

# Attentional biases in ruminators and worriers

Mieke Beckwé<sup>1</sup> · Natacha Deroost<sup>1</sup>

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**Abstract** This study aims to investigate whether attentional biases typically associated with depression and anxiety already exist on a sub-clinical level. A transdiagnostic characteristic, both affective disorders have in common at a sub-clinical level, is persistent negative thinking (PNT), called rumination in depression and worrying in anxiety disorders. We investigated the association between these two types of PNT and attentional biases, using two different versions of the exogenous cueing tasks (ECT) in two different experiments. In Experiment 1, the cues of the ECT were negative and positive personality traits. This allowed us to investigate whether high-ruminators ( $N = 29$ ), analogous to depressed patients, have difficulties to disengage attention from negative personality traits, as compared to low-ruminators ( $N = 40$ ). In Experiment 2, the cues of the ECT were negative words related to themes participants frequently worry about versus positive words. This was done to investigate whether high-worriers ( $N = 26$ ), analogous to anxious persons, have a strong tendency to automatically direct attention toward worry-related information, as compared to low-worriers ( $N = 27$ ). The results of Experiment 1 showed that high-ruminators have difficulties to disengage their attention from negative personality traits. The results of Experiment 2 indicated that there were no attentional biases for high-worriers. These results show that the attentional bias typically associated with depression is already present at a sub-clinical level, whereas this seems not to be the case for the attentional bias typically associated with anxiety.

## Introduction

Major depressive disorder (MDD) and generalized anxiety disorder (GAD) are the two most prevalent mental disorder worldwide (Ormel et al., 1994). Both are characterized by a great amount of psychological suffering (Wicks-Nelson, & Israel, 2009), high relapse-rates (Ansseau et al., 2008), and there is a high degree of comorbidity between both affective disorders (Kessler et al., 2008). As a person who goes through a depressive or anxious episode will probably go through such episodes again later in life, ideally, we should develop transdiagnostic treatments that are able to prevent a first full-blown episode of MDD or GAD.

One possible way to achieve this might be to reduce persistent negative thought (PNT). PNT plays a causal and sustaining role in both MDD and GAD (Segerstrom, Tsao, Alden, & Craske, 2000), and is thus a transdiagnostic, sub-clinical characteristic of both affective disorders. Several types of PNT exist, rumination and worrying being the two most important types. Rumination is a cognitive symptom commonly described in relation to depression. Ruminative thoughts often deal with negative past events, such as failures and losses, and focuses on the origin, causes, and consequences of negative emotions as well as on the symptoms of depression (Nolen-Hoeksema, 1991). Worry, on the other hand, is the defining symptom of the GAD. Typically, the content of worry-thought is related to possible negative events in the future and strategies to prevent such events from occurring (Borkovec, & Inz, 1990). Despite its potential clinical importance, little is known about the underlying causes of PNT. Why do some people have a strong tendency to worry or ruminate whereas others do not?

In the current study we investigate attentional biases for negative information as a possible underlying vulnerability

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✉ Mieke Beckwé  
mbeckwe@vub.ac.be

<sup>1</sup> Department of Experimental and Applied Psychology, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium

mechanism of PNT. It has been shown persistently that anxiety and depression are associated with a valence-specific bias (Mogg, & Bradley, 2005). For instance, several studies have reported that depressed persons have an impaired ability to divert their attention away from negative information (for a review, see De Raedt, & Koster, 2010). According to Mogg and Bradley (2005), the attentional bias for negative information in depression is most pronounced in experiments using negative self-descriptive (i.e., participant-selected) information, because it activates negative self-schemata in depressed persons (e.g. Segal, Gemar, Truchon, Guirguis, & Horowitz, 1995). Anxious persons, on the other hand, rather show an attentional bias towards threat-related information at an early stage of information processing (for a review, see Bar-Haim, Lamy, Pergamin, Bakersman-Kranenburg, & van IJzendoorn, 2007). For example, trait anxiety in healthy participants is associated with an attentional bias toward fearful facial expressions (Fox, 2002) and threatening pictures (Yiend, & Mathews, 2001). In specific phobias, such as arachnophobia, threat-related information is relatively clearly delineated, but persons suffering from GAD or students scoring high on trait anxiety, for instance, have a wide range of concerns, which may vary from individual to individual. Therefore it was suggested by Reidy and Richards (1997) that the most appropriate stimuli to test anxious patients are stimuli related to each individual's current concerns, i.e., worry-related information.

It is still unclear whether this valence-specific attentional bias should be seen as a symptom, or rather as a cause (vulnerability factor) of anxiety and depression. Initially, the bias was seen as a symptom of affective disorders, but more recently a number of researchers have suggested that the bias (1) plays a causal role in the development of affective disorders in general, and (2) has a negative impact on recovery (Mogg, & Bradley, 1998). Recent experimental findings support the hypothesis of a causal role of attentional bias in anxiety disorders (MacLeod, Rutherford, Campbell, Ebsworthy, & Holker, 2002). In one study, an experimentally induced valence-specific attentional bias in students led to increased distress reactions (measured with a self-report questionnaire) in a subsequent stress task. In this stress task, participants had to complete a mixture of difficult and insoluble anagrams, under time pressure, with false failure feedback, and while being videotaped. Inversely, the experimental reduction of a pre-existing bias led to a decrease of distress reactions (MacLeod et al., 2002). Like for anxiety, the attentional bias typically associated with depression may also play a causal role in depression. According to the impaired disengagement hypothesis (Koster, De Raedt, Leyman, & De Lissnyder, 2011) impaired attentional control in depression causes an inclination for perseverative negative cognition,

which in turn amplifies depression. De Lissnyder et al. (2012), for instance, found support for this idea in a longitudinal study with healthy university students. The study showed that students who exhibited an impaired attentional control for emotional information in the first phase of a study, ruminated more in reaction to stress (pre-exams study period) 6 weeks later.

