Stuck in a sad place: Biased attentional disengagement in rumination

Ben Grafton [a, b], Felicity Southworth [c], Ed Watkins [a, c], and Colin MacLeod [a, b]

University of Western Australia [a]

Babes-Bolyai University [b]

University of Exeter [c]

Author Note

Ben Grafton, Centre for the Advancement of Research on Emotion, School of Psychology, University of Western Australia, and School of Psychology, Babes-Bolyai University; Felicity Southworth, Department of Psychology, University of Exeter; Ed Watkins, Study of Maladaptive to Adaptive Repetitive Thought Lab, Department of Psychology, University of Exeter, and Centre for the Advancement of Research on Emotion, School of Psychology, University of Western Australia; Colin MacLeod, Centre for the Advancement of Research on Emotion, School of Psychology, University of Western Australia, and School of Psychology, Babes-Bolyai University.

Ben Grafton and Felicity Southworth jointly first-authored the manuscript.

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Correspondence should be addressed to Ben Grafton, Centre for the Advancement of Research in Emotion, School of Psychology, the University of Western Australia, M304, 35 Stirling Highway, Crawley, Western Australia, 6009, Australia. Email: ben.grafton@uwa.edu.au

Abstract

Previous research has demonstrated that heightened ruminative disposition is characterized by an attentional bias to depressogenic information at 1000 ms exposure durations. However, it is unknown whether this attentional bias reflects facilitated attentional engagement with depressogenic information, or impaired attentional disengagement from such information. The present study was designed to address this question. In keeping with recent theoretical proposals, our findings demonstrate that heightened ruminative disposition is associated only with impaired attentional disengagement from depressogenic information, and does not involve facilitated attentional engagement with such information. In addition to resolving this key issue, the present study provided converging support for the previous claim that rumination-linked attentional bias is specific to depressogenic information, and also lends weight to the contention that rumination-linked attentional bias may be evident only when controlled attentional processing is readily permitted by using stimulus exposure durations of 1000 ms. We discuss the theoretical implications of these findings, and highlight key issues for future research.

Keywords: rumination, attentional bias, disengagement, engagement, attentional-probe task

Rumination is a form of repetitive negative thinking that typically is focused on the causes and implications of distressing situations or events (Watkins, 2008). People differ in the degree to which rumination is elicited by negative mood state, and this variation in ruminative disposition most commonly has been assessed using the Ruminative Responses Scale (RRS; Nolen-Hoeksema & Morrow, 1991). Heightened ruminative disposition is associated with increased vulnerability to depression, as evidenced by the fact that individuals who score higher on the RRS have a greater probability of depressive onset (Just & Alloy, 1997; Nolen-Hoeksema, 2000; Nolen-Hoeksema, Parker, & Larson, 1994; Spasojevic & Alloy, 2001), and also tend to experience greater persistence of depressive symptoms (Kuehner & Weber, 1999; Nolen-Hoeksema, Morrow, & Fredrickson, 1993). Given that heightened ruminative disposition may play a role in the development and maintenance of depression, investigators have called for research to illuminate the cognitive factors that underpin this disposition (e.g. Koster, Lissnyder, Derakhshan, & De Raedt, 2011; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). One cognitive factor that has been of particular interest to researchers is selective attention.

Investigators have been motivated by the hypothesis that an attentional bias to negative information may underlie heightened ruminative disposition (c.f. Koster et al., 2011). The attentional-probe task (MacLeod, Mathews, & Tata, 1986) has been used to assess this attentional bias. In this task, participants are briefly exposed to stimulus pairs that usually comprise one negative member and one non-negative member. A probe subsequently appears in the location where either member of the stimulus pair was just displayed, and participants are required to quickly make a discriminatory response to this probe. The degree to which discrimination responses are speeded to probes appearing in the locus of the negative member compared to the non-negative member of the stimulus pair is taken as an index of attentional bias to negative information. To date, two studies have investigated the association between variability in this attentional bias and in ruminative disposition, and these are considered in turn below.

Using this attentional-probe task, Donaldson, Lam, and Mathews (2007) sought to determine whether heightened ruminative disposition is characterized by an attentional bias to negative information. The investigators were also interested in the role that automatic vs. controlled attentional processes may play in the expression of such bias. Hence, they exposed stimulus pairs for either 500 ms or 1000 ms, reasoning that controlled attentional processes would exert a greater impact on attentional selectivity at the longer exposure duration compared to the shorter exposure duration, while automatic processes would have as great an influence at the shorter exposure duration as at the longer exposure duration (Kim & Cave, 1999; Lamy & Egeth, 2003; McNally, 1995; Mogg & Bradley, 2005; Theeuwes, Atchley, & Kramer, 2000). It was found that participants who scored higher in ruminative disposition, as assessed by the RRS, were disproportionately speeded to discriminate probes in the locus of negative information compared to those in the locus of positive information, but only at the longer 1000 ms exposure duration. This association between ruminative disposition and attentional bias remained evident when participant's concurrent levels of depression were statistically accounted for. Thus, these findings are consistent with the hypothesis that heightened ruminative disposition is characterized by an attentional bias to negative information, while also suggesting that this pattern of attentional selectivity may reflect the operation of controlled attentional processes.

