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BRIEF ARTICLE

Mapping the interplay among cognitive biases, emotion regulation, and depressive symptoms

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ABSTRACT
Cognitive biases and emotion regulation (ER) difficulties have been instrumental in understanding hallmark features of depression. However, little is known about the interplay among these important risk factors to depression. This cross-sectional study investigated how multiple cognitive biases modulate the habitual use of ER processes and how ER habits subsequently regulate depressive symptoms. All participants first executed a computerised version of the scrambled sentences test (interpretation bias measure) while their eye movements were registered (attention bias measure) and then completed questionnaires assessing positive reappraisal, brooding, and depressive symptoms. Path and bootstrapping analyses supported both direct effects of cognitive biases on depressive symptoms and indirect effects via the use of brooding and via the use of reappraisal that was in turn related to the use of brooding. These findings help to formulate a better understanding of how cognitive biases and ER habits interact to maintain depressive symptoms.

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Depression is a prevalent psychiatric illness causing a severe personal and societal burden (Kessler & Wang, 2009). Despite effective psychological interventions for depression, the relapse and recurrence rates remain high and a considerable group of patients does not respond to treatment (Boland & Keller, 2009). This indicates that existing therapies do not sufficiently target the mechanisms through which depressive symptoms develop and are maintained. Efforts to identify the mechanisms underlying depression are therefore particularly important to further our understanding of the disorder and to optimise contemporary treatment options.

Cognitive biases and emotion regulation (ER) in depression

Extensive research has demonstrated that cognitive biases and ER processes are intimately linked to cardinal symptoms of depression. Depression is characterised by emotional biases in cognitive processes such as attention and interpretation, which result in exaggerated processing of negative over positive material. Compared to healthy individuals, subclinically and clinically depressed individuals allocate more attention to negative compared to positive material (Armstrong & Olatunji, 2012) and also tend to infer more negative than positive interpretations from emotional information (Wisco, 2009). Studies have shown that attention and interpretation biases can predict future depressive symptoms and constitute important risk factors to depression (Gotlib & Joormann, 2010).

The ER processes that people habitually use to repair their negative mood in response to negative events seem also the key in differentiating healthy from depressogenic emotional functioning. Depressed people habitually implement rumination and use positive reappraisal less frequently than healthy people (Aldao, Nolen-Hoeksema, & Schweizer,

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2010). Rumination involves repetitively analysing the causes, implications, and meaning of experienced sad mood and distress (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008) and is typically considered a "maladaptive" regulatory process. In particular, the brooding subtype of rumination, defined as moody pondering, has been linked to more pathological outcomes (Treynor, Gonzalez, & Nolen-Hoeksema, 2003).[1] Positive reappraisal involves altering the meaning of an emotion-eliciting event to reduce its negative impact and is associated with "adaptive" outcomes (Jamieson, Nock, & Mendes, 2012). These ER habits are purported to lie at the core of hallmark depressive symptoms such as increased negative and reduced positive affect.

Toward an integrative perspective

Although considerable progress has been made in identifying depression-linked cognitive biases and ER difficulties, the interplay among these distorted processes in depression is not well understood because most studies have investigated these processes in isolation. Only recently, investigators have started to examine linkages among cognitive biases and among ER difficulties in depression. Studies testing interactions between cognitive biases have shown that a negative attention bias regulates the interpretation of emotional information, resulting in a congruent negative interpretation bias that is related to depressive symptoms (Everaert, Duyck, & Koster, 2014; Everaert, Tierens, Uzieblo, & Koster, 2013). Moreover, studies examining relations among ER processes have documented that depressed individuals are both more likely to use brooding and less likely to use reappraisal (D'Avanzato, Joormann, Siemer, & Gotlib, 2013). To date, few studies have examined relations between cognitive biases and ER processes in depression. Research in (sub)clinically depressed samples has revealed that higher brooding levels are related to negative biases in both attention (Duque, Sanchez, & Vazquez, 2014; Joormann, Dkane, & Gotlib, 2006) and interpretation (Mor, Hertel, Ngo, Shachar, & Redak, 2014). Unfortunately, research linking depression-related cognitive biases to reappraisal is lacking. Studies in healthy samples have often yielded mixed evidence for the link between emotional attention and reappraisal (Bebko, Franconeri, Ochsner, & Chiao, 2014). However, a recent finding suggests that emotional attention may influence one's ability to reappraise indirectly through its impact on interpretation bias (Sanchez, Everaert, & Koster, 2015).

