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BRIEF ARTICLE



## Attention to negative words predicts daily rumination among people with clinical depression: evidence from an eye tracking and daily diary study

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### ABSTRACT

The present study examined relationships between attention to negative words and daily rumination and daily adjustment in a sample of clinically depressed individuals. We recorded eye movements of 43 individuals diagnosed with major depression while they were freely viewing dysphoric, threat-related, neutral, and positive words. Then, each day for one week, participants provided measures of their daily rumination and psychological adjustment. Multilevel analyses found that attention to dysphoric and threat-related words was positively related to daily rumination and attention to threat-related words was negatively related to daily adjustment. These findings suggest that the impaired ability to disengage from negative words is positively related to rumination in daily life and is negatively related to well-being, as defined in terms of Beck's Triad.

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Cognitive theories of depression posit that persistent negative cognitions and cognitive biases, such as attentional bias to negative information, lead to the development and maintenance of depression (e.g. Beck, Rush, Shaw, & Emery, 1979). Negative cognitions, characterized by repetitive, recurrent, intrusive, and uncontrollable thoughts, have been broadly defined as rumination (Brinker & Dozois, 2009). Moreover, attentional biases and rumination play key roles in the NIMH Research Domain Criteria (RDoC) of Negative Valence Systems construct of Loss (NIMH, 2008). Although research has found that depression is related to attentional biases (e.g. Armstrong & Olatunji, 2012) and increased ruminative thinking (e.g. Aldao, Nolen-Hoeksema, & Schwiezer, 2010), only a few studies have examined direct relationships between attentional biases and ruminative style in depression.

In a study of a clinically depressed sample, Donaldson, Lam, and Mathews (2007) found a positive relationship between trait rumination and attentional biases to depression-related information using a dot-

probe task. Similarly, Joormann, Dkane, and Gotlib (2006) reported that rumination was associated with increased attention to sad faces in currently depressed adults.<sup>1</sup> Sustained visual processing of negative faces was found to be associated with a stronger ruminative style in dysphoric and non-dysphoric students (Duque, Sanchez, & Vazquez, 2014). Consistent with this, Owens and Gibb (2017) found that rumination was positively related to attention to sad faces and was negatively related to happy faces in non-depressed individuals.

Nevertheless, to our knowledge, no study has examined relationships between attention to negative words and daily rumination in clinically depressed individuals. Moreover, to our knowledge, no study has used eye-tracking to examine relationships between attentional biases and rumination among those with clinical depression. The present study examined relationships between attention to emotional words and daily reports of rumination and psychological adjustment among the clinically depressed.

### **Attentional biases in depression**

Although a recent meta-analysis questioned the association between attentional bias and depressive symptoms (Marchetti et al., 2018), the bulk of research has found that attentional biases in depression consist of greater maintenance of gaze on negative information and a lack of the positive attentional bias that is typically reported in healthy people in eye-tracking studies (Armstrong & Olatunji, 2012). Biased attention to emotional stimuli affects the course of depression by elevating the rate of incoming negative emotional information and decreasing the rate of incoming positive information, which leads to more persistent sad moods (Joormann & Arditte, 2013). Consistent with this, in a study of depressed individuals, Disner, Shumake, and Beevers (2017) found that attention to negative words was positively related to increases over time in depressive symptoms, and Donaldson et al. (2007) found that attentional bias for negative words was positively related to trait rumination.

### **Impaired disengagement hypothesis of rumination**

The impaired disengagement hypothesis of rumination posits that the positive relationship between the amount of time spent processing negative self-referential material and levels of rumination is due to impaired attentional disengagement (Koster, De Lissnyder, Derakshan, & De Raedt, 2011), and as discussed by Koster et al. (2011), several studies have found that rumination is related to impairments and valence-specific biases in attentional control. A lack of inhibitory control over negative information prevents individuals from implementing emotion regulation strategies that may be more adaptive than rumination, such as redirection of attention or positive reappraisal (Joormann & D'Avanzato, 2010) and leads to increases in the amount of negative information entering working memory (Koster et al., 2011). Consistent with this, Southworth, Grafton, MacLeod, and Watkins (2017) found that rumination was positively related to difficulty in disengaging attention from negative to positive words.