Joormann, Dkane, and Gotlib (2006) also employed the attentional-probe task to investigate the attentional basis of rumination. These researchers sought to determine whether rumination-linked attentional bias is specific to depression-related information, or reflects increased attention to negative information in general. On each trial of their assessment task, participants were exposed for 1000 ms to stimulus pairs that comprised one emotional member (either negative or positive), and one member that was devoid of emotional meaning. In some stimulus pairs, the emotional member was more related to depression, and in others it was more related to anxiety. It was found that participants who reported heightened ruminative disposition on the RRS showed greater attentional bias to negative information, but only when this negative information was specifically related to depression. Again, this association between ruminative disposition and attentional bias remained evident when participant's concurrent levels of depression were statistically controlled for. In addition, unlike Donaldson et al. (2007), these researchers also examined the association between this attentional bias and two subscales of the RRS, the ruminative brooding subscale and the ruminative reflection subscale, originally distinguished by Treynor, Gonzalez, & Nolen-Hoeksema (2003). The results showed that the observed attentional bias effect was more a function of the former subscale than the latter. Taken together, these findings are consistent with the hypothesis that heightened ruminative disposition is characterized by an attentional bias that operates to specifically favor the processing of depressogenic information, and also invite speculation that this bias might differentially implicate ruminative brooding and ruminative reflection.

However, as has recently been pointed out by LeMoult, Arditte, D'Avanzato, and Joormann (2013), these studies cannot illuminate whether this rumination-linked attentional bias reflects enhanced attentional engagement with this negative information, or impaired attentional disengagement from such information. The present study was designed to resolve this issue. Specifically, we sought to determine whether this rumination-linked attentional bias involves increased attentional engagement with negative information, reflecting a disproportionate tendency for attention to be captured by attentionally distal information that is emotionally negative in content, or whether it involves reduced attentional disengagement from negative information, reflecting a disproportionate tendency for attention to be more firmly held by attentionally proximal information that is negative in content. Some researchers have argued, on theoretical grounds, that the attentional bias associated with heightened ruminative disposition may specifically involve only impaired attentional disengagement from negative information (Koster et al., 2011). As others have pointed out, however, existing findings could equally well reflect facilitated attentional engagement with negative information, meaning that investigators must directly evaluate the validity of these alternative possibilities (Grafton & MacLeod, 2013). Determining the attentional characteristics of heightened ruminative disposition is of particular importance given the key role that rumination appears to play in increasing susceptibility to depression.

To determine which facet of attentional selectivity characterizes heightened ruminative disposition requires a task that can yield separate measures of selective attentional engagement with, and selective attentional disengagement from, negative information. It is generally accepted that the conventional attentional-probe task cannot provide independent measures of these two facets of attentional selectivity (Mogg, Holmes, Gardner, & Bradley, 2008; Yiend, 2010). Hence, a number of investigators have sought to develop tasks capable of independently measuring engagement bias and disengagement bias (e.g. Fox, Russo, Bowles, & Dutton, 2001; Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006; Yiend & Mathews, 2001). Unfortunately, as pointed out in recent critiques, the attentional assessment tasks used in most previous attempts to differentiate engagement bias and disengagement bias cannot fully satisfy the methodological criteria that must be met to yield discrete measures of these two facets of attentional selectivity (Clarke, MacLeod, & Guastella, 2012; Grafton & MacLeod, 2014; Mogg et al., 2008; Rudaizky, Basanovic, & MacLeod, 2014). As noted in these critiques, because selective attentional engagement reflects a disproportionate tendency for attention to become focused on initially distal negative information, assessment tasks designed to specifically index bias in attentional engagement with negative compared to non-negative information must present this differentially valenced information distal from the location in which participants' attentional focus is initially secured. In contrast, because selective attentional disengagement reflects a disproportionate tendency for attention to remain focused on initially proximal negative information, assessment tasks designed to specifically index bias in attentional disengagement from negative compared to non-negative information must present this differentially valenced information in the location where participants' attentional focus is initially secured. Selective attention to alternative categories of emotional information can then be assessed in the usual manner, by comparing relative latencies to respond to target probes appearing in either the same or opposite locus of this emotional information. The degree to which attention moves towards negative compared to positive information presented distally from initial attentional focus indexes the capacity of negative information to capture attention more readily than positive information, and so provides a measure of heightened attention to negative information as a result of engagement bias. The degree to which attention remains in the locus of negative compared to positive information presented proximally to initial attentional focus indexes the capacity of negative information to hold attention more firmly than positive information, and so provides an index of heightened attention to negative information as a result of disengagement bias.

Grafton, Watkins, and MacLeod (2012) introduced a variant of the attentional-probe task that fulfils these methodological criteria, and so yields separate measures of selective attentional engagement with, and selective attentional disengagement from, negative information. Each trial of this task begins with the presentation of an anchor probe, and ends with the presentation of a target probe. Participants are required to respond only to the target probe, by indicating whether its identity matches that of the anchor probe. Intervening between these two probe presentations, a pair of letter strings is displayed, one of which is an emotionally toned word. By configuring the position of the anchor probe, the word member of the letter string pair, and the final target probe, this task permits the discrete assessment of variability in selective engagement with emotional information distal to initial attentional focus, and in selective disengagement from emotional information proximal to initial attentional focus. Specifically, because the participant must apprehend the orientation of the briefly presented anchor probe, this secures their initial attentional focus in a predetermined screen location. The pair of letter strings that then appears, for either 500 ms or 1000 ms, contains an emotionally toned word of either negative or positive valence, and a length matched non-word, devoid of emotional meaning. Thus, the emotional word can be shown in the opposite screen location to the anchor probe, meaning that this emotional information appears distally from initial attentional focus, or in the same location as the anchor probe, meaning that this emotional information appears proximally to initial attentional focus. The target probe is then presented in either screen location, with equal frequency, with relative discrimination latencies for the target probes shown in each location serving to index the distribution of attention following letter string offset. The degree to which speeding to target probes in the locus of the words compared to non-words is greater when these words are negative compared to positive in emotional tone, provides an index of heightened attentional bias to negative information. The tendency for attention to become captured by distal negative information (i.e. engagement bias) is revealed by this measure of heightened attention to negative, relative to positive, emotional words, when these words were presented distally from initial attentional focus. In contrast, the tendency for attention to remain held by proximal negative information (i.e. disengagement bias) is revealed by this measure of heightened attention to negative, relative to positive, emotional words, when these words were presented proximally to initial attentional focus. Examples of these trials are shown in Figure 1.