These initial empirical findings demonstrate that neither cognitive biases nor ER difficulties are processes that operate in isolation. An integrative approach that considers interrelations among cognitive biases and ER processes seems highly necessary to gain insight into how cognitive biases modulate ER processes in the context of depressive symptoms. This knowledge would help to formulate a better understanding of the foundations of depression. The scarcity of integrative research motivated this study.

The present study

This study was designed to investigate relations among cognitive biases (attention, interpretation), ER processes (brooding, positive reappraisal), and depressive symptoms. We hypothesised that individual differences in cognitive biases would predict the habitual use of ER processes and that ER habits would in turn predict depressive symptoms (Joormann & D'Avanzato, 2010). To test this hypothesis, we constructed a path model based on the prior research and contemporary theoretical insights. First, based on prior research (Everaert et al., 2013, 2014), we hypothesised that a negative attention bias would modulate the interpretation of emotional material, resulting in a congruent interpretation bias. Second, following recent cognitive accounts of depression (Joormann & D'Avanzato, 2010), we assumed that a negative interpretation bias would be negatively related to the use of positive reappraisal and positively related to the use of brooding. Third, in line with studies showing relations between ER processes (Aldao et al., 2010; D'Avanzato et al., 2013), we anticipated that positive reappraisal would have a dampening effect on brooding. Finally, we expected that cognitive biases as well as ER processes would predict depressive symptoms.

To provide a rigorous test of the path model, this cross-sectional study utilised established measures of cognitive biases, ER processes, and depressive symptoms as well as powerful data-analytic techniques that allow a comprehensive test of sets of a-priori hypothesised pathways between multiple variables. Thereby, the present study aimed to provide a first empirical investigation of the theorised relations among multiple cognitive biases, ER processes, and depression levels.

Method

Participants

A total of 119 participants with minimal to severe depression levels were sampled from the Ghent University research participant pool. Sampling was based on prescreening depressive symptoms levels to obtain large variability at testing. All participants were native Dutch speakers with normal or corrected-to-normal vision. They provided informed consent and received course credits or 15 euro. The institutional review board approved the study protocol.

Depressive symptom severity

The 21-item Beck Depression Inventory – Second Edition (BDI-II-NL; Van der Does, 2002) assessed depressive symptom severity at testing. Participants indicated the extent to which they suffered from depressive symptoms in the past two weeks for each item on a scale from 0 to 3. The BDI-II-NL has good psychometric properties (Van der Does, 2002). The internal consistency was $\alpha = 0.93$ in this study. A broad range in depression levels was observed with 78 individuals reporting minimal, 13 mild, 15 moderate, and 6 severe symptom levels.

ER processes

Rumination subtypes

The 22-item Ruminative Response Scale (RRS-NL; Raes et al., 2009) measured how often participants ruminate in response to sad or depressed mood. The questionnaire's subscales reflection and brooding measured the rumination subtypes (Treynor et al., 2003). Participants answered to each item using a four-point scale (Almost never–Almost always). The subscales have sound psychometric properties (Treynor et al., 2003). The internal consistency of the reflection ($\alpha = 0.71$) and brooding ($\alpha = 0.78$) subscales was adequate. As noted in endnote 1, this study particularly focused on the brooding scale.

Positive reappraisal

The positive reappraisal subscale of the 36-item Cognitive Emotion Regulation Questionnaire (CERQ; Garnefski, Kraaij, & Spinhoven, 2001) assessed how often participants use positive reappraisal after experiencing negative life events. Participants rated all items on a five-point scale (Almost never–Almost always). The questionnaire has sound psychometric properties (Garnefski et al., 2001). The internal consistency of the positive reappraisal scale was $\alpha = 0.82$ in this study.

