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ORIGINAL ARTICLE

The Role of Emotional Memory in Reappraising Negative Self-referent Thoughts

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Abstract

Background Reappraisal is an emotion regulation strategy that has been linked to positive emotional and health outcomes. However, the basic cognitive mechanisms underlying the effectiveness of reappraisal remain understudied and not well understood. To address this limitation, the present study examined whether long-term memory processes, including emotional memory accessibility, memory bias, and overgeneral memory, are related to individual differences in reappraisal effectiveness.
Methods All participants ($N = 101$) completed a memory accessibility and sentence completion memory task to measure bias, specificity, and accessibility of emotional memories. Next, participants completed an emotion regulation task requesting them to either attend to or reappraise negative self-referent thoughts.
Results The results of the linear regression models showed that memory bias, but not memory specificity or accessibility, accounted for a significant proportion of the variance in the effectiveness of reappraisal. Retrieval of more negative memories was related to lower reductions in negative mood.
Conclusions These findings suggest that emotional long-term memory processes, and particularly memory bias, may modulate downregulation of negative emotions when implementing reappraisal. These insights could be leveraged to guide psychological treatments using cognitive techniques that rely on successful reappraisal use.

Keywords Reappraisal · Memory · Emotion Regulation · Cognitive Bias

Introduction

Reappraisal is an important cognitive emotion regulation strategy that involves changing the meaning of an emotional stimulus to reduce its emotional impact (Gross & Thompson, 2007). Prior research has shown that reappraisal use is reliably associated with positive effects on emotional outcomes (Webb et al., 2012), higher psychological well-being and life-satisfaction (Gross & John, 2003; Kashdan et al., 2006), as well as lower physiological activation in response to negative emotions (Jackson et al., 2000; Urry, 2009). Alternatively, difficulties in using reappraisal have been associated with various forms of psychopathology (Aldao et al., 2010; Hofmann et al., 2012; Webb et al., 2012) and unsuccessful attempts to implement reappraisal may lead to more negative evaluations of stimuli (Yeh et al., 2020). Therefore, understanding the mechanisms underlying (in)effective reappraisal may be particularly important to improve emotion regulation interventions (Berking et al., 2008).

There has been an upsurge of studies examining cognitive processes underlying reappraisal use. Various cognitive processes, including attention, interpretation, and memory have been implicated in emotion regulation (Gross, 2007). Studies have investigated the role of emotional attention in reappraisal effectiveness, with mixed results. Some research has failed to find evidence for the causal role of attention deployment on emotion regulation success when manipulating participants' gaze towards negative emotional stimuli (Bebko et al., 2014; Urry, 2010). However, recent work suggests that attention processes may moderate the effect of reappraisal on negative emotions (Manera et al., 2014) and that training individuals to form more positive meanings through gaze-contingent feedback subsequently improves the ability to use reappraisal to downregulate negative emotions

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elicited by negative images (Sanchez et al., 2016). Extending this work, researchers have started to investigate the role of interpretation processes in relation to difficulties in reappraisal. Emerging research has found that more negative interpretations of ambiguous material are associated with a reduced tendency to use positive reappraisal in response to distress, while more positive interpretations are associated with a higher use of cognitive reappraisal (Everaert et al., 2017, 2020). Finally, several studies have examined emotional working memory processes in relation to positive reappraisal. Research has found that there is a positive association between the capacity to inhibit negative emotional information and reappraisal use (Joormann & Gotlib, 2010). Moreover, the effectiveness of reappraisal use is moderated by the ability to update emotional information in working memory (Pe et al., 2013). However, the latter finding has not been consistently replicated in other studies (Hoorelbeke et al., 2016). Together, initial research suggests that attention, interpretation, and working memory processes may be involved in difficulties in using reappraisal to downregulate negative emotions.