Grafton et al. (2012) and others have validated the capacity of this task to separately assess bias in attentional engagement with, and attentional disengagement from, negative information (Grafton & MacLeod, 2014; Rudaizky et al., 2014). Using this task, it has been demonstrated that elevated anxiety vulnerability is characterized both by facilitated attentional engagement with, and impaired attentional disengagement from, anxiety-related negative information, and that these two attentional biases are quite unrelated to one another. However, as yet, this methodological approach has not been employed to shed light on the present question, concerning whether the attentional bias to negative information that characterizes heightened ruminative disposition reflects facilitated attentional engagement with, or impaired attentional disengagement from, negative information.

Hence, in the present study, we delivered a variant of the attentional-probe task, closely based on the approach introduced by Grafton et al. (2012), to participants who varied widely in their ruminative disposition, as assessed by the RRS, to determine whether heightened ruminative disposition is characterized by facilitated attentional engagement with negative information, or by impaired attentional disengagement from negative information. We followed the approach of Donaldson et al. (2007) by employing both a 500 ms and a 1000 ms exposure duration, which enabled us to investigate whether observed patterns of attentional selectivity were more evident at the longer exposure duration, suggesting the involvement of controlled attentional processes in rumination-linked attentional bias. We followed the lead of Joormann et al. (2006) by employing both depression- and anxiety-related emotional information, which enabled us to investigate whether observed rumination-linked bias in attentional engagement or disengagement is specific to depression-related material, or instead reflects biased attentional responding to negative information more generally. Also, like Joormann et al., we investigated whether any pattern of attentional bias associated with heightened ruminative disposition, as assessed by the total RRS score, differentially implicated ruminative brooding vs. ruminative reflection, as assessed by their respective RRS subscales. Finally, like Donaldson et al. and Joormann et al., we assessed participant's levels of depression to determine whether any observed association between ruminative disposition and attentional bias remains evident when controlling for concurrent variation in depression.

Method

Participants

Participants were 144 (24 male) undergraduate psychology students from the University of Western Australia, and from the University of Exeter, ranging in age from 17 to 47 years (M =18.85, SD = 2.75). At recruitment, the mean score of these participants on the Ruminative Response Scale (RRS) was M = 42.92 (SD = 12.87; Min = 23; Max = 76; Interquartile Range = 17.75).

Questionnaire Measures

***Ruminative Responses Scale*.** Ruminative disposition was assessed using the Ruminative Responses Scale (RRS; Nolen-Hoeksema & Morrow, 1991), which requires participants to rate their tendency to experience each of 22 particular ruminative symptoms when in a negative mood. The RRS has both high internal reliability and validity (c.f. Luminet, 2004). Investigators also have distinguished two RRS subscales: ruminative brooding and ruminative reflection. Both of these subscales show acceptable reliability and consistency (Treynor et al., 2003).

Beck Depression Inventory – II. Depression was assessed using the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996), which requires participants to respond to 21 statements describing various depressive symptoms, on a scale ranging from 0 – 3. The BDI-II has good reliability (Wiebe & Penley, 2005) and validity (Storch, Roberti, & Roth, 2004).

Experimental Stimuli

In the present study, we required 64 letter string pairs each comprising an emotional word, either negative or positive in emotional tone, and a length matched non-word devoid of emotional meaning. The words were selected from a larger initial pool of 400 candidate words, on the basis of ratings obtained from six clinical psychologists, who rated the candidate words on two dimensions. One rating concerned the emotional valence of the word, which was judged on a 7 point scale ranging from -3 (extremely negative) to +3 (extremely positive). The other rating concerned the degree to which the candidate words were related either to the emotional domain associated with variation in depression (ranging from sad to happy experiences), or to the emotional domain associated with variation in anxiety (ranging from anxious to relaxed experiences), and was judged on a 7 point scale ranging from 3x (extremely associated to sad/happy domain) to 3y (extremely associated to anxious/relaxed domain).

Half of the experimental words (32 words) were chosen on the basis of receiving highly negative ratings, while half were chosen because they had received highly positive ratings. This gave rise to a Stimulus Valence factor (Negative Words vs. Positive Words). Half of the negative words and half of the positive had been judged more closely related to the sad/happy domain, and half had been judged to more closely related to the latter anxious /relaxed domain. This gave rise to a Stimulus Domain factor (Sad/Happy Words vs. Anxious/Relaxed Words).