Cognitive biases assessment

The task measuring attention and interpretation biases was modelled after our earlier work (Everaert et al., 2014). In this study, attention allocation to emotional information was assessed in real time using eye tracking while participants completed an interpretation task (a computerised version of the scrambled sentences test (SST)). This design enables investigation of how individuals allocate attention to actively select competing (positive vs. negative) information when making meaningful inferences about themselves.

Stimuli

A set of 43 scrambled sentences (28 emotional, 15 neutral sentences) was retrieved from a prior study (Everaert et al., 2014). All scrambled sentences were self-referent and six words long. Negative and positive target words in each emotional sentence (e.g. "winner" and "loser" in "am winner born loser a I") were matched between valence categories on word length, word class, and word frequency using WordGen (Duyck, Desmet, Verbeke, & Brysbaert, 2004). No significant differences emerged on these lexical variables (all $Fs < 1$).[2] Word position within each scrambled sentence was randomised with the constraint that target words occurred neither next to each other nor as the first or the last word within a scrambled sentence, in order to avoid that their fixation times would be confounded by sentence wrap-up effects. The positive and negative target word order in the emotional sentences was counterbalanced. The same criteria were applied to target words in the neutral sentences.

Experimental task

Each trial of the SST started with the presentation of a fixation cross at the left side of the screen until participants fixated the point. The following *stimulus display* presented either a neutral or an emotional scrambled sentence at the centre of the screen (lowercase Arial, 25 pt). Participants were instructed to unscramble the sentences mentally to form a grammatically correct and meaningful statement using five of the six words as quickly as possible (e.g. "I am a born winner" in an emotional trial). Upon completion, participants pressed a button to continue to the *response display*. In this trial part, each word of the scrambled sentence was presented with a number prompting participants to report their unscrambled solution to the experimenter using the corresponding numbers (to reduce social desirable responding). The sentence was presented until response or for a maximum of 8000 ms. Figure 1 depicts the flow of trial events.

After a practice phase of three trials with neutral scrambled sentences, participants started the test phase which presented 40 scrambled sentences dispersed over four blocks. Each block contained seven emotional and three neutral stimuli presented in a fixed random order for each participant. No more than two emotional scrambled sentences were presented consecutively in a block to reduce priming effects. A cognitive load procedure was added to prevent socially desirable report strategies. As in prior research with the SST (Rude, Wenzlaff, Gibbs, Vane, & Whitney, 2002), participants memorised a six-digit number before each block (presented for 5 s) which they had to recall at the end of the block. Interpretation bias was indexed by the ratio of negatively unscrambled sentences over the total correctly completed emotional sentences.

Participants' gaze behaviour was recorded during the stimulus display trial parts via eye tracking. This enabled online measurement of visual attention while participants selected competing stimuli (e.g. "winner" and "loser" in "am winner born loser a I") to interpret the emotional material (e.g. "I am a born winner" vs. "I am a born loser"). As in our prior study, the total number of fixations (i.e. total fixation frequency) on the target words in the scrambled sentences (i.e. the areas of interest) served as a dependent variable to index attention bias.[3] Relative bias scores were calculated within-subjects. The total fixation frequency on negative words was divided by the total fixation frequency on emotional (positive and negative) words in the emotional scrambled sentences. Note that this relative bias index controls for inter-individual baseline fixation differences due to typical inter-individual variability in reading performance.

Eye tracker

A tower-mounted Eyelink 1000 eye tracking device (SR Research, Mississauga, Ontario, Canada) recorded gaze behaviour with eye-gaze coordinates sampled at 1000 Hz. Participants were seated approximately 60 cm from the eye tracker. Visual fixations were considered when longer than 100 ms. Stimulus presentation and eye movement recording were controlled by SR Research Experiment Builder.

Procedure

This study was part of a larger assessment battery to investigate relations between depressive symptoms, cognitive control, cognitive biases, and ER habits.[4] All participants started with the cognitive biases assessment procedure. A nine-point grid calibration procedure was repeated before each block of the SST, and drifts from proper calibration were checked at the start of each trial. The system was recalibrated when necessary. The experimenter recorded participants' verbal responses (i.e. the coded unscrambled sentences and cognitive load number) manually. Participants were given the opportunity to take a short break after each block of trials to ensure optimal concentration. To avoid mood priming, participants then completed the self-report measures (presented in a random order). The experimental session lasted for approximately 1.5 hours.