In sum, there seems to be a relationship between affective disorders and attentional biases that is possibly mediated by PNT. For this reason, we want to determine whether attentional biases also exist at a subclinical level, focusing on one particular transdiagnostic symptom of anxiety and depression: PNT. To this aim, we will investigate the exact nature of attentional biases related to worry and rumination at a subclinical level. The relation between attention and trait worry or rumination is barely investigated. To our knowledge, only one study exists on the connection between trait worry and attention: Verkuil, Brosschot, Putman and Thayer (2009) investigated the association between attentional biases and trait worry and trait anxiety in an undergraduate sample using pictorial stimuli (happy, neutral or angry schematic faces). Only those students with elevated scores on both trait worry and trait anxiety scales showed a decreased capacity to divert attention away from angry faces. The attentional biases in worriers were never investigated before using verbal stimuli. There is one single study on the connection between trait rumination and attention, conducted in a clinical sample of depressed patients: Donaldson, Lam and Mathews (2007) showed that depression is associated with an attention bias toward negative verbal information, and that this bias is stronger in individuals with a strong tendency to ruminate. The relation between trait rumination and attention was never before investigated in a healthy sample. Moreover, to our knowledge, attentional biases were never before simultaneously investigated in worriers and ruminators.

In the current study the attention bias in worriers and ruminators was studied using the exogenous cueing task (ECT; Posner, 1980). In an ECT, respondents are presented with a fixation cross in the middle of a computer-screen. To the left and to the right of this cross there is a square in which a cue may appear. In the emotional version of the original ECT (Posner, 1980) cues are either negative or positive words. Subsequently, a dot (target) appears in one of the squares, and respondents are asked to react to its location as quickly as possible. The target can either appear in the same square as the cue (valid trial), or in the other square (invalid trial). When cue presentation is short (<300 ms), respondents are typically quicker to react on valid trials than on invalid trials, because their attention had already been drawn by the cue speeding up performance when the target appears in the same location in a

valid trial. This effect is called the cue validity effect (CVE; Posner, & Cohen, 1984). When cue presentation is longer (>300 ms), however, attention shifts from the cue-location to other locations, and the cue-location is inhibited. Respondents will thus be quicker to respond to invalid trials after a long cue target interval (CTI). This effect is called inhibition of return (IOR; Posner, & Cohen, 1984). Surprisingly, when the cues in the ECT are emotionally charged, it has been found that some respondents continue to react quicker to valid trials after long cue presentation (>300 ms), because their attention is being held by the emotional information. This is called the enhanced cue validity effect (ECVE; Fox, Russo, & Dutton, 2002). By calculating the (E)CVE for different cue dimensions, we can thus determine which information (negative, personally relevant, etc.) grabs respondents' attention the most. Additional indices such as Attention Engagement and Attention Disengagement scores allow further differentiation between attentional capture and attentional holding, respectively (Koster, Crombez, Verschuere, Van Damme, & Wiersema, 2006). Attention Engagement scores are calculated by subtracting reaction times for valid trials with negative cues from reaction times for valid trials with positive cues. Attention Disengagement scores are calculated by subtracting reaction times for invalid trials with positive cues from reaction times for invalid trials with negative cues. Typically, CVE and Attention Engagement scores for short CTI trials are used to investigate early attentional processes such as initial vigilance, whereas IOR effects or ECVE and Attention Disengagement scores for longer CTI-trials enable to study late attentional processes such as difficulties to disengage attention.

In the current study, we used the ECT specifically to determine the association between PNT and attentional biases typically associated with affective disorders. We administered a different type of ECT to each specific type of PNT, namely rumination and worrying. In the first ECT, administered in Experiment 1, we investigated whether persons with a strong tendency to ruminate have difficulties to disengage attention from negative self-descriptive information, as has been established in MDD. Likewise, in the second ECT, administered in Experiment 2, we determined whether persons with a strong tendency to worry automatically focus on worry-related information, just like has been found in anxiety.

In order to optimally adjust the ECT experiment to possible attentional biases in ruminators and worriers respectively, we used specific cues. More precisely, in Experiment 1, we used personality traits in the ECT experiment, as we expect an attentional bias in high-ruminators, analogous to depression, to be most pronounced when using negative self-descriptive information (Mogg, & Bradley, 2005). In Experiment 2, on the other hand, we

used words related to themes healthy university students frequently worry about, because we expect high-worriers, in analogy with anxious participants, to exhibit an automatic attention bias towards worry-related information (Reidy, & Richards, 1997). The worry-themes administered in Experiment 2 were developed in a pilot-study in 310 undergraduate students showing that (1) fear of failure, (2) relationships, (3) health and (4) loss are the most prevalent worry-themes in this particular population. This is in accordance with earlier studies investigating worry-themes (e.g. Brown, 2009). Before completing the actual experiment, respondents in the current study were asked to indicate which of the personality traits and worry-words were personally relevant for them, in the first and second experiment, respectively. By personally relevant, we mean in this case, respectively (1) words that describe their personality, and (2) words related to themes they frequently worry about. Since previous studies indicated that people react more strongly to personally relevant stimuli (e.g. Oathes, Siegle, & Ray, 2011; Siegle, Steinhauer, Carter, Ramel, & Thase, 2003), we expect attentional biases for negative information in both experiments to be more pronounced when the negative cues are personally relevant.