In spite of these advances, an important gap remains: research has yet to uncover the role of autobiographical (long-term) memory in reappraisal effectiveness. Available research has studied how reappraisal of negative stimuli impacts emotional memory. For example, when participants are instructed to reappraise negative images, later recall and recognition of those images improve, as compared to participants instructed to just view them (Richards & Gross, 2000; Yeh et al., 2020). Also, instructing participants to focus vs. reinterpret negative events leads to differences in memory retrieval (negative vs. positive memory retrieval, respectively) (Rusting & DeHart, 2000). Finally, recent studies have examined how autobiographical memories elicit emotion regulation processes. It has been found that retrieving highly central memories, as compared to retrieving low central memories, is linked to a more frequent use of emotion regulation strategies including reappraisal (del Palacio-Gonzalez & Berntsen, 2020). However, research is still limited and continued empirical research on how emotional long-term memory processes may modulate reappraisal effectiveness is much needed.

The scarcity of research in this area is surprising because there are good reasons to assume that emotional memory plays a central role in emotion (dys)regulation. Prior research has shown that mood-incongruent memories can be effectively used to downregulate negative emotions (Rusting & DeHart, 2000). Also, there is extensive evidence that emotional autobiographical memory processes are disrupted in common forms of psychopathology (e.g., depression) and thought to contribute to hallmark emotional disturbances in these disorders (e.g., high negative, low positive mood). In particular, mood dysregulation has been linked to negative biases of long-term memory (Mathews & MacLeod, 2005; Matt et al., 1992), overgeneral autobiographical memories (Williams et al., 2007), and differential accessibility of emotional memories (MacLeod & Campbell, 1992).

With respect to emotional biases, a meta-analysis found that people without psychopathology tend to show a positive memory bias characterized by enhanced recall of positive stimuli, whereas the opposite pattern is found for people with depression (Matt et al., 1992). As for memory specificity, depressed individuals tend to retrieve more overgeneral memories (i.e. categories of events) when asked to retrieve specific memories (Hermans et al., 2008; Williams, 1996), while healthy controls usually retrieve more specific memories (Dritschel et al., 2011; LeMoult & Gotlib, 2019). The term overgeneral memory (OGM) is used to refer to the tendency to retrieve past general (e.g., "the times I go out for a drink") instead of specific (e.g., "the time I had a drink at my brother's wedding 2 years ago") memories (Raes et al., 2007). Finally, regarding memory accessibility, the time needed to retrieve emotional memories is associated with mood. Specifically, the time to recall a memory is shorter when there is congruency between mood state and memory valence (MacLeod & Campbell, 1992).

In the context of reappraisal, the emotional bias, specificity, and accessibility of autobiographical emotional memories may modulate the effectiveness of reappraising negative stimuli. In particular, it is plausible that negatively biased recall of autobiographical memories, more overgeneral memories, and greater accessibility of negative memories is related to less effective use of reappraisal (i.e., lower reductions of experienced negative emotions). The present study aimed to test this hypothesis in the context of reappraising negative self-referent cognitions. To this end, this study considered the three memory processes in a single design to examine whether these processes account for individual differences in reappraisal effectiveness.

Method

Participants

101 Dutch-speaking undergraduate students were recruited from a research participant pool (85 women; age range: 17–34 years) at Ghent University. All participants provided informed consent and received a course credit or 5 euro. The institutional review board approved the study protocol. The sample size was determined through power analysis ($1 - \beta = 0.80$, $\alpha = 0.05$) to allow detection of medium-sized effects ($r \approx 0.30$). This effect size was chosen based on prior research examining relations between interpretation bias and positive reappraisal (Everaert et al., 2017).

Measures

Emotional Memory Tasks

Memory Accessibility Task A cued-recall task was modeled after prior work (Joormann & Siemer, 2004; MacLeod & Campbell, 1992). Participants were presented 40 three-word descriptions of common events and asked to retrieve a specific personal memory in response to each cue. Each description consisted of an indefinite article, an adjective, and a noun. 20 pleasant (e.g., a welcome invitation) and 20 unpleasant (e.g., a broken promise) descriptions were selected from MacLeod and Campbell (1992). These descriptions were presented on a computer screen and participants had to press a key on the keyboard as soon as they recalled a memory that fitted the cue description. The memory cue was presented for maximally 8000 ms and disappeared as soon as the participant pushed the button. The presentation of pleasant and unpleasant memory cues was randomized for each participant. Recalled memories were not recorded. Reaction times to retrieve memories in response to positive and negative cues were recorded and used as indexes of *memory accessibility* of positive and negative experiences. Split-half reliabilities were good for reaction time indices for negative cues ($\lambda = 0.93$) and positive cues ($\lambda = 0.94$).