Data-analytic plan

The path model was fitted by full information maximum likelihood estimation using the lavaan package in R (Rosseel, 2012). Figure 2 depicts the tested path model. Model fit was evaluated with different fit measures sensitive to model misspecification. The χ^2 test, the Root Mean Square Error of Approximation (RMSEA), and the Standard Root Mean-squared Residuals (SRMR) served as indexes of the overall model fit, and the Confirmatory Fit Index (CFI) served as an incremental fit index. A well-fitting model has a non-significant test statistic on the χ^2-test ($p > .05$), an RMSEA value lower than 0.05, an SRMR value less than 0.06, and a CFI value greater than 0.95.

The assumed mediational effects in the path model were further examined through bootstrapping. A serial mediation model was tested with attention bias as an independent variable, depressive symptom levels as a dependent variable, and interpretation bias, reappraisal, as well as brooding as intervening variables. By relying on confidence intervals to determine the significance of the total, direct, and indirect effects, this nonparametric

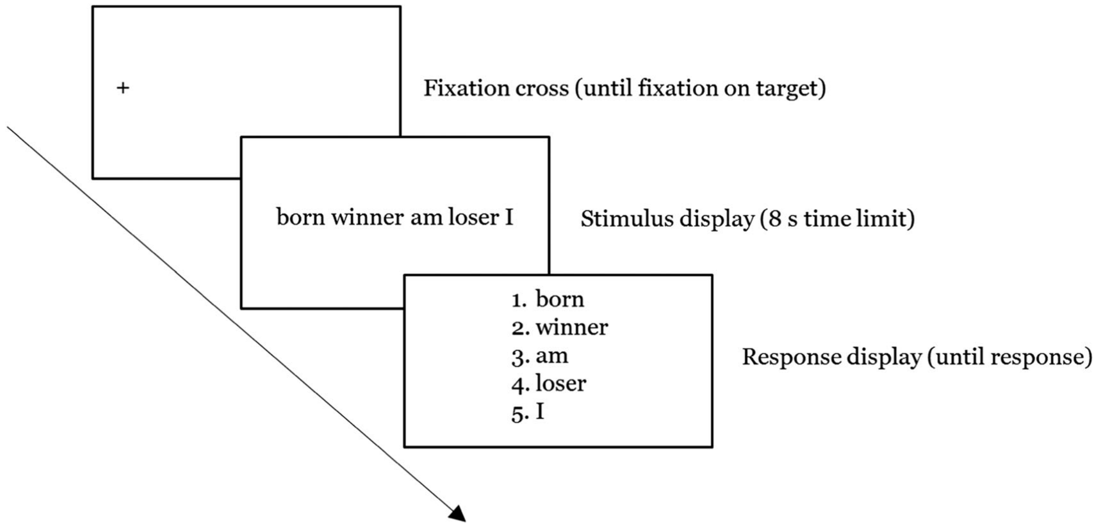

Figure 1. Schematic depiction of the flow of trial events in the cognitive biases assessment task.

statistical method avoids problems associated with traditional approaches (e.g. unrealistic assumptions regarding multivariate normality; Preacher & Hayes, 2008). For this study, we estimated 5000 bias-corrected bootstrap 95% confidence intervals which should not contain 0 for the respective effect to be significant.

Results

Sample characteristics

The final sample included 112 individuals (101 women; $M_{age} = 21.84$, $SD_{age} = 4.20$, 17–42 years). This sample size was obtained after removal of seven individuals who only partially completed the questionnaires or for whom there were difficulties in detecting and tracking the eyes. Table 1 presents descriptive statistics on all study variables.