To briefly summarize our goal, this study aims to investigate whether the attentional biases described in anxious and depressive persons are already sub-clinically present in persons with a strong tendency for perseveration in negative thought. We expect persons with a strong tendency for rumination to have difficulties to disengage attention from negative self-referent information, and persons with a strong tendency for worrying to automatically direct their attention towards worry-related information. More precisely, for high-ruminators we expect a bigger ECVE and high Attention Disengagement scores in long (1500 ms) CTI-trials with negative personality traits as cues, and for high-worriers we expect a bigger CVE and high Attention Engagement scores in short (250 ms) CTI-trials with negative worry-related words as cues. In addition, we expect these attentional biases to be more pronounced when the cues are personally relevant for the respondents.

## Experiment 1: ECT with personality traits as cues

### Method

#### *Participants*

Sixty-two participants (49 females) with a mean age of 19.68 years ( $SD = 3.99$ ) were selected from a sample of undergraduates who were taking an introductory

**Table 1** Participant characteristics in Experiment 1 (SD between parentheses)

|                     | High-ruminators | Low-ruminators | Total         |
|---------------------|-----------------|----------------|---------------|
| Age (years)         | 19.79 (4.01)    | 19.60 (4.02)   | 19.68 (3.99)  |
| Males/females       | 9/20            | 11/29          | 20/49         |
| PSWQ score          | 57.21 (8.12)    | 46.05 (13.45)  | 50.81 (12.69) |
| RRS score           | 61.45 (5.55)    | 39.59 (8.04)   | 48.91 (12.96) |
| State anxiety score | 41.34 (11.62)   | 35.08 (8.95)   | 37.71 (10.55) |
| BDI score           | 13.93 (7.53)    | 7.25 (5.66)    | 10.06 (7.26)  |

psychology course ( $N = 286$ ). Their selection was based on extremely high ( $>58$ ) versus extremely low ( $<43$ ) Ruminative Response Scale scores (RRS), measured 6 months earlier. Just before the computer experiments, the RRS was again administered and two groups were then formed based on a median split of the RRS score of this second measurement: respondents with a high score were assigned to the high-ruminators group (raw score RRS  $>54$ ,  $N = 29$ ). Respondents with low scores were assigned to the low-ruminators group (raw score RRS  $<55$ ,  $N = 40$ ). Both groups did not differ significantly in male/female ratio ( $\chi^2(1, 69) = 0.10$ ,  $p = .75$ ) or mean age ( $t(67) = 0.20$ ,  $p = .84$ ). For additional details on these groups, see Table 1.

### Material

**Self-report questionnaires** The Penn-State Worry Questionnaire (PSWQ) (Meyer, Miller, Metzger, & Borkovec, 1990; Authorized Dutch version: Van Rijsoort, Vervaeke, & Emmelkamp, 1997) is a 16-item questionnaire that assesses the tendency to worry. The items are rated on a five-point scale for the degree to which they characterize the participant. The Dutch version of the PSWQ has a high internal consistency (Cronbach's  $\alpha = 0.88$ – $0.90$ ; Kerkhof et al., 2000; Van Rijsoort, Emmelkamp, & Vervaeke, 1999).

**The Ruminative Response Scale (RRS)** The RRS (Trenor, Gonzalez, & Nolen-Hoeksema, 2003; Authorized Dutch version: Raes et al., 2009) consists of items measuring the tendency to ruminate when in a depressed mood. Each item is rated on a four-point scale ('almost never' to 'almost always'). A study by Raes et al. (2009) showed that the Dutch version of the RRS with 26 items has a good internal consistency (Cronbach's  $\alpha = 0.88$ ).

**The State-Trait Anxiety Inventory (STAI)** The STAI (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983; Authorized Dutch version: Van der Ploeg, 2000) is a 40-item self-report scale designed to measure two distinct anxiety concepts: state anxiety (A-state) and trait anxiety (A-trait). Item scores range from 1 to 4. An excellent internal consistency (Cronbach's  $\alpha = 0.91$ ) is reported for

the Dutch version of the STAI (Van der Ploeg, 2000). Respondents only completed the A-state inventory of the STAI.

**Beck Depression Inventory (BDI-II)** The BDI-II (Beck, Steer, & Brown, 1996; Authorized Dutch version: Van der Does, 2002) is a self-rating measure for severity of depression. It consists of 21 items measuring depressive symptoms, as defined by the DSM-IV (APA, 1994). Participants are asked to mark the statements that describe best how they felt during the 2 weeks prior to participation, with item scores ranging from 0 to 3. Internal consistency (Cronbach's  $\alpha = 0.88$ ) of the Dutch version is good (Van der Does, 2002).

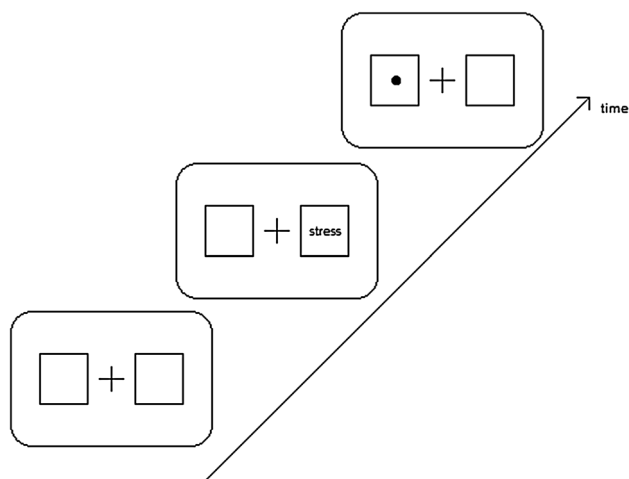
**Apparatus and cues of the ECT** The ECT was conducted on IBM-compatible Pentium 4 personal computers with a 17-inch screen, using E-prime Psychology Software Tools Inc. version 2.0 software (Schneider, Eschman, & Zuccolotto, 2002).