### **Issues in measuring rumination**

Studies of relationships between rumination and attentional processes have used single-assessment

measures of dispositional rumination such as the Ruminative Responses Scale (RRS) (Treynor, Gonzalez, & Nolen-Hoeksema, 2003). Respondents indicate how they are on average or usually, often without referring to specific temporal or situational circumstances. As discussed by Nezlek (2012), measuring individual differences using single-assessments has important limitations. Single assessments may reflect more recent or more important states than more temporally distant or less important states, e.g. a negative event from the past week influences responses more than the positive events from the week. Also, the temporal frame of questions is often not specified, and individual differences in how people interpret "generally" or "typically" can influence responses. To overcome some of these limitations, in the present study we measured rumination on a daily basis using a measure that focused on the present day.

### **The present study**

Despite the results of previous studies, the role of visual processing of negative stimuli in maintenance of depression needs to be clarified. Although several studies have found positive relationships between rumination and impaired executive control, few studies have examined the impaired attentional disengagement hypothesis using methods that can distinguish engagement and disengagement biases (Southworth et al., 2017) or that included continuous measures of eye behaviour (Owens & Gibb, 2017). The present study examined relationships between attention to negative words and daily rumination and daily psychological adjustment in depressed individuals. We assumed that attention to negative words would be related to a depressogenic thinking style/process, rumination, and would be related to depressogenic thought content, a measure of adjustment based on Beck's cognitive triad.

We measured attention to negative words using eye-tracking. This provided a direct measure of attention which we believe is an improvement over methods that evaluate the allocation of attention indirectly from response latencies to probes. Difficulty in disengaging attention from negative stimuli should be manifested by longer attention (dwell time) to negative stimuli. We hypothesized that dwell time on negative words would be positively related to daily rumination and negatively related to daily adjustment.



## Method

### Participants

Participants were recruited via an open call posted on internet portals. The call invited volunteers to participate in a study about how people feel and how they process information in their daily lives. Initially, 221 people responded to this call, and of these, 199 completed an online version of the CES-D (Radloff, 1977). Individuals who had CES-D scores of greater than 20 ( $N = 73$ ) were invited for an individual interview during which the Mini-International Neuropsychiatric Interview (V. 5.0.0; Sheehan et al., 1998) was administered by a trained clinician. To be eligible for the study, individuals had to be diagnosed as currently experiencing a major depression disorder episode. Individuals were excluded if they had bipolar disorder, substance abuse, a current or lifetime psychotic disorder or current suicidal tendencies. Ten participants dropped out from the study after beginning the study. Due to technical problems with recording eye movements (e.g. poor calibration) or compliance with instructions the final sample consisted of 43 participants ( $F = 29$ ,  $M_{age} = 34.42$ ,  $SD = 12.71$ ). Thirty-two participants (74%) had a comorbid diagnosis, 27 of whom were diagnosed with an accompanying anxiety disorder. Participants were paid approximately 30USD.

### Procedure

First, participants came the laboratory and completed the eye-tracking task and three questionnaires. They then maintained an online diary for at least 7 consecutive days.

The research protocol was approved by the IRB of the authors' institution. All participants provided written informed consent.

### Self-report measures

Participants completed three measures: the Center for Epidemiologic Studies Depression Scale (CES-D:

Radloff, 1977), the trait subscale of the State-Trait Anxiety Inventory (STAI: Spielberger, 1989), and the Penn State Worry Questionnaire (PSWQ: Meyer, Miller, Metzger, & Borkovec, 1990). Descriptive statistics for these measures are presented in Table 1.

### Eye tracking measures

#### Four words task

Following the procedure used by Ellis, Beevers, and Wells (2011), we presented 12 slides with 4 words on each, and participants were asked to read the words. Words were selected from the Affective Norms for English Words (ANEW, Bradley & Lang, 1999). There were four categories of words: dysphoric (e.g. gloom, sad), threat-related (e.g. killer, angry), neutral (e.g. ankle, sphere), and positive (e.g. home, sun). Each slide was presented for 10 sec and contained one word from each category. Words presented on the same slide were matched for length, and the order of slides was randomized. At the beginning of each trial a fixation cross appeared in the middle of the screen for 1000 ms.