Associations among cognitive biases, ER, and depression levels

Zero-order correlations generally supported the expected associations among depressive symptom severity, cognitive biases, and ER processes (see Table 1). Depression levels were positively correlated with brooding and interpretation bias, and negatively correlated with positive reappraisal. Surprisingly, however, no significant correlation was found between depression levels and attention bias. Attention and interpretation biases were positively correlated. Furthermore, interpretation bias was positively correlated with brooding and negatively correlated with positive reappraisal. Attention bias had a marginally significant positive correlation with brooding but was not correlated with positive reappraisal.

Importantly, depression levels did not correlate with the total fixation frequency on neutral words, $r = -.03$, $p > .05$. This suggests that baseline fixation patterns, and thus reading times, did not differ as a function of depression severity.

Functional relations among cognitive biases, ER, and depression levels

Path analysis revealed an excellent fit for the hypothesised model, $\chi^2(2) < 1$, $p = .61$, CFI = 1.00, RMSEA = 0.00, SRMR = 0.026. Inspecting the path coefficients, depression levels were predicted by interpretation bias, $\beta = 0.34$ (SE = 0.08), $p < .001$, and brooding, $\beta = 0.39$ (SE = 0.08), $p < .001$, but not by positive reappraisal, $\beta = -0.08$ (SE = 0.08), $p = .32$, nor by attention bias, $\beta = -0.13$ (SE = 0.07), $p = .09$. Brooding was predicted by interpretation bias, $\beta = 0.29$ (SE = 0.09), $p < .01$, and by positive reappraisal, $\beta = -0.22$ (SE = 0.09), $p < .05$. Reappraisal was predicted by interpretation bias, $\beta = -0.24$ (SE = 0.09), $p < .01$, which was in turn predicted by attention bias, $\beta = 0.29$ (SE = 0.09), $p < .01$. The path coefficients provided evidence for the hypothesised effects.