To measure attentional biases we used emotional cues taken from the affective word list by Hermans and De Houwer (1994), which lists valence (1 = very negative, 7 = very positive) and familiarity (1 = not familiar at all, 7 = very familiar) ratings for 740 Dutch nouns and personality traits.

### Procedure

Six months before the actual computer experiment a sample of undergraduates who were taking an introductory psychology course completed four questionnaires: the PSWQ, the RRS, the State Anxiety scale of the STAI, and the BDI-II (see above). Based on extremely high versus extremely low RRS or PSWQ scores, participants were selected for respectively Experiment 1 or 2. The BDI-II and STAI were administered as standard screening instruments to determine the presence of clinical symptoms. Prior to the ECT, students again completed these four questionnaires and signed an informed consent declaring that, the day of the experiment, they had not overconsumed any alcohol, coffee or other substances, had not used any medication (with the exception of anticonception), and

were in a normal general health condition, physically as well as psychologically. Consequently, participants had to indicate on a pen and paper word list which words described their personality, and which words did not. We administrated a list of 30 negative and 30 positive personality traits (see “Appendix” for the English translation of the words used in Experiment 1) from which participants chose 10 words for each valence that described their personality versus 10 words that did not. This allowed us to distinguish personally relevant from non-personally relevant personality traits. Based on their answers, ECTs were tailor-made for each participant, with the restriction that cues always consisted of 20 personally relevant words (10 positive and 10 negative) and 20 non-personally relevant words (again 10 positive and 10 negative). Respondents were shown instructions on a computer screen, saying that a word, followed by a dot, would appear to the left or to the right of the fixation cross. If the dot appeared to the left, they had to press the “W” key on an azerty keyboard and the “N” key if it appeared to the right. They were also asked to work as quickly and as accurately as possible. Initially, for 500 ms a white fixation cross flanked by two white squares of 6 cm high and wide was shown on a black background. A word (the cue) then appeared in the middle of one of the squares for 250 or 1500 ms. The cue disappeared and was replaced by the fixation cross and the squares for 50 ms. Subsequently, a white dot (the target) appeared in the center of one of the squares. The target remained visible until the respondent pressed a response key (“W” or “N”). Trials were either valid, i.e. both cue and target appeared in the same square, or invalid (see Fig. 1). There were as many valid trials as invalid trials. Each ECT was composed of 108 trials. To determine whether respondents paid more attention to negative cues, we calculated the CVE for short CTI-trials (250 ms) and the IOR effect or ECVE for long CTI-trials (1500 ms). The



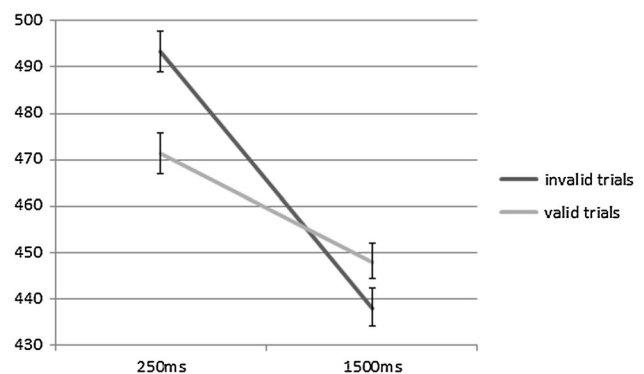
**Fig. 1** Procedure of the ECT (example of an invalid trial)

(E)CVE was determined by subtracting the RT for valid trials from the RT for invalid trials with a particular cue dimension (for instance personally-relevant, negative,...). The higher this number, the more attention is drawn to cues with a particular dimension. The ECTs were carried out in individual testing cubicles in the psychology lab of the Vrije Universiteit Brussel (VUB). All participants completed the ECT as only experimental paradigm administered, no other experiments were administered.

## Results

We performed our analyses on the mean RTs of accurate trials. In accordance with common practice (Koster, De Raedt, Goeleven, Franck, & Crombez, 2005), RTs lower than 150 ms and higher than 750 ms were considered outliers and were excluded from the dataset, as well as data from respondents with a mean total accuracy below 80 %. We retained 91.3 % of the initial data.

First, we determined whether high-ruminators struggle to disengage attention from negative personality traits in long (1500 ms) CTI-trials. To this end, we conducted a  $2 \times 2 \times 2$  repeated measures ANOVA with validity (invalid, valid) and duration (250, 1500 ms) as within-subjects factors and group (high-ruminators, low-ruminators) as between-subjects factor. This analysis revealed a main effect of the factor duration,  $F(1, 67) = 101.48, p < .001, \eta^2 = .602$ , showing that respondents were slower to react on trials with a short CTI ( $M = 482.97, SD = 65.90$ ) than on trials with a long CTI ( $M = 444.25, SD = 61.12$ ). In line with our expectations, there was an interaction-effect between validity and duration,  $F(1, 67) = 25.09, p < .001, \eta^2 = .272$ , denoting a significant CVE (invalid trials:  $M = 493.24, SD = 74.41$  minus valid trials:  $M = 471.27, SD = 64.72$ ) for short CTI-trials (250 ms), and an IOR effect (valid trials:  $M = 448.00, SD = 59.93$  minus invalid trials:  $M = 438.07, SD = 66.83$ ) for long CTI-trials (1500 ms) (see Fig. 2). Other main/interaction effects were not significant.