### Apparatus

The stimuli were presented on a 22' diameter monitor at a viewing distance of 70 cm. Participants' eye movements were recorded with a SMI RED eye-tracker, with a sampling rate of 120 Hz and a 9-point calibration before the task. Measurements were made in a room with no windows and constant ambient light. SMI's standard BeGaze dispersion-based algorithm was used for detecting fixations and saccades. The minimal fixation duration was set to 80 ms.

Rectangular areas of interest were drawn around each word, and we calculated the total time spent fixating on the target stimuli (dwell time). One participant had an extreme value (+ 3SD) of dwell time on positive words. We conducted the analyses with and without this case, and the results were similar, so we report the results with all cases included.

**Table 1.** Correlations and descriptive statistics for level 2 variables.

		Mean (SD)	1	2	3	4	5	6	7
1	Depression (CES-D)	38.63 (7.09)	–						
2	Worry (PSWQ)	60.86 (9.73)	.23	–					
3	Anxiety (STAI-T)	54.81 (5.50)	.30 <sup>.06</sup>	.54***	–				
	Attention (ms) to								
4	Threat-related words	1674.96 (551.47)	.19	.17	.09	–			
5	Dysphoric words	1762.31 (641.58)	.28 <sup>.07</sup>	.13	.13	.61***	–		
6	Neutral words	1635.54 (420.30)	.06	.11	–.01	.78***	.60***	–	
7	Positive words	1917.72 (810.88)	–.16	–.35*	–.27 <sup>.08</sup>	–.02	–.05	.07	–

Note: <sup>.06, .07, .08</sup> statistical tendency, \* $p < .05$ , \*\*\* $p < .001$ .

### One-week online diary

At the end of each day for a week participants used a secure online platform to answer a series of questions about their daily rumination and adjustment. Daily rumination was measured using three items from the Rumination-Reflection Questionnaire (Trapnell & Campbell, 1999) that were reworded for daily administration. Participants answered the following questions: How much today did you "ruminate" or dwell on things that happened to you? How much today did you play back over in your mind how you acted in a past situation? How much time today did you spend rereading things that are over and done with? Daily adjustment was measured with three items based on Beck et al.'s (1979) cognitive triad: Thinking about today in general how positive were your thoughts about yourself? How well did things go today? Today, how optimistic are you about how your life (in general) will be tomorrow? Participants answered using 1–7 scales, scored so that higher numbers indicated more rumination and better adjustment during the day.

### Compliance with instructions

Before analysing the data, we inspected the time of participants' entries. Valid entries were defined as those provided after 6 pm of the day in question and no later than 6 am of the following day. Following this procedure, we analysed 251 days, and participants provided on average 6.0 days of diary data.

## Results

The data were conceptualized as a two level structure in which days were nested within individuals. We analysed the data using multilevel models using the programme HLM following guidelines described by Nezlek (2012). Before the primary analyses, the reliability of our measures was examined using three level models in which items were nested within days and days were nested within persons (Nezlek, 2017). These analyses provided the multilevel equivalent of a Cronbach's alpha, corrected for differences between persons and days. The reliabilities were satisfactory (see Table 2).

**Table 2.** Descriptive statistics for daily measures.

Daily measure	Variance		Reliability
	Mean	Between	
Rumination	3.25	1.03	.76
Adjustment	4.20	.26	.71

### Descriptive statistics for daily rumination and adjustment

The first analyses were null models (no predictors at either level of analysis). These analyses estimated the means and the within- and between-variances of our daily measures, and the results are summarized in Table 2. The model is below. There were  $i$  days nested within  $j$  persons. The variance of  $r_{ij}$  is the within-person (level 1) variance, and the variance of  $u_{0j}$  is the between-person (level 2) variance.

$$\text{Within-person: } y_{ij} = \beta_{0j} + r_{ij}$$

$$\text{Between-person: } \beta_{0j} = \gamma_{00} + u_{0j}$$

These analyses found that there was sufficient within-person variability to conclude that people varied from day to day, while there was also sufficient stability within-persons (the between-person variance) to make it meaningful to examine between-person differences in means of our daily measures. Moreover, the means for both measures were toward the midpoint of the scale, suggesting that floor and ceiling effects would not influence our results.

