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# Testing the attentional scope model of rumination: An eye-tracking study using the moving window paradigm

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### ABSTRACT

The attentional scope model of rumination predicts that rumination is associated with a narrowed attentional scope which magnifies emotional responding and reduces problem-solving. This study examined this prediction by using a moving window paradigm, allowing for a more direct measurement of attentional scope at a perceptual level. High and low trait ruminators were asked to read self-related and other-related sentences under small, medium, large, and no moving window conditions while their visual fixations during reading were recorded. Results showed significant group differences in the small window size condition, with the high rumination group processing faster and making fewer fixations when reading the sentences. Further analyses confirmed that differences remained after controlling for mood state and the level of depression. These findings indicate that people with high levels of trait rumination are characterized by a narrower attentional scope when processing information. Clinical implications in relation to rumination are discussed.

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## 1. Introduction

Rumination is considered a form of responding to negative mood that focuses in a perseverative and repetitive manner on the implications, causes and meanings of one's feelings and problems (Nolen-Hoeksema, 1991). It is one of the most important cognitive risk factors for development and maintenance of depressive symptoms (Mor & Winquist, 2002; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Previous studies mostly focused on the negative content of rumination (Watkins, 2008), whereas more recent research has begun to investigate the mechanisms involved in the persistent use of rumination (Nolen-Hoeksema et al., 2008). Cognitive control, which involves top down control in processing, updating, and inhibiting of information has been shown to play a critical role in depression (Disner, Beevers, Haigh, & Beck, 2011) and specifically in rumination (Joormann, 2010; Koster, De Lissnyder, Derakhshan, & De Raedt, 2011). Therefore, investigation of the influence of rumination on information processing may help to gain a better understanding on the underlying mechanism of rumination and provide insights into prevention and treatment of depression.

Several theoretical frameworks have been developed to conceptualize the information-processing mechanisms that contribute to the persistence in the use of ruminative response styles (i.e., trait rumination). For example, some cognitive views propose that persistent rumination is associated with deficient inhibition (Joormann, 2010) and impaired disengagement from negative self-related information (Koster et al., 2011). Recently, a complementary framework has been proposed by Whitmer and Gotlib (2013), which posits that *attentional scope* is an important factor that affects the repetitive nature of thinking in trait ruminators. Attentional scope here has a broad definition and can refer both to the amount of information that is directly perceived from the environment as well as to the amount of information that is activated in working memory, where the perceived information is temporarily stored and manipulated. Overall, the attentional scope model of rumination (Whitmer & Gotlib, 2013) proposes that a limited attentional scope accounts for various characteristics observed in high trait rumination: in a neutral mood, high trait rumination is frequently associated with a narrower attentional scope which sometimes benefits to task-related information processing (Altamirano, Miyake, & Whitmer, 2010). However, under negative mood states, high trait rumination would be associated with a stronger focus on the causes and problems related to distress, at the expense of processing other information relevant for problem solving. Accordingly, the attentional scope model of rumination predicts that people with high levels of rumination would be char-

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acterized by a narrow attentional scope even when they are in a neutral mood and are processing neutral information. Then, as their negative mood increases or positive mood decreases, high trait ruminators' attentional scope will become increasingly narrow by only focusing on negative self-related themes. This model also posits that people with low rumination levels are characterized by a broader attentional scope, which reduces their level of ruminative thinking by increasing their chance to reallocate attention to other sources of information or distracting stimuli.

Although the attentional scope model provides an explanation for a large number of previous findings in relation to rumination and information-processing (Altamirano et al., 2010; Joormann & Tran, 2009), only few empirical studies directly examined the model's predictions on attentional scope at a perceptual level. In a recent study (Grol, Hertel, Koster, & De Raedt, 2015), healthy undergraduates were induced to either engage in a state of rumination or in a state of problem-solving after which their visuospatial attentional scope towards self- or other-related information was examined. This study found that participants with a higher level of trait rumination who underwent the state rumination induction showed a more narrow attentional scope for self-related information relative to other-related information. Moreover, in a second experiment, Grol et al. (2015) also demonstrated that even in absence of a manipulation of rumination state, higher levels of trait rumination (i.e., brooding) were related to a more narrow scope of attention for self-related information relative to other-related information. This suggests that ruminative thinking is associated with a narrowed attentional scope in visual attention, especially when confronted with self-related information.