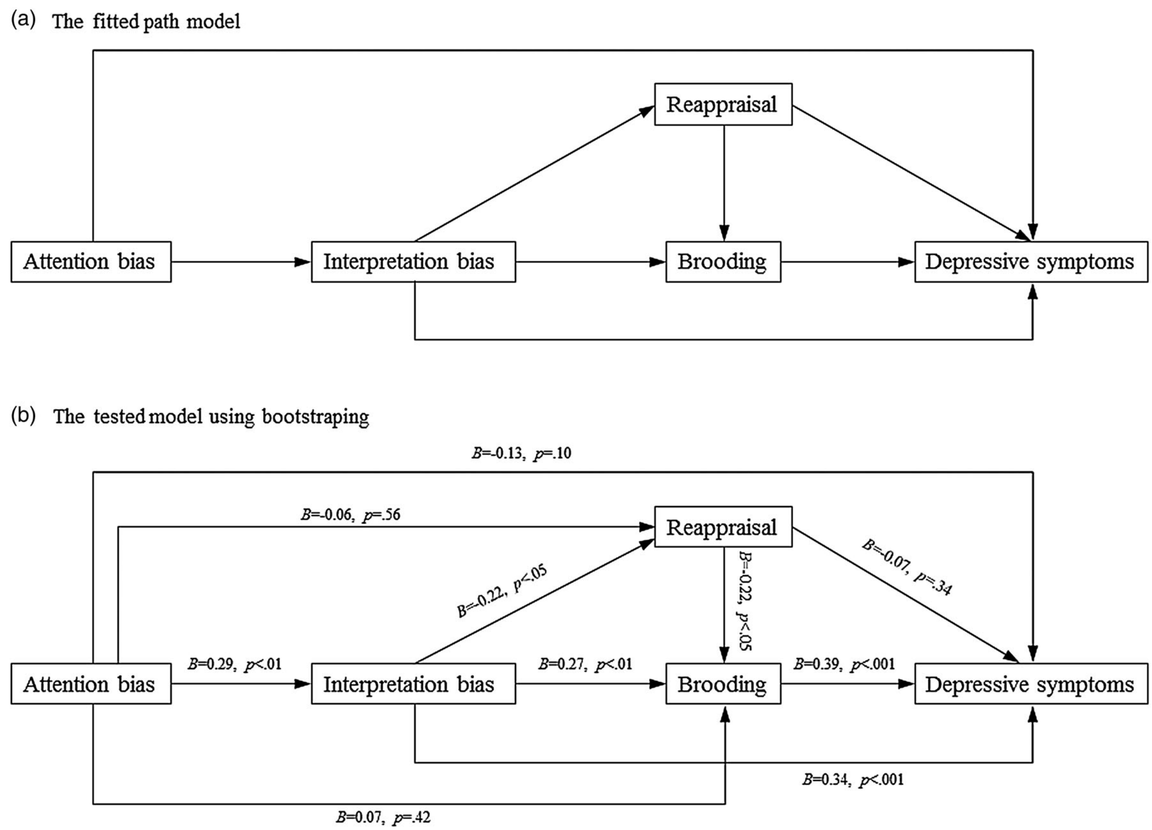

Figure 2. Schematic depiction of the tested models.

The results of the path analysis suggest that attention bias has an indirect effect on depression levels via interpretation bias and ER habits. Note that the absence of the direct effect of attention bias on depression levels makes it impossible to describe the results of the bootstrapping analysis in terms of partial or full mediation (cf. Mathieu & Taylor, 2006). Instead, the term "indirect effect models" is better suited to describe indirect relations between attention bias and depression levels. The 5000 samples bias-corrected bootstrapping analysis provided further support for several indirect effect models suggested by the path analysis (see Table 2). The effect of attention bias on depression via interpretation bias was positive and statistically different from zero, suggesting that cognitive biases are directly related to depressive symptoms independent from ER habits. Concerning the effects of cognitive biases on depressive symptoms via ER, the indirect effect of attention bias on depression levels via

Table 1. Correlations between study variables.

	2	3	4	5	6	7	8	*M* (SD)	Range
1. Depressive symptom severity	0.60***	.61***	.39***	.52***	−.27**	.05	.48***	10.83 (9.93)	0–49
2. Anxiety symptoms	1	.43***	.29**	.40***	−.09	−.03	.30**	6.12 (6.64)	0–33
3. Rumination – total score		1	.69***	.84***	−.20*	.21*	.41***	42.27 (12.46)	22–76
4. Rumination – feflection			1	.41***	−.05	.17†	.28**	8.83 (3.05)	5–17
5. Rumination – brooding				1	−.30**	.18†	.36***	9.91 (3.34)	5–20
6. Positive reappraisal					1	−.12	−.25**	11.97 (3.74)	4–20
7. Attention bias						1	.29**	49.00 (5.01)	33–60
8. Interpretation bias							1	27.65 (19.71)	0–92

Note: Anxiety levels were assessed using the Anxiety scale of the Depression and Anxiety Stress Scale (DASS; Lovibond & Lovibond, 1995).
†p < .10; *p < .05; **p < .01; ***p < .001.

Table 2. Results of the bootstrapping analysis.

Indirect effect	Coefficient	SE	95% CI
1	0.0979	0.0419	[0.0340, 0.2018]
2	0.0296	0.0144	[0.0095, 0.0716]
3	0.0054	0.0049	[0.0004, 0.0249]
4	0.0490	0.0419	[–.0023, 0.0257]
5	0.0042	0.0114	[−0.0079, 0.0485]
6	0.0269	0.0324	[−0.0271, 0.1021]
7	0.0047	0.0105	[−0.0106, 0.0351]

Note: n.s., not significant. Indirect effects:
1 Attention bias → interpretation bias → depressive symptoms.
2 Attention bias → interpretation bias → brooding → depressive symptoms.
3 Attention bias → interpretation bias → reappraisal → brooding → depressive symptoms.
4 Attention bias → interpretation bias → reappraisal → depressive symptoms, *n.s.*
5 Attention bias → reappraisal → depressive symptoms, *n.s.*
6 Attention bias → brooding → depressive symptoms, *n.s.*
7 Attention bias → reappraisal → brooding → depressive symptoms, *n.s.*

interpretation bias and brooding was supported. Importantly, there was support for the indirect effect of attention bias on depressive symptoms via interpretation bias, positive reappraisal, and brooding. No other indirect effects were significant. The non-significant total effect, $c = 0.0487$ (SE = 0.0909), $t = 0.54$, $p = .59$, 95% CI: [−0.1314, 0.2288], and direct effect, $c' = 0.1249$ (SE = 0.0757), $t = -1.65$, $p = .10$, 95% CI: [−0.2750, 0.0252], provide evidence for the indirect effect models (Mathieu & Taylor, 2006).