### Relationships between attention to words and self-report measures

Next, we examined relationships between attention to the four word categories and trait measures of depression, worry, and anxiety. Descriptive statistics for and correlations between these measures are presented in Table 1. There were significant positive correlations between attention to threat-related, dysphoric, and neutral words. Attention to positive words was negatively related to worry, whereas anxiety was positively correlated with worry. Attention to threat-related and neutral words was not significantly related to any trait measure, and dysphoric words at statistical tendency level were positively related to depression.

### Relationships between attentional bias and mean daily rumination and daily adjustment

Next, we examined relationships between eye-tracking measures and daily rumination and adjustment by including measures of dwell times as level 2 predictors (see below). We conducted separate analyses for each measure of dwell time. The results of these analyses are summarized in Table 3. Level 2 predictors were standardized before analysis.



$$\text{Between-person: } \beta_{0j} = \gamma_{00} + \gamma_{01} * (\text{dwell time}) + u_{0j}$$

As expected, we found significant relationships between dwell time on negative words and daily rumination and adjustment. Daily rumination was positively related to dwell time on dysphoric words ( $\gamma_{01} = .36$ ,  $t = 3.23$ ,  $p < .01$ ) and to dwell time on threat-related words ( $\gamma_{01} = .63$ ,  $t = 3.96$ ,  $p < .001$ ), and daily adjustment was negatively related to dwell time on threat-related words ( $\gamma_{01} = -.21$ ,  $t = 2.53$ ,  $p < .02$ ). In general, the longer participants dwelled on both dysphoric and threat-related words, the more they ruminated each day, and the more they dwelled on threat-related words the poorer was their psychological adjustment each day. In contrast, we found no significant relationships between attention to positive words and daily rumination or adjustment. To control for individual differences in attention per se, we calculated the amount of time participants spent looking at parts of the stimuli that were not words. The relationships we found between rumination and dwell time on dysphoric and threat-related words and between adjustment and dwell time on threat-related words remained significant after controlling for time spent looking at parts of the stimulus array that were not words. The coefficient between daily rumination and dysphoric words was  $\gamma_{01} = .33$  ( $p = .005$ ), the coefficient between daily rumination and threat-related words was  $\gamma_{01} = .62$  ( $p = .001$ ), and the coefficient between daily adjustment and threat-related words was  $\gamma_{01} = -.18$  ( $p < .05$ ).

Using similar models, we examined relationships daily rumination and adjustment and the CES-D, STAI, and PSWQ (see Table 3). Daily rumination was positively related to CES-D scores ( $\gamma_{01} = .24$ ,  $t = 2.14$ ,  $p < .04$ ) and daily adjustment was negatively related to PSWQ scores ( $\gamma_{01} = -.20$ ,  $t = 2.31$ ,  $p < .03$ ). We then examined relationships between our daily measures and the self-report and eye-tracking measures that were significant in the original analyses. For daily rumination, when attention to dysphoric words, attention to threat-related words, and depression were simultaneously included as level 2 (person-level predictors), only attention to threat-related words remained significant related to daily rumination ( $\gamma_{01} = .64$ ,  $t = 2.97$ ,

$p < .01$ ). For daily adjustment, when attention to dysphoric words, attention to threat-related words, and worry were simultaneously included as level 2 (person-level predictors), attention to threat-related words and worry were negatively related to daily adjustment, although not at the .05 level ( $\gamma_{01} = -.17$ ,  $t = 1.76$ ,  $p = .087$ ;  $\gamma_{01} = -.18$ ,  $t = 1.96$ ,  $p = .057$ , respectively).

### Within-person relationship between rumination and adjustment

We examined within-person relationships between daily rumination and daily adjustment by including daily adjustment as a level 1 predictor of rumination, and we found a significant negative relationship ( $\gamma_{10} = -.32$ ,  $t = 2.88$ ,  $p < .01$ ). Analyses of trait level moderation did not find that this relationship varied as a function of our trait level variables (all  $ps > .2$ ).

### Discussion

As expected, attention to negative words (dysphoric and threat-related) was positively related to how much depressed people ruminated each day. In contrast, attention to positive and neutral words was not related to daily rumination or adjustment. These results are consistent with the proposal that sustained processing of negative information leads to rumination (Koster et al., 2011; Whitmer & Gotlib, 2013).