Sentence Completion Test In this task (Raes et al., 2007), participants need to complete 11 sentence stems (e.g., "When I think back to/of …") with personal past experiences. Two trained independent raters coded the valence ($r = 0.80$) and specificity of the sentence completions (Cohen's kappa = 0.70). The valence was rated using a 9-point scale from 1 ('extremely negative') to 9 ('extremely positive'). The specificity was coded using the following categories from prior work (Raes et al. 2007): *Specific memory, categoric memory, extended memory, semantic associate, and error.* Specific memories referred to one specific moment or a particular time (e.g., I still remember well how… sad I was the day my grandfather died). Categoric memories referred to a repeated activity or a category of similar events without the specification of a particular time (e.g., I can still picture how … my grandmother used to play games with me when I was little). Extended memories referred to an extended period of time which lasted longer than a day (e.g., When I think back to/of … my time in junior high, I feel happy). Semantic associates referred to personal overgeneral semantic information (e.g., In the past… I was a very shy person). Finally, sentences completions were coded as erroneous when the sentence was not completed in a meaningful way. The overall valence of the autobiographical memories recalled in response to the fixed neutral sentence stems was reverse-coded and served as an index of memory bias (higher scores refer to more negative memories). Moreover, the proportion of specific memories over total number of generated memories was used as specificity index.

Emotion Regulation Procedure

A reappraisal task was designed based on prior work (Ochsner et al., 2002; Vanderhasselt et al., 2013). Each trial of this task started with the presentation of a negative self-referent statement for 6000 ms (e.g., "something must be wrong with me"). Participants were instructed to think about a moment during which they had, or could have experienced, a similar thought. Next, participants rated the extent to which the thought evoked negative emotions using a 10-point scale from 0 ('not at all) to 9 ('very much'). After the ratings, a cue was presented, instructing participants to either attend or reappraise the negative thought. The 'attend' condition was introduced as a control where participants were instructed to just 'let themselves respond emotionally by being aware of their feelings without trying to alter them'. The 'reappraisal' condition required participants to 'cognitively reframe the negative thought by generating an alternative interpretation to down-regulate their negative feelings'. Participants were encouraged to retrieve memories that helped them reappraise the negative thought. A total of 24 attend and 24 reappraisal trials were presented in pseudo-random order in that no more than two of the same trial type could occur consecutively. After 10 s, participants again rated their negative emotional experience using the same scale and the personal relevance of the thought was also recorded. Adequate to good test–retest reliability was found for the negative mood scores for appraisal (ICC = 0.90) and reappraisal (ICC = 0.75).

Questionnaires

Symptoms of Depression The Dutch version of the Beck Depression Inventory—second edition (Van der Does, 2002) measured severity of depressive symptoms with 21 items rated on a scale from 0 to 3. Respondents rated the extent to which they were bothered by common cognitive, affective, and somatic symptoms of depression during the past two weeks. The BDI-II-NL has shown good psychometric properties (Van der Does, 2002). The internal consistency was $\alpha = 0.89$ in this study.

Trait Anxiety State-Trait Anxiety Inventory (STAI-T, (Spielberger et al., 1983) is a 20-item measure of anxiety and stress symptoms. Participants have to rate their level of anxiety using a 1 (not at all) to 4 (very much so) scale. It has shown good psychometric properties (Van der Ploeg, 2000) and the internal consistency for this study was $\alpha = 0.89$.

Procedure

Participants started with the emotional memory tasks. The order of the memory tasks was counterbalanced across participants. Next, participants completed the emotion regulation procedure. Finally, participants completed the questionnaires (presented in random order).