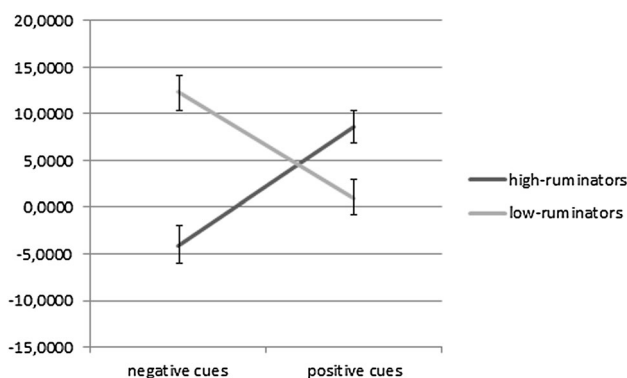


**Fig. 2** CVE and IOR effect in the ECT in Experiment 1

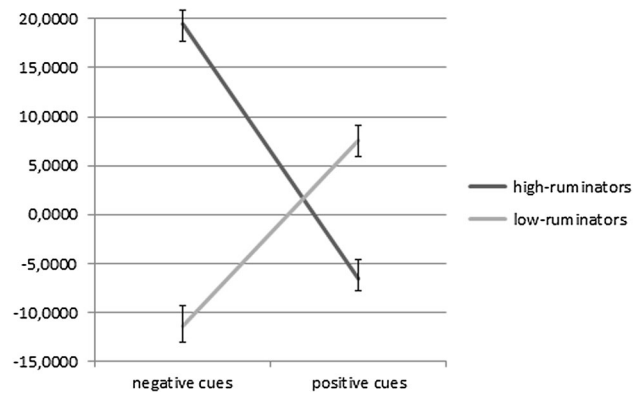


Subsequently, we investigated cue dimension-specific differences between high-ruminators and low-ruminators in trials with a long CTI (1500 ms) because we expect people with a strong tendency to ruminate to have problems especially with disengaging attention from negative personality traits (i.e., in later attention processes), and possibly even more when these negative personality traits are personally relevant. To this end, we determined the IOR effect for trials with a 1500 ms CTI. The IOR effect was calculated by subtraction of the RT for invalid trials from the RT for valid trials. A positive number indicates an IOR effect, a negative number indicates an ECVE showing that participants' attention is being held by the emotional information. The higher the absolute values of this score, the stronger the effect. We performed a  $2 \times 2 \times 2$  repeated measures ANOVA with the factors personal relevance (personally relevant, not personally relevant) and valence (negative, positive) as within-subjects factors, and group (high-ruminators, low-ruminators) as between-subjects factor on the IOR scores. As expected, we found an interaction-effect of the factors group and valence,  $F(1, 67) = 5.15, p = .028, \eta^2 = .097$ , showing a significantly smaller IOR effect for high-ruminators ( $M = -4.10, SD = 67.23$ ) than for low-ruminators ( $M = 12.41, SD = 56.61$ ) when they were confronted with negative cues (see Fig. 3). The mean value of the IOR effect for negative cues was negative for high-ruminators, meaning that they exhibited an ECVE for negative cues. However, there was no main or interaction effect of personal relevance, showing that attention disengagement difficulties in high-ruminators are not influenced by personal relevance of the cues.

Finally, we calculated the Attention Disengagement score; these scores are a reflection of difficulties to disengage attention from negative cues, and they are calculated by subtracting RTs for invalid trials with positive cues from RTs for invalid trials with negative cues. A high Attention Disengagement score means a subject has more



**Fig. 3** Differences in IOR effect between high-ruminators and low-ruminators



**Fig. 4** Differences in Attention Disengagement scores between high-ruminators and low-ruminators

difficulties disengaging attention from negative cues, as opposed to from positive cues. We performed a  $2 \times 2$  repeated measures ANOVA with the factor personal relevance (personally relevant, not personally relevant) as within-subjects factors, and group (high-ruminators, low-ruminators) as between-subjects factor. A main effect of the factor group,  $F(1, 64) = 4.21, p = .044, \eta^2 = .063$ , confirms the hypothesis that high-ruminators ( $M = 19.51, SD = 43.19$ ) are less able to disengage their attention from negative cues than low-ruminators ( $M = -11.39, SD = 58.82$ ) (see Fig. 4). When we added personal relevance as an extra variable, there were again no main or interaction effects with personal relevance.

Importantly, the aforementioned interaction-effects of group  $\times$  valence on the IOR effect, and of group on the Attention Disengagement score were no longer significant when we controlled for depression by entering raw BDI scores as a covariable (respectively:  $F(1, 47) = 3.14, p = .083$  and  $F(1, 62) = 3.15, p = .081$ ).

Since worrying and rumination are very similar processes we investigated whether high-worriers within the same group displayed similar attentional biases as high-ruminators. A group of high-worriers and low-worriers was formed based on a median split of the PSWQ scores.<sup>1</sup> All the above ANOVA's were rerun substituting high and low ruminators with high and low worriers. There were no main or interaction effects with the factor Group. In other words, there are no differences between high-worriers and low-worriers in the ECT using personality traits as cues, as was expected.

In summary, we can conclude that high-ruminators have difficulties to disengage their attention from negative personality traits in trials with a long CTI (1500 ms).

<sup>1</sup> Correlation between raw RRS and PSWQ scores:  $r = .644, p < .001$ , overlap between groups, divided based on median split: 50 % (31 out of 62 students score low on both RRS and PSWQ or high on both RRS and PSWQ).

**Table 2** Participant characteristics in Experiment 2 (SD between parentheses)

|                     | High-worriers | Low-worriers  | Total         |
|---------------------|---------------|---------------|---------------|
| Age (years)         | 18.92 (1.52)  | 20.56 (7.82)  | 19.75 (5.69)  |
| Males/females       | 2/24          | 8/19          | 10/43         |
| PSWQ score          | 60.19 (4.96)  | 41.37 (10.44) | 50.60 (12.51) |
| RRS score           | 51.62 (11.26) | 37.44 (11.61) | 43.57 (14.58) |
| State anxiety score | 44.88 (11.82) | 31.37 (9.37)  | 37.30 (13.47) |
| BDI score           | 15.62 (8.99)  | 4.92 (4.71)   | 10.17 (8.89)  |

## Experiment 2: ECT with worry-related words as cues

### Method

#### Participants

Fifty-three participants (43 females) with a mean age of 19.75 years ( $SD = 5.69$ ) were selected from a sample of undergraduates who were taking an introductory psychology course ( $N = 286$ ). Their selection was based on extremely high ( $>57$ ) versus extremely low ( $<45$ ) PSWQ scores measured 6 months earlier. Right before the computer experiment, the PSWQ was again completed. A group of high-worriers and low-worriers was formed based on a median split of the PSWQ scores of this second measurement: respondents with a high score were assigned to the high-worriers group (raw score PSWQ  $> 53$ ,  $N = 26$ ). Respondents with low scores were assigned to the low-worriers group (raw score PSWQ  $< 54$ ,  $N = 27$ ). Again, both groups did not differ significantly in male/female ratio ( $\chi^2(1, 53) = 2.85$ ,  $p = .09$ ) or mean age ( $t(51) = -1.05$ ,  $p = .30$ ). For additional details on these groups, see Table 2.

#### Material and procedure

The material and procedure were exactly the same as in Experiment 1, except in the following respects. The main difference is that the cues of the ECT were negative worry-related words versus positive words instead of personality traits. Prior the ECT task, participants were presented with four words, which represented common worry themes: (1) fear of failure, (2) relationships, (3) health, and (4) losses.<sup>2</sup> Participants had to indicate which words reflected personally relevant worry-themes for them, and which ones did not. Each worry-theme corresponded to a list of four

<sup>2</sup> None of the participants did not indicate any worry-theme as being relevant; two participants indicated that all of the worry-themes were personally relevant for them. On average, respondents indicated that two out of the four worry-themes were personally relevant to them.

strongly associated negative words, which were presented during the experiment as negative words. This allowed us to distinguish personally relevant from non-personally relevant negative worry words. (See “Appendix” for the English translation of the words used in Experiment 2.)

### Results

Again, we only performed analyses on the mean RTs of accurate trials. RTs lower than 150 ms and higher than 750 ms were considered outliers and were excluded from the dataset, as well as data from respondents with a mean total accuracy below 80 %. We retained 91.8 % of the original dataset.

In the second experiment, we investigated whether high-worriers automatically focus on negative worry-related words in short (250 ms) CTI-trials. First, we conducted a  $2 \times 2 \times 2$  repeated measures ANOVA with validity (invalid, valid) and duration (250, 1500 ms) as within-subjects factors and group (high-worriers, low-worriers) as between-subjects factor. Again, as shown by an interaction-effect of the factors validity and duration,  $F(1, 50) = 15.67$ ,  $p < .001$ ,  $\eta^2 = .239$ , a clear CVE (invalid trials:  $M = 416.15$ ,  $SD = 61.83$  minus valid trials:  $M = 406.54$ ,  $SD = 53.89$ ) was found for short CTI-trials (250 ms), and a weaker IOR effect (valid trials:  $M = 438.06$ ,  $SD = 52.65$  minus invalid trials:  $M = 434.18$ ,  $SD = 53.52$ ) was found for long CTI-trials (1500 ms). Other main/interaction effects were not significant.

Subsequently, we investigated cue dimension-specific differences between high-worriers and low-worriers in trials with a short CTI (250 ms) because we expect people with a strong tendency to worry to focus their attention automatically towards negative worry-related words (i.e., in early attention processes), and possibly more specific, towards negative worry-related words that are personally relevant. To this end, we performed a  $2 \times 2 \times 2$  repeated measures ANOVA with the factors personal relevance (personally relevant, not personally relevant) and valence (negative, positive) as within-subjects factors, and group (high-worriers, low-worriers) as between-subjects factor on the CVE scores (RT invalid trials minus RT valid trials). None of the main effects or interaction-effects of the factor group proved significant, however.

Subsequently, initial vigilance for negative cues was determined using Attention Engagement scores, calculated by subtracting RTs for valid trials with negative cues from RTs for valid trials with positive cues. High positive scores point toward strong vigilance for negative cues, high negative scores point towards strong vigilance for positive cues. A  $2 \times 2$  repeated measures ANOVA with personal relevance (personally relevant, not personally relevant) as within-subjects factor, and group (high-worriers, low-

worriers) as between-subjects factor revealed no differences between high-worriers and low-worriers. Thus, people with a strong tendency for worrying do not automatically focus their attention on negative worry-related words.