A two-way ANOVA, which considered the factors Stimulus Valence (Negative Words vs. Positive Words) and Stimulus Domain (Sad/Happy Words vs. Anxious/Relaxed Words), was carried out on the valence ratings. This analysis confirmed a significant main effect of Stimulus Valence, F (1, 60) = 3357.61, $p < .001$, partial $\eta^2 = .98$. Neither the main effect of Stimulus Domain, F (1, 60) = 1.88, $p = .18$, partial $\eta^2 = .03$, nor the interaction between the two factors, F (1, 60) = 1.60, $p = .21$, partial $\eta^2 = .03$, was significant. Hence, stimulus valence differed as required as a function of the Stimulus Valence factor, and was not confounded with the domain distinction. An equivalent two-way ANOVA carried out on the domain ratings confirmed a significant main effect of Stimulus Domain, F (1, 60) = 642.80, $p < .001$, partial $\eta^2 = .92$. Neither the main effect of Stimulus Valence, F (1, 60) = .49, $p = .49$, partial $\eta^2 = .01$, nor the interaction between the two factors, F (1, 60) = .91, $p = .34$, partial $\eta^2 = .02$, was significant. Thus, stimulus domain rating differed as a function of the Stimulus Domain factor as required, and was not confounded with the valence distinction. Additional ANOVAs carried out on word frequency (according to Kucera & Francis, 1967) and on word length (expressed in terms of letters) revealed no significant differences as a function of Stimulus Valence, Stimulus Domain, or their interaction. The full set of experimental words is provided in the Appendix.

Attentional Assessment Task

Each trial commenced with the 1000 ms presentation of an upper and lower string of asterisks that demarcated the two critical screen regions. These asterisk strings were centralized horizontally on the screen, and separated vertically by a distance of 3 cm. Between them was an arrow display pointing either towards the upper or the lower region with equal frequency. Participants were required to direct their attention to the screen region (demarcated by the row of asterisks) indicated by the arrow direction. The screen was then cleared, and an anchor probe was briefly exposed (150 ms) in this attended region. The anchor probe was a small (2 mm) red line, sloping upwards 45 degrees to either the left or right, with equal probability. A letter string pair was then presented, one member appearing in each of the two screen regions. On half of the trials, the word member of this pair appeared in the locus distal to that where the participant was already attending (Attentional Engagement Bias Assessment Trials), and on the remaining half of trials, the word appeared in the locus where the participant was already attending (Attentional Disengagement Bias Assessment Trials). This letter string pair was exposed for either 500 ms or 1000 ms with equal frequency. The screen was then cleared, and a target probe appeared in either of the two screen regions with equal probability. This target probe also was a small (2 mm) red line, sloping upwards 45 degrees to either the left or to the right. Participants were required to quickly indicate whether the slope direction of the target probe matched that of the anchor probe, which was the case on 50% of trials. They registered their response by pressing either the right or left mouse button, to respectively indicate that the slope of the target probe either did or did not match that of the anchor probe. The latency to make this discrimination response to the target probe was recorded, as was its accuracy. Following detection of the response, the screen was cleared for 1000 ms, before the next trial began. This sequence of events is summarized in the example trials illustrated in Figure 1.

[Insert Figure 1 about here]

The attentional assessment task delivered 256 trials. Across these trials, each of the 64 letter string pairs were presented, in a random order, once before any were presented a second time, and each was repeated once before any were exposed for a third time, and so on. Hence, over the task, each letter string pair was presented a total of 4 times. On two of these occasions, the word member of the letter string pair was presented proximal to initial attentional focus, and on the other two of these occasions the word member was presented distal to initial attentional focus. In each case, the target probe appeared once in the locus of the word member, and once in the locus of the non-word member, of the letter string pair.

Procedure

Participants were tested individually. Each participant was seated approximately 60 cm from the computer screen, and given instructions for the attentional assessment task. These instructions emphasised that the participant should ensure accurate identification of whether the target probe matched the slope of the anchor probe, but should respond as quickly as possible without compromising accuracy. A short practice comprising 20 trials that employed only neutral stimuli was given. Then the participant completed the attentional assessment task, before being thanked and debriefed.

Results and Discussion

Computation of Engagement and Disengagement Bias Index Scores

Probe discrimination latencies can only indicate attentional distribution when probe discrimination responses are accurate, thus we eliminated participants whose overall accuracy was atypically low using a 95% confidence interval. Eight participants displayed high error rates meeting the exclusion criteria. The remaining 136 participants averaged less than 12% errors. There was no association between accuracy and RRS rumination scores, r (134) = .02, p = .83.

To compute the Engagement Bias Index scores, and the Disengagement Bias Index scores, we first calculated participants' latencies to correctly discriminate probes under each experimental condition, following the recommendations of Leys, Ley, Klein, Bernard, and Licata (2013). Specifically, we eliminated probe discrimination latencies that fell further than 2.5 times the median absolute deviation from the participant's median RT under each experimental condition, then calculated each participant's median probe discrimination latencies for each condition. These latency data were then used to compute an index of engagement bias and disengagement bias, as follows.

The Engagement Bias Index, reflecting degree to which attention selectively moved to the locus of negative information compared to positive information that was presented distally from the initial locus of attentional focus, was calculated using probe discrimination latency data from those trials on which the emotional words were presented distally from initial attentional focus, following the equation:

Engagement Bias Index = (Anchor probe distal to negative word in letter string pair: RT for target probe distal to negative word – RT for target probe proximal to negative word) –

(Anchor probe distal to positive word in letter string pair: RT for target probe distal to positive word – RT for target probe proximal to positive word).