Discussion

Cognitive biases and ER difficulties are crucial processes underlying hallmark symptoms of depression but the interplay among these processes is not well understood. This study tested a set of a-priori predictions regarding relations among cognitive biases (attention, interpretation bias) and ER habits (positive reappraisal, brooding) in accounting for variability in depressive symptom severity levels. The results revealed significant correlations among cognitive biases, ER habits, and depression levels. Path and bootstrapping analyses demonstrated that cognitive biases were directly linked to depressive symptoms as well as indirectly through ER habits. These results are discussed in turn.

The correlational results provide evidence for associations among depression levels, cognitive biases, and ER processes. First, negative attention bias was correlated with negative interpretation bias (Everaert et al., 2013, 2014). However, only the latter bias was related to depressive symptoms. Although other studies also reported a null association between attention bias and depressive symptoms (e.g. Everaert et al., 2013), a majority of studies have observed evidence for such an association (Armstrong & Olatunji, 2012). Even though depression levels were not directly related to attention bias, its relation with interpretation indicates that negative attention bias remains of importance through its influence on other cognitive biases that are related to depression (i.e. interpretation bias). This also illustrates that it is important to study different cognitive processes together in one design. Second, in line with prior research (Aldao et al., 2010; D'Avanzato et al., 2013), it was observed that depression levels were positively related to brooding and negatively related to positive reappraisal, with a negative correlation between these ER habits. This indicates that individuals with elevated depressive symptoms habitually implement brooding and tend to use positive reappraisal less frequently than individuals with lower symptoms levels. Third, brooding was related to interpretation bias (Mor et al., 2014) but only weakly to attention bias. The latter finding is different from prior research showing such an association in depressed individuals (Duque et al., 2014; Joormann et al., 2006; but see below). Finally, positive reappraisal was related to interpretation bias and not to attention bias, which is consistent with the finding that emotional attention alters reappraisal ability via interpretation of emotional material (Sanchez et al., 2015).

Evidence for specific functional relations between cognitive biases, ER processes, and depressive symptoms was revealed by the path and bootstrapping analyses. In line with the hypothesis that ER intervenes in the relation between cognitive biases and depressive symptoms (Joormann & D'Avanzato, 2010), the data supported two indirect effect models in which cognitive biases were related to depressive symptoms through the use of adaptive and maladaptive ER processes. The first model indicates that attention bias is related to interpretation bias which predicts brooding which is in turn associated with depressive symptoms. This observation suggests that the correlations between attention bias and brooding observed in prior research (Duque et al., 2014; Joormann et al., 2006) may not reflect a direct effect of attention bias on brooding, but an indirect effect through interpretation bias. Brooding may not be merely facilitated by a focus of attention on negative aspects of a situation (e.g. signs of disapproval in a daily interaction) but rather by the negative meanings assigned to the attended negative stimuli (e.g. "the person dislikes me"). The second indirect effect model suggests that a larger negative attention bias predicts a negative interpretation bias that is positively related to brooding and negatively related to positive reappraisal which again is related to brooding, to account for depressive symptoms. Thus the tendency to infer negative meaning may hinder the positive reinterpretation of negative material which again strengthens ruminative brooding. These results suggest that cognitive biases both facilitate the use of maladaptive regulatory processes and hinder protective effects of using adaptive regulatory processes in maintaining symptoms of depression. Moreover, the results also revealed that cognitive biases were also directly related to depression levels in addition to the indirect effect through adaptive and maladaptive ER habits. The findings supported an indirect effect of attention bias on depression levels via interpretation bias and did not provide evidence for a direct effect of attention bias on depressive symptoms. Taken together, the data support both direct and indirect effects via ER habits of cognitive biases on depressive symptoms.