Previous research has consistently found positive relationships between rumination and biases in attentional control, inhibition, and set shifting functions (e.g. Koster et al., 2011); however, these studies assessed cognitive control functions, not attention itself. Moreover, most previous research has not studied people who were clinically depressed, but individuals (often undergraduates) with elevated depressive symptoms, and they measured rumination using single assessment questionnaires. The current study represents an improvement over the existing research because it examined a clinically depressed sample, measured attention directly, and measured rumination on a daily basis.

**Table 3.** Relationships between daily rumination, daily adjustment and level 2 predictors.

	Attention to words				Self-report measures		
	Dysphoric	Threat-related	Positive	Neutral	Anxiety	Worry	Depression
Rumination	.36**	.63***	.04	.20	.22	.10	.24*
Adjustment	-.10	-.21*	-.08	-.14	-.14	-.20*	-.09

Note: Coefficients accompanied by \* were significant at  $*p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

Our study extends previous research by demonstrating that attention to dysphoric and threat-related words is positively related to the strength of daily rumination in clinically depressed individuals. Although the relationship between rumination and attention to threat-related words was somewhat unexpected, it is consistent with some previous research. For example, Siegle, Thompson, Carter, Steinhauer, and Thase (2007) discussed how depressed individuals may also be hyperresponsive to threat. As noted previously, 30 of our 43 participants had been diagnosed with an anxiety disorder, and analyses of participants who did not have an accompanying anxiety diagnosis found the same relationships that were found in the analyses of the full sample. These results suggest that depressed individuals may be more hypersensitive to threatening stimuli independent of the fact they also tend to be anxious.

On the other hand, some have suggested that the heightened threat response observed among depressed people might be due to the comorbidity of depression and anxiety (Engels et al., 2010), and the mean STAI score was elevated compared to Polish norms for a distressed sample (e.g. Wrześniowski, Matusik, & Sosnowski, 2002). The results of analyses that included only participants with STAI scores below the mean reported by Wrześniowski et al. were similar to the results that included all participants. We address this issue below.

We also found that attention to threat-related words was negatively related to a measure of daily adjustment based on Beck's depressive cognitive triad. Biased attention to negative words may facilitate sustained processing of negative information which in turn may manifest itself by increased depressive thoughts and catastrophizing about the self, the current day, and the near future (Beck's triad). We also found a negative relationship between adjustment and worry, which suggests that the aspects of depression we measured are related more to threat sensitivity than to sadness per se. Consistent with such a possibility, Rochat, Billieux, and Van der Linden (2012) found that difficulty in disengaging from negative stimuli was positively related to maladaptive self-referential thinking, including rumination, self-blame, and catastrophizing.

### **Limitations and future directions**

Although the present study supported our predictions, it had limitations. For example, even though there are

no data or theoretically based reasons that suggest that our results are specific to our use of end of day reports, it is possible that other data collection protocols, e.g. multiple assessments each day, would have produced different results. Also, we did not have a large enough sample to provide a basis for comparing individuals who were depressed but not anxious to individuals who were depressed and anxious.

More important, our design did not provide a basis for making strong inferences about causality. Further research is needed to verify that attention to negative words leads to increases in daily rumination. This could be done by examining if modifying attentional biases alters daily rumination. Although there is preliminary evidence that modification of attentional biases may reduce state rumination (Cohen, Daches, Mor, & Henik, 2014), and although the unidirectional nature of the relationship between attentional processes and rumination is assumed in prominent theoretical accounts (cf. Koster et al., 2011), such relationships are far from clearly established. Aside from the concerns about whether attentional bias and depressive symptoms are related (e.g. Marchetti et al., 2018) there is possibility that rumination may be triggered by higher-order processes and constructs (for example, metacognitions) that in turn influence both attention and attentional biases.

The present findings suggest some directions for development of attention bias modification programmes in depression. If attention to negative stimuli leads to rumination, it may be possible to reduce rumination by reducing attention to negative stimuli, which may be associated with or lead to a reduction in depressive symptoms. Moreover, rumination is a transdiagnostic process that is related to several forms of psychopathology (Aldao et al., 2010), and so understanding the sources of rumination could be important for the prevention and treatment of variety of affective disorders, including mood, anxiety, and eating disorders.

### **Note**

1. Based on the distinction between reflection and rumination as two types of self-focused attention made by Trapnell and Campbell (1999) we use the term "rumination" to refer to what some describe as "brooding rumination".

### **Disclosure statement**

No potential conflict of interest was reported by the authors.



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