The Disengagement Bias Index, reflecting degree to which attention was selectively held by negative information compared to positive information that was presented in the same locus as initial attentional focus, was calculated using probe discrimination latency data from those trials on which the emotional words were presented proximally to initial attentional focus, following the equation:

Disengagement Bias Index = (Anchor probe proximal to negative word in letter string pair: RT for target probe distal to negative word – RT for target probe proximal to negative word) – (Anchor probe proximal to positive word in letter string pair: RT for target probe distal to positive word – RT for target probe proximal to positive word).

The indices of engagement bias and disengagement bias are shown in Table 1. Scores on these two bias indices will be higher to the extent that participants display relatively greater attention to the negative words compared to the positive words, with the two indices respectively reflecting the specific involvement of engagement bias and disengagement bias in such attentional selectivity.

Analysis of Engagement Bias Index Scores

The Engagement Bias Index scores were subjected to a repeated measures ANCOVA that considered the two within-subject factors Stimulus Domain (Sad/Happy Words vs. Anxious/Relaxed Words), and Exposure Duration (500 ms Exposure vs. 1000 ms Exposure). The RRS rumination scores were entered as a continuous variable (i.e., they were entered as a covariate in the SPSS repeated measures ANCOVA). This analysis did not reveal evidence of any significant effects (all p's > .09). Of most relevance, the main effect of RRS Score, F (1, 134) = .01, p =.92, partial $\eta^2 = 0$, the two-way interaction of Stimulus Domain x RRS Score, F (1, 134) = .01, p =.92, partial $\eta^2 = 0$, the two-way interaction of Exposure Duration x RRS Score, F (1, 134) = 1.96, p =.16, partial $\eta^2 = .01$, and the three-way interaction of Stimulus Domain x Exposure Duration x RRS Score, F (1, 134) = 2.83, p =.10, partial $\eta^2 = .02$, all failed to reach statistical significance. Hence, there was no evidence to suggest that heightened ruminative disposition is characterized by facilitated attentional engagement with negative information.

Analysis of Disengagement Bias Index Scores

The Disengagement Bias Index scores were subjected to the same repeated measures ANCOVA. This analysis revealed a significant main effect of Stimulus Domain, F (1, 134) = 5.28, p = .02, partial $\eta^2 = .04$, that was subsumed within a significant two-way interaction of Stimulus Domain x RRS Score, F (1, 134) = 4.33, p = .04, partial $\eta^2 = .03$. This two-way interaction was itself subsumed within a three-way interaction involving Stimulus Domain x Exposure Duration x RRS Score, F (1, 134) = 4.76, p = .03, partial $\eta^2 = .03$, which was the only other significant effect to emerge from the analysis. Hence, it is necessary to examine the nature of this higher-order interaction to reveal the pattern of biased attentional disengagement from negative information that characterizes heightened ruminative disposition.

This three-way interaction reflected the fact that the simple two-way interaction of Stimulus Domain x RRS Score was significant under the 1000 ms exposure condition, F (1, 134) = 8.45, p = .01, partial $\eta^2 = .06$, but not under the 500 ms exposure condition, F (1, 134) = .002, p = .97, partial $\eta^2 = 0$. This supports the idea that rumination-linked attentional bias may involve relatively controlled, rather than automatic, attentional processes. Given existing evidence that rumination-linked attentional bias may be particularly evident on depressogenic material, it would be expected that the rumination-linked attentional bias, evident under the 1000 ms exposure condition, would be more evident on stimuli from the Sad/Happy domain, rather than the Anxious/Relaxed domain. Consistent with such expectation, RRS scores showed a significant positive association with Disengagement Bias Index scores, obtained under this exposure condition, only for stimuli from the Sad/Happy domain, r (134) = .21, p = .01[1], as shown in Figure 2, with no such positive association being evident for stimuli from the Anxious/Relaxed domain, r (134) = -.14, p = .10. Hence, this pattern of findings indicates that heightened ruminative disposition is characterized by impaired attentional disengagement only from negative relative to positive information on the sadness-happiness dimension, and only at the longer 1000 ms exposure duration.

[Insert Figure 2 about here]

To determine whether ruminative brooding and ruminative reflection, as assessed by their respective RRS subscales, were differentially implicated in the observed attentional disengagement bias, we separately computed the association between scores from the RRS brooding and RRS reflection subscales, and the Disengagement Bias scores on stimuli from the Sad/Happy domain at the 1000 ms exposure duration. These Disengagement Bias Index scores had a significant positive association with both RRS brooding scores, r (134) = .17, p = .05, and with RRS reflection scores, r (134) = .16, p = .05. The magnitude of these two correlations did not significantly differ from one another, Z = .06, p = .95. Hence, there was no evidence to suggest that ruminative brooding and ruminative reflection were differentially implicated in the observed disengagement bias effect.

As previously noted, heightened ruminative disposition is often accompanied by heightened depression and indeed, in our present sample, RRS scores were positively correlated with BDI-II scores, r (133) = .46, $p < .001$. Thus, it was important to determine whether the observed impairment in disengaging attention from depressogenic information at the 1000 ms exposure duration was a specific characteristic of heightened ruminative disposition, rather than a characteristic of the elevated depression that accompanied this ruminative disposition. We entered both RRS scores and BDI-II scores simultaneously into a multiple regression in which the Disengagement Bias scores on stimuli from the Sad/Happy domain, at the 1000 ms exposure duration, was the dependent variable. The regression model was significant, F (2, 132) = 3.28, p = .04 and, of most importance to the issue under consideration, the RRS rumination scores predicted independent variance in the disengagement bias scores, $\beta = .24$; t (132) = 2.50, p = .01, while the BDI-II depression scores did not, $\beta = -.06$; t (132) = -.62, p = .54. Thus, these results indicate that there was a direct association between heightened ruminative disposition and the observed impairment in attentional disengagement from depressogenic information.