Data Reduction and Analysis

Prior to testing the hypotheses, the distribution of the variables was inspected to identify outliers using the interquartile rule. The interquartile range (IQR) was multiplied by 1.5. This was then added to the third quartile and subtracted from the first quartile (Tukey, 1977). Values outside these cutoffs were considered outliers. To reduce the impact of the identified outliers, the extreme values (1.8%) were replaced by cutoff values of $Q3 + 1.5 \times IQR$ (for extremely high values) or $Q1 - 1.5 \times IQR$ (for extremely low values). All analyses were also performed without correcting for outliers and results did not change significantly (see Supplementary Materials).

To examine the effect of emotion regulation instructions (i.e. attend to vs. reappraise negative thoughts) on changes in negative mood state, a 2 (Condition: Attend vs. Reappraise) × 2 (Time: Pre, Post) repeated measures ANOVA was conducted on the mood state ratings. The Bonferroni correction was applied in post-hoc analyses.

Linear regression analyses were used to test whether emotional memory accounted for variance in mood changes resulting from the emotion regulation procedure. Similar models were fitted for both conditions, with the reappraisal condition being of primary interest. The dependent variable of these regression models was the residualized negative mood state change score computed by regressing pre-instruction on post-instruction negative mood ratings. The standardized residuals for each participant were saved. Using this procedure, the variability among residuals can be considered independent from the pre-instruction negative mood state scores (Cohen & Cohen, 1983). Different linear models (models 1–3) were used to test whether each memory index (memory accessibility memory bias, overgeneral memory) separately accounted for variation in mood ratings as a result of the within-subject emotion regulation conditions. Then, model 4 was used to analyze the unique effect of each memory index. All models included BDI-II and STAI-T scores as independent variables to control for potential confounding effects of psychopathology severity levels. Assumptions of homoscedasticity and normality of residuals were met for each model.

Results

Descriptive statistics and zero-order correlations are presented in Table 1.

Changes in Mood Ratings During the Emotion Regulation Procedure

Results of the repeated measures ANOVA showed significant main effects of Condition ($F(1, 99) = 56.79$, $p < 0.001$, $\eta^2 = 0.37$) and Time ($F(1, 99) = 53.22$, $p < 0.001$, $\eta^2 = 0.35$). Overall valence ratings were significantly higher (i.e., more negative) for the attend ($M = 5.61$, $SD = 1.54$) vs. reappraise ($M = 4.79$, $SD = 1.41$)

Table 1 Descriptive statistics and correlations

	M	SD	1	2	3	4	5	6	7	8	9
Memory bias											
1. RT Negative	2640.38	831.82	1								
2. RT Positive	2705.75	843.33	0.67[b]	1							
3. Memory bias	3.54	0.61	− 0.04	0.03	1						
4. Specificity	0.38	0.16	− 0.09	− 0.08	− 0.05	1					
Reappraisal task											
5. Pre-reappraisal	5.43	1.32	0.00	0.05	0.04	− 0.08	1				
6. Post-reappraisal	4.16	1.21	− 0.10	− 0.01	0.18	− 0.14	0.74[b]	1			
7. Pre-attend	5.35	1.50	− 0.04	− 0.03	0.07	− 0.10	0.79[b]	0.56[b]	1		
8. Post-attend	5.86	1.55	− 0.02	− 0.06	0.02	− 0.05	0.72[b]	0.44[b]	0.90[b]	1	
Self-reported symptoms											
9. BDI-II-NL	14.09	8.07	− 0.18	0.21[a]	0.19	− 0.03	0.21[a]	0.20	0.16	0.16	1
10. STAI-T	46.16	10.02	− 0.12	0.21[a]	0.11	− 0.12	0.27[a]	0.32[b]	0.24[a]	0.22[a]	0.67[b]

M Mean, *SD* Standard Deviation, *r* Pearson correlation, *RT* Reaction Time, *BDI-II-NL* Beck Depression Inventory- second edition-Dutch version, *STAI-T* State Trait Anxiety Inventory

[a]$p < 0.05$, [b]$p < 0.001$

condition. Moreover, valence ratings were higher at pre (M = 5.39, SD = 1.41) compared to post (M = 5.01, SD = 1.62) emotion regulation instructions. Importantly, these main effