to the cognitive theory of depression (Beck, 1976; Beck & Dozois, 2014) [45, 46], namely the view that life stressors do not invariably lead to negative affect in and of themselves, but rather the individual's cognitive appraisals of life stressors (e.g., rumination) and their habitual use of these emotion regulation strategies (e.g., trait rumination) seem to be critical in determining emotional outcomes. The better we understand how individuals employ ruminative thought in their everyday lives, hopefully the better able we will be in interrupting this counterproductive dynamic.

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