General Discussion

Previous research has demonstrated that heightened ruminative disposition is characterized by an attentional bias to negative information. The purpose of the present study was to determine whether this rumination-linked attentional bias to negative information reflects facilitated attentional engagement with, or impaired attentional disengagement from, negative information. Our findings show that heightened ruminative disposition is associated with impaired attentional disengagement from negative information, and there was no evidence to suggest that such ruminative disposition is associated with facilitated attentional engagement with negative information. Of course, appropriate caution should always be exercised when interpreting null results, and it will be important for future researchers to replicate the current findings. Nevertheless, our results are fully consistent with the hypothesis that heightened ruminative disposition is characterized specifically by impaired attentional disengagement from negative information.

In addition to resolving this key issue, the present study provided converging support for the previous claim that rumination-linked attentional bias is specific to depressogenic information (Joormann et al., 2006), by showing that heightened ruminative disposition was associated with impaired attentional disengagement from negative information only when this was depression-relevant. Our results also lend weight to the contention that rumination-linked attentional bias may be evident only when controlled attentional processing is readily permitted (Donaldson et al., 2007), as we found that heightened ruminative disposition was associated with impaired attentional disengagement from negative information only when stimuli were exposed for 1000 ms, and not when they were exposed for 500 ms. It is common to assume that attentional effects observed only at longer stimulus exposure intervals reflect the operation of controlled processing (McNally, 1995; Mogg & Bradley, 2005), inviting the inference that controlled attentional processes may play an important role in the attentional disengagement bias associated with heightened ruminative disposition. However, it should be acknowledged that 500 ms exposure durations do permit sufficient time to enable the operation of controlled attentional processes, albeit to a lesser extent that would be possible at longer exposures (Holender, 1986; Mogg, Bradley, & Williams, 1995). It could be that evidence of biased disengagement from negative information was more evident 1000 ms after stimulus onset, compared to 500 ms after stimulus onset, only because attentional disengagement from these stimuli necessarily must temporally follow engagement, and differences in disengagement bias, as a function of ruminative disposition and stimulus valence, could be detected only when sufficient time was permitted for such disengagement to occur. Future researchers could seek to determine the relative involvement of automatic and controlled processes in the presently observed rumination-linked disengagement bias by using a secondary load to disrupt controlled attentional processing (Sternberg, 1966; van Dillen, Papies, & Hofmann, 2012). If the restriction of rumination-linked biased attentional disengagement to the 1000 ms exposure duration, in the present study, does reflect the fact that this bias results from patterns of controlled attentional processing, then it would be expected that this bias would be attenuated under secondary load conditions.

The current findings also indicate that the observed disengagement bias effect was a function of ruminative disposition in general, as there was no evidence to suggest that this effect differentially implicated ruminative brooding and ruminative reflection. Further, although ruminative disposition was correlated with depression, as expected, this pattern of biased attentional disengagement was found to be a direct function of ruminative disposition, rather than an indirect function of accompanying heightened depression.

The pattern of results obtained in our current study are in keeping with the theory recently put forward by Koster et al. (2011), according to which heightened ruminative disposition is caused in part by specific difficulty disengaging attention from depressogenic information. The current study cannot shed light on the causal nature of the observed association between such disengagement bias and heightened ruminative disposition. Using an attentional-probe task variant configured to systematically modify attentional response to negative information, Yang, Ding, Dai, Peng, and Zhang (2014) have recently shown that experimentally induced change in attentional bias can serve to influence subsequent rumination, consistent with the possibility that such attentional selectivity causally contributes to rumination. It will be now be important for researchers to directly interrogate the causal role of impaired attentional disengagement from depressogenic information in heightened ruminative disposition, using training variants of the conventional attentional-probe task specifically configured to directly modify attentional disengagement from depressogenic information. Of course, the finding that impaired attentional disengagement from depressogenic information makes a causal contribution to ruminative disposition would not preclude the possibility that such disposition also may causally influence this attentional bias in a reciprocal manner. Future research addressing this issue could make a valuable contribution to the literature.

Attentional bias is not the only information processing anomaly that has been found to be associated with heightened ruminative disposition. There is evidence that such ruminative disposition is characterized by enhanced recall of negative information (McFarland & Buehler, 1998), an increased tendency to impose negative interpretations on situations (Lyubomirsky & Nolen-Hoeksema, 1995), and a reduced expectancy for positive future events (Pyszczynski, Holt, & Greenberg, 1987). Moreover, within the domain of attentional processing there is growing evidence that heightened ruminative disposition may be characterized by deficient attentional control (Koster et al., 2011). The pattern of biased attentional disengagement observed in the present study, and such a deficit in attentional control, may represent two quite independent characteristics of rumination. However, a more intriguing possibility is that this impaired attentional disengagement from depressogenic information may result from deficient attentional control. The nature of the relationship between each attentional anomaly and variation in ruminative disposition should now be investigated by measuring disengagement bias, using the current attentional assessment task, while also including an established measure of attentional control such as the anti-saccade task (e.g. Derakhshan, Ansari, Hansard, Shoker, & Eysenck, 2009), within the same studies. This would reveal whether the presently observed association between disengagement bias and ruminative disposition is direct, or is mediated by rumination-linked variation in attentional control.

There are, of course, some limitations associated with the current study. For one thing, our participants were not selected on the basis of displaying the excessively high ruminative disposition characteristic of pathological ruminators. Hence, it remains to be seen whether clinical patients exhibiting such pathological rumination would exhibit only impaired attentional disengagement from depressogenic information, as observed in the present participants. One intriguing possibility worthy of future consideration is that the attentional characteristics of pathological rumination might differ from the pattern of attentional selectivity presently found to be associated with high ruminative disposition in a non-clinical sample. Specifically, while the latter individuals only showed evidence of impaired attentional disengagement from negative information, it may be the case that the former individuals could show both impaired attentional disengagement from, and facilitated attentional engagement with, depressogenic information.

For the moment, we can conclude that heightened ruminative disposition, as assessed by the RRS, is characterized by impaired attentional disengagement from negative information, relative to positive information, that this attentional bias appears to specifically favour the processing of depression-relevant information, and that it is only evident when stimuli are exposed for 1000 ms, rather than 500 ms, exposure durations. We hope that this work, and the suggestions we have made concerning how future research can build upon this foundation, will be of value to investigators seeking to better understand the attentional basis of rumination.

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Table 1.

Mean (and SD) of Engagement and Disengagement Bias Indices obtained under each experimental condition.

	500 ms Exposure Duration		1000 ms Exposure Duration	
Attentional Bias Type	Sad/Happy Stimulus Domain	Anxious/Relaxed Stimulus Domain	Sad/Happy Stimulus Domain	Anxious/Relaxed Stimulus Domain
Engagement Bias Index	.-9.04 (248.45)	-12.32 (236.13)	-23.77 (264.71)	-40.04 (317.16)
Disengagement Bias Index	-47.44 (294.55)	-2.58 (270.62)	3.04 (280.01)	12.01 (332.95)

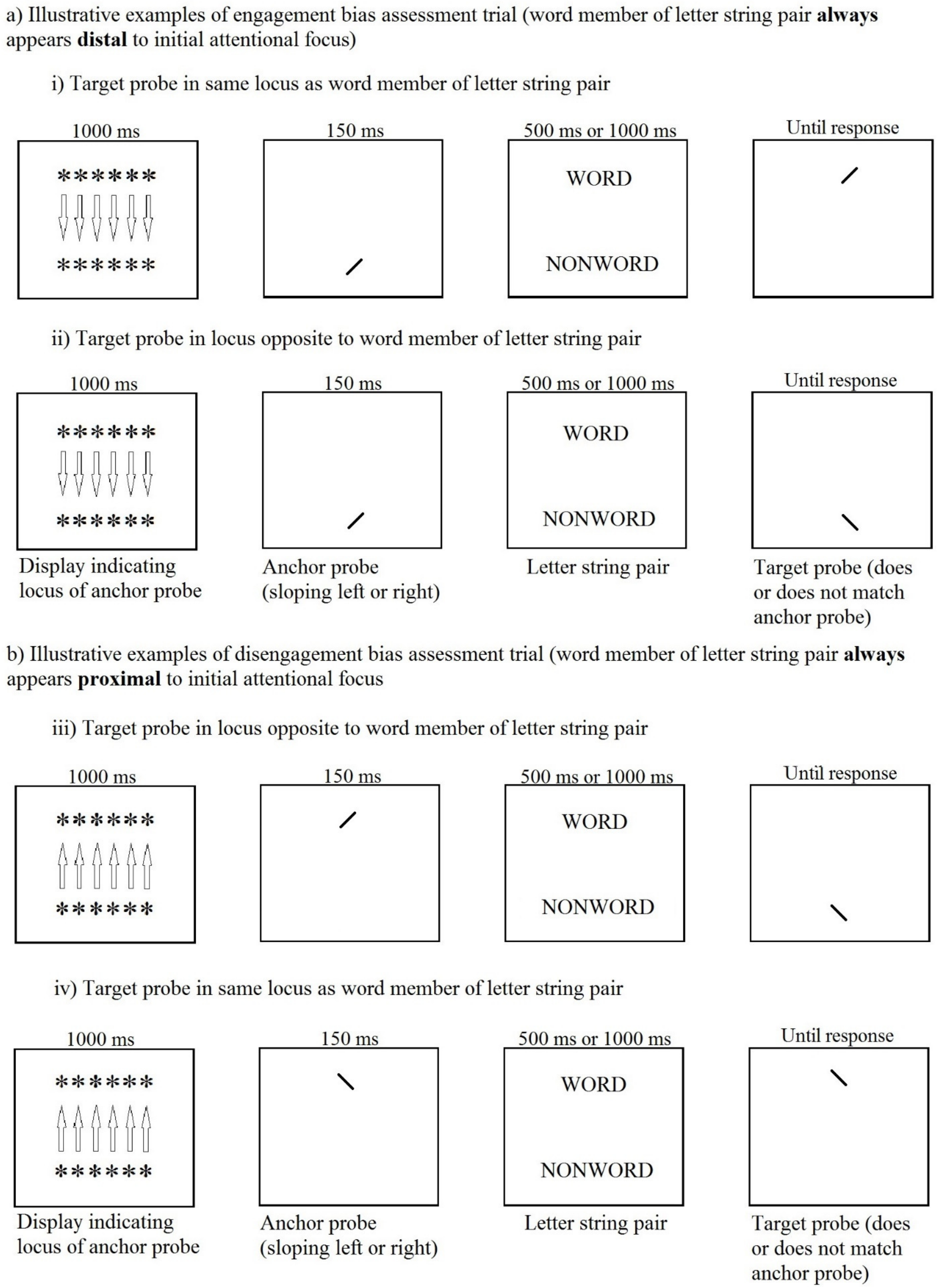

Figure 1. Illustrative examples of sequence of events on attentional engagement bias assessment trial (panel a), and on attentional disengagement bias assessment trial (panel b).