The knowledge gained as a result of this study has several theoretical and clinical implications. First, the results indicate that theorists should consider the interplay between cognitive biases and ER habits when formulating models to explain individual differences in depressive symptoms. At present, few theoretical models make specific predictions regarding interactions between cognitive biases and ER habits (e.g. Joormann & D'Avanzato, 2010) and future theoretical attempts may need to consider their interplay to gain an integrated understanding of how cognitive biases cause and/or maintain in depression. Second, the presented results open possibilities to improve the clinical potential of training procedures aimed at reducing cognitive biases or increasing adaptive ER in depression. The observed paths suggest that successful delivery of attention (Sanchez et al., 2015) or interpretation (Williams et al., 2015) training procedures may be hindered by the presence of maladaptive ER habits and, analogously, successful implementation of ER training (e.g. Denny & Ochsner, 2014) could be hindered by negative cognitive biases that hinder the use of adaptive processes and facilitate the use of maladaptive processes. Therefore, a combined training approach targeting negative cognitive biases and the implementation of adaptive ER processes may more efficiently result in decreases in depressive symptoms. Note, however, that this cross-sectional study is the first to model the interplay among multiple cognitive biases and ER processes and caution is required with respect to causal direction of the modelled effects.

Several limitations should be acknowledged. First, the cross-sectional design of this study precludes claims regarding causality. Experimental manipulation of cognitive biases is required to assess their impact on the use of positive reappraisal and brooding. Cognitive training methods provide the tools to test whether cognitive biases have a causal influence on ER processes through manipulation of the cognitive process in an experimental context. Second, the study was conducted in a nonclinical sample which may limit generalisability of the findings to clinical samples. Given that cognitive biases observed in nonclinical samples of individuals with varying depression levels often differ from clinical samples in degree rather than type (Armstrong & Olatunji, 2012), it can be expected that the observed relations among cognitive biases, ER difficulties, and depressive symptoms are even more clearly expressed in clinical samples. Despite this limitation, besides their theoretical value, the reported findings remain of clinical importance because individuals with subclinical symptom levels experience significant suffering and are at risk to develop clinical depression. The factors under investigation in this study are likely to contribute to this pathogenesis. Finally, the majority of participants in this sample were female, which may limit the generalisability of the findings to men. Given the gender differences in ER (e.g. Nolen-Hoeksema & Hilt, 2009), future research could investigate potential gender differences in the interplay between cognitive biases and ER difficulties.[5]

Conclusion

This study tested the interplay among cognitive biases, ER processes, and depressive symptoms in a mixed sample of non-depressed and subclinically depressed individuals. Evidence was found for direct effects of cognitive biases on depressive symptoms as well as indirect effects through facilitating the use of maladaptive ER (i.e. brooding) and through hindering the use of adaptive ER (i.e. positive reappraisal) that in turn increased the likelihood of using maladaptive processes. The findings help to formulate an integrated understanding of emotionally distorted functioning characteristic for depression.

Notes

1. Reflection, the second subtype of rumination, refers to repetitive thinking focused on one's problems and has long been considered as an adaptive form of rumination. However, current evidence regarding its adaptive nature is mixed (Nolen-Hoeksema et al., 2008). To ensure theory-driven and evidence-based path model building in the present study, we focused only on empirically supported pathogenic difficulties in emotion regulation in depression.
2. Word length: *M* negative words = 8.79 (SD negative words = 1.71), *M* positive words = 8.58 (SD positive words = 1.97); Word frequency (log frequency per million): *M* negative words = 1.02 (SD negative words = 0.47), *M* positive words = 1.04 (SD positive words = 0.62).
3. The analyses using fixation times led to similar results and conclusions. The results are available upon request.
4. In addition to the measures reported in this article, the participants completed two cognitive control tasks (affective shifting task, emotional *n*-back task) after the cognitive biases assessment and before the questionnaires. The results on the relations among cognitive control components and cognitive biases are reported elsewhere.
5. Analyses exploring gender differences in the modelled relations among cognitive biases, emotion regulation, and depressive symptoms showed that the results remained unchanged when male participants were excluded.

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