There were no differences between high- and low-worriers when we studied late attentional processes (see analysis “[Experiment 1: ECT with personality traits as cues](#)”) either, so we can conclude that there were no attentional biases for high-worriers. Also, when a group of high-ruminators and low-ruminators was formed based on a median split of the RSS scores within the same group, there were no differences in RTs between high-ruminators and low-ruminators in the ECT with worry-related cues.<sup>3</sup> Finally, we determined whether sub-clinical State Anxiety was associated with attentional biases. The same analyses were again performed, but with the factor group (high-anxious, low-anxious) as between-subjects factor. Based on a median split of State Anxiety scales, respondents were assigned to a low-anxious or a high-anxious group. Results indicated that there were no main or interaction effects of the factor group.

In summary, we can conclude that there are no attentional biases for high-worriers.

## Discussion

The present study investigated the relation between attentional biases and persistent negative thought (PNT). Previous research showed that valence-specific attentional biases are related to affective disorders, with GAD being more specifically associated with an automatic attentional bias towards worry-related information (Bar-Haim et al., 2007), whereas MDD is associated with impaired disengagement from negative self-related information (De Raedt & Koster, 2010). In the current study, we investigated whether these biases already exist on a sub-clinical level, in persons with a strong tendency to worry or to ruminate, respectively. This is the first study, to our knowledge, that simultaneously investigated attentional biases in worrying and rumination in a sub-clinical population.

Using an emotional version of the ECT, we examined the ability of ruminators and worriers to move their attention away from and towards negative versus positive personality traits and negative worry-related versus positive words. More precisely, we expected rumination, analogous to depression, to be associated with an impaired

ability to disengage attention from negative personality traits. As for worrying, analogous to findings in GAD, we expected this type of PNT to be associated with a strong tendency to automatically direct attention toward negative worry-related information.

The results of Experiment 1 show that people with a strong tendency to ruminate have a significant attentional bias for negative information. More specifically, as was expected, high-ruminators showed an impaired ability to move their attention away from negative personality traits in long CTI-trials (1500 ms). This was demonstrated by the enhanced cue validity effect (ECVE) and the high Attention Disengagement scores for long CTI-trials with negative cues. This bias was not more pronounced when personally-relevant cues were used.

The results of Experiment 2 indicate that persons with a strong tendency to worry, on the other hand, do not exhibit any attentional biases in our experiment.

The found association between rumination and impaired attention disengagement from negative self-referring information corresponds to the bias that has been previously described in clinical depression (De Raedt, & Koster, 2010). Moreover, a covariate analysis indicated that the attentional bias found in high-ruminators was positively correlated with sub-clinical scores on the BDI (none of our participants had a clinically elevated BDI-score). This seems evident, as the BDI measures depressive symptoms, and rumination is a symptom of depression. The BDI contains items on self-referent cognitions, such as “as I look back, I see a lot of failures”, “I blame myself for everything bad that happens”, as well as items that ask about the controllability of thoughts, such as “I have trouble making any decision”. These same negative cognitions are typically the subject of ruminative thought. The results of the covariance analysis thus supports that the attentional bias found in the current study is present at a sub-clinical level of depression.

The results of our study show an attentional bias for negative personality traits in ruminators in the rumination-experiment. Contrary to previous studies (e.g. Koster et al., 2005, 2010), the group of ruminators in our study did not exhibit a generalized attentional bias for negative words, as there was no attentional bias for negative (worry-related) words in the worry-experiment. We believe this could be explained by the fact that the attentional bias in ruminators is far more pronounced when stimuli related to personally relevant worries are involved. In ruminators, negative personality traits are often strongly associated to personally relevant worry topics, related to others’ or their own judgement of themselves such as “I’ll never be able to find a job”, “everyone will think I’m loser”, “I’m such a failure”. According to Segal et al., (1995), the attentional bias for negative information in depressed persons is most

<sup>3</sup> Correlation between raw RRS and PSWQ scores:  $r = .704$ ,  $p < .001$ , overlap between groups, divided based on median split: 53 % (28 out of 53 students score low on both RRS and PSWQ or high on both RRS and PSWQ).



pronounced in experiments using negative self-descriptive information because negative self-descriptive information activates negative self-schemata. Possibly this is also the case in persons with a strong tendency to ruminate without depression. Further research is needed to clarify this issue.

Despite the similarity between the processes of worrying and rumination and the strong correlation between self-report measures of both types of PNT, a valence-specific attentional bias proved absent in worriers. There are several explanations for the lack of attentional biases for worriers in our study. First, it could be that persons with a strong tendency to worry are better at compensating for a possible attentional bias. For instance, several studies have shown that worrying is associated with elevated levels of perfectionism (e.g. Pratt, Tallis, & Eysenck, 1997). Consequently, one could expect that participants with a high worry-score are more likely to do their utter best during the experiment, possibly obscuring attentional biases. However, when studying the results in more detail, worriers did not show higher accuracy rates or quicker RTs than low-worriers (respectively:  $t(51) = 1.13$ ,  $p = .26$ ;  $t(51) = -0.08$ ,  $p = .94$ ), indicating that perfectionism probably had little influence on worriers' task performance.

Another possibility is that visual cues are more likely to draw worriers' attention than verbal cues. Research on the association between anxiety and attentional biases generally uses visual cues such as threatening facial expressions (Bradley, Mogg, Falla, & Hamilton, 1998) and pictures of fear-relevant animals (Lipp, & Derakshan, 2005). We chose to employ verbal cues instead because (1) given the verbal nature of worrying, we expected more interference from verbal cues, (2) the greater specificity and diversity of validated verbal cues makes them easier to link to worry themes, and (3) verbal cues are less ambiguous than visual cues, enabling more control on the semantic content of cues (positive, personally-relevant,...). Future research should, however, determine whether worriers do show an attentional bias when visual instead of verbal cues are used.