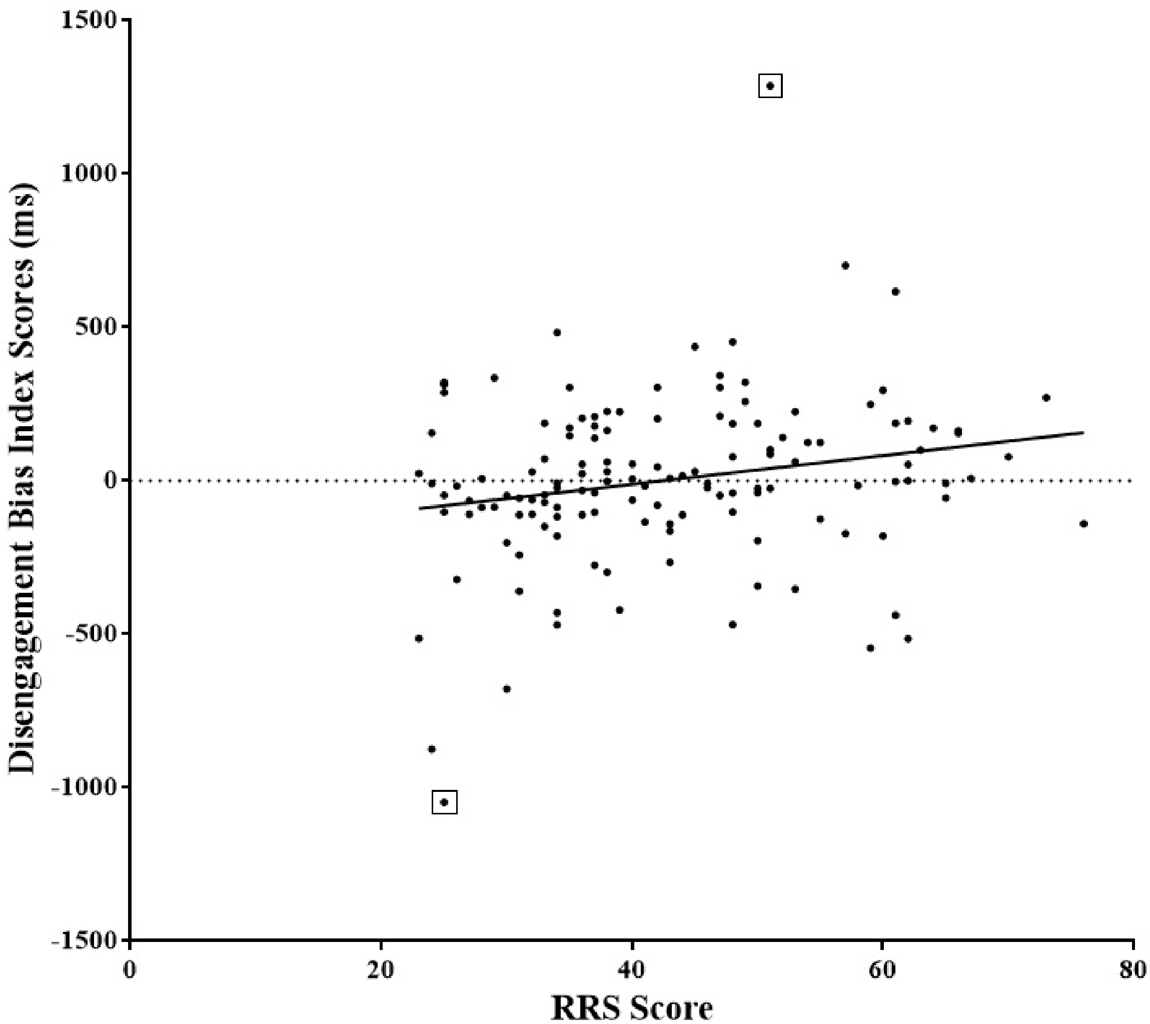

Figure 2. Scatterplot showing the association between RRS scores and Disengagement Bias Index scores when stimuli came from the Sad/Happy domain at the 1000 ms exposure duration.

Footnote

[1] Two outlying bias scores, identified in Figure 2 by the square outlines, were detected using box-and-whisker plots. The correlation between these two variables remained positive and significant when these outliers were excluded, $r\ (134) = .18$, $p = .04$.

Appendix

Sad/Happy		Anxious/Relaxed	
Negative Word	Positive Word	Negative Word	Positive Word
sluggish	happier	intimidated	brave
disappointed	enjoy	fretting	ease
aimless	pleased	fearful	relaxed
unhappy	brightness	tense	composed
emptiness	energetic	dangerous	heroic
lonely	lively	worried	confident
dreary	satisfaction	neurotic	serene
forlorn	buoyant	agitation	calm
dismal	merry	frightened	restful
defeat	passionate	nervous	tranquil
brooding	euphoric	suffocating	assertive
hopeless	zeal	attack	courageous
gloomy	excited	panicky	peaceful
failure	eager	uneasy	secure
upset	fulfilled	restless	safe
discouraged	fun	alarmed	fearless