Although results from Grol et al. (2015) are promising in clarifying the association between rumination and attentional scope, a drawback is that the manipulation of self-relevant information was rather limited as this entailed presenting the word "me" versus another two letters. Moreover, the task was a rather complicated dual-task where inferences on attention were purely based on accuracy rates. Further research is required to clarify whether rumination is specifically associated with narrowed attentional scope for self-relevant information or whether this impairment emerges for other information. Moreover, the approach used in Grol et al. (2015) and other frequently employed methodologies (e.g., *Global-Local Navon Letter task*, Navon, 1977) rely on indirect indices to estimate perceptual processes of attentional scope (e.g., participants' detection accuracy, reaction times). Hence, it seems crucial to investigate the relation between rumination and attentional scope using more direct measures of individuals' natural attentional scope for different types of information (i.e., self-related vs. other-related neutral information).

### 1.1. The current study

The current study was designed to explore the association between trait rumination and attentional scope in a more direct manner. We used a moving window task (McConkie & Rayner, 1975), which is a well-validated eye movement paradigm to measure attentional scope at the perceptual level (Pollatsek, Rayner, Fischer, & Reichle, 1999; Rayner, 2014). During this task, there is a window frame on the screen moving with participants' eye movements through which one can only see a limited amount of letters belonging to a sentence while the text outside the window is masked. To control how much information is available to participants, the width of the window is manipulated in different conditions (i.e., different sizes). The rationale of this task is that when the window size is smaller than a reader's attentional scope, the reading process will be different from the natural (i.e., no window and no mask) reading condition (Rayner, 1998). In contrast, the reading process will not differ from the natural reading condition

when the window size is as large as or larger than a reader's attentional scope. Specifically, previous research using this paradigm has taken eye movements as a measure of reading process, showing that increased processing difficulty is correlated with slower reading rate, longer fixation duration and larger number of fixations (Pomplun, Reingold, & Shen, 2001; Rayner, Chace, Slattery, & Ashby, 2006). Therefore, in the present study, we used these eye movement indices (i.e., total sentence reading time, average fixation duration, number of fixations, and reading rate) as indicators of the degree of processing difficulty in reading during the moving window task (Brzezicka, Krejtz, von Hecker, & Laubrock, 2012; Choi, Lowder, Ferreira, & Henderson, 2015; Häikiö, Bertram, Hyönä, & Niemi, 2009).

The first aim of the current study was to examine whether individual differences in the general tendency to ruminate (trait rumination) are associated with the magnitude of attentional scope at a perceptual level, as measured by eye movement indices at different window sizes during reading. Based on the prediction of the attentional scope model of rumination (Whitmer & Gotlib, 2013), we hypothesized that individuals with high levels of trait rumination would show a more narrow perceptual scope in comparison with individuals with low levels of trait rumination. This should be reflected by faster reading time (shorter total reading time, shorter average fixation duration, and faster reading rate) and less number of fixations when the window size is more compatible with the size of attentional scope of individuals with high rumination than the ones with low rumination (i.e., at small window size conditions). Furthermore, the attentional scope model of rumination states that the association between individual differences in rumination and attentional scope emerges not only in negative but also in neutral mood states. Therefore, participants' current mood state levels and depression levels were measured and included as covariates when significant effects that related to rumination group were observed.

Our second aim was to clarify under which conditions attentional narrowing effects can be observed. In the present study we used neutral sentences to examine the prediction of the attentional scope model of rumination that the association between trait rumination and attentional scope would emerge. In order to test whether the attentional narrowing effect would be dependent on the activation of self-representations, we manipulated the self-relevance of sentences. As suggested by Grol et al. (2015), trait rumination might be more strongly associated with narrowed attentional scope when confronted with self-related information rather than other-related information. Therefore, in the present study, we used both self- and other-related sentences as reading material to explore whether the presence of self-related information influences the association between trait rumination and attentional scope. In line with the evidence suggesting that ruminative thinking might be specifically related to narrowed attention towards self-related content (Grol et al., 2015), we expected that there would be specific differences between individuals with high and low trait rumination when processing self-related sentences.

## 2. Method

### 2.1. Participants

Participants were prescreened on the basis of their scores on the Ruminative Response Scale (RRS; Nolen-Hoeksema & Morrow, 1991; Raes, Hermans, & Eelen, 2003) from a database of 305 students of Ghent University. Only individuals scoring in the highest 25% (high ruminators) and the lowest 25% (low ruminators) of the RRS were invited to participate in the current study. Based on the medium effect size (partial  $\eta^2 = .07$ ) provided in the recent study of Brzezicka et al. (2012) using the similar moving window task

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