A third possibility is that the chosen worry-related cues were not specific enough to evoke attentional biases in worriers. We composed the word lists ourselves after all, and let respondents choose worry-themes that correspond to an entire list. Perhaps it would be better to ask respondents to choose every individual word themselves as we did with the personality traits. However, it proved to be practically impossible to find enough worry-words that could be matched, per cue dimension, for familiarity and word length. Although perhaps sacrificing specificity, we were forced to let participants choose from a limited number of preselected worry themes. A final important limitation of the used stimulus material is the fact that we compared negative worry-words with positive words. Alternatively, we could have used neutral instead of positive words, since a meta-

analysis by Bar-Haim et al., (2007) has shown that anxiety is related to an attention bias towards threat-related material compared to neutral information. Because of the large number of variables in our study, we have limited ourselves to the use of negative versus positive stimulus material, but we feel it could be very useful for future research to use neutral stimuli as well.

Shortcomings put aside, our results suggest that worrying and rumination are associated with different attentional biases, despite other process-based resemblances. It seems highly relevant for clinical practice to further investigate this issue. Previous research has shown that worrying and rumination are both associated with impaired cognitive control (Beckwé, Deroost, Koster, De Lissnyder, & De Raedt, 2013). This impairment was neither valence-specific, nor more pronounced for personally relevant information, and could be a mechanism that influences persistent thought in general. Content-wise, worrying and rumination do differ, however. Worry-thoughts are primarily about possible negative events in the future and strategies to prevent such events from occurring (Borkovec, & Inz, 1990), ruminative thoughts are rather about negative past events, such as failures, losses, etc., and focus on the origin, causes, and consequences of negative emotions and the symptoms of depression (Nolen-Hoeksema, 1991). Because of the differences in content, it seems plausible that worrying and rumination are associated with different attentional biases. This is why we used specific cues to investigate attentional biases in worriers and ruminators. Since our results suggest that only persons with a strong tendency to ruminate exhibit a valence-specific attentional bias, this might indicate that the influence of valence is smaller in worrying, and that worrying is mainly associated with an impaired capacity for controlling thought in general, for both negative and positive information. This is in contrast to rumination, in which information processing impairments seem rather valence-specific.

Although we investigated attentional biases in PNT, and their possible causal role in affective disorders, it is important to note that the present study merely shows an association between factors, and in no way proves a causal relation. To be able to determine causality requires a longitudinal study that investigates whether people with attentional biases are more likely to have perseverative cognitions in stress-situations, and are therefore more likely to develop an affective disorder over time. But even when doing so, one should be careful to speak in terms of causality, as an attentional bias might be present as a symptom of an already slumbering depression or anxiety disorder. For example, an attentional bias for positive information could be induced using attentional bias modification (ABM; Hakamata et al., 2010), with the idea to investigate whether this has a protecting function against affective disorders on a long term. Nevertheless, the

connection between PNT and attention needs to be further clarified prior to conducting interesting studies along these lines. The present study was a first attempt to do that.

To summarize, our findings suggest that at a sub-clinical level of depression, in persons with a strong tendency to ruminate, there is already an impaired ability to divert attention away from negative personality traits. Since this attentional bias may contribute to depression, it might be useful to address whether treating it at a subclinical level for instance by using ABM can contribute to the prevention of depression.

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## Appendix

English translation of the personality traits and worry words used in respectively Experiment 1 and 2

|                           | Negative words |                                    | Positive words                   |               |
|---------------------------|----------------|------------------------------------|----------------------------------|---------------|
| Personality traits        | Cowardly       | Brutal                             | Happy                            | Honest        |
|                           | Asocial        | Rude                               | Hopeful                          | Positive      |
|                           | Irritating     | Frustrated                         | Sympathetic                      | Friendly      |
|                           | False          | Jealous                            | Smart                            | Sincere       |
|                           | Unhealthy      | Annoying                           | Polite                           | Creative      |
|                           | Suspicious     | Unreliable                         | Relax                            | Enthusiastic  |
|                           | Cruel          | Complaining                        | Alert                            | Nice          |
|                           | Lonely         | Loveless                           | Energetic                        | Lively        |
|                           | Depressed      | Doubtful                           | Helpful                          | Optimistic    |
|                           | Bossy          | Hateful                            | Healthy                          | Funny         |
|                           | Liar           | Selfish                            | Cheerful                         | Pleasant      |
|                           | Unpleasant     | Pessimistic                        | Understanding                    | Righteous     |
|                           | Mean           | Hostile                            | Active                           | Social        |
|                           | Aggressive     | Unhappy                            | Thankful                         | Original      |
|                           | Indecisive     | Intolerant                         | Reliable                         | Merry         |
|                           | Worry words    | <i>Fear of failure<sup>a</sup></i> | <i>Relationships<sup>a</sup></i> | Cat           |
| Anxiety                   |                | Separation                         | Room                             | Consistent    |
| Exams                     |                | Jealous                            | Entertaining                     | Juice         |
| Nervous                   |                | Lonely                             | Objectively                      | Exhibition    |
| Incompetent               |                | Unreliable                         | Sewing machine                   | Sophisticated |
| <i>Losses<sup>a</sup></i> |                | <i>Health<sup>a</sup></i>          | Pants                            | Direct        |
| Grief                     |                | Cancer                             | Decent                           | Adventurous   |
| Funeral                   |                | Illness                            | Firm                             | Pen           |
| Sorry                     |                | Unhealthy                          |                                  |               |
| Depressed                 |                | Unattractive                       |                                  |               |

<sup>a</sup> Negative words are arranged according to worry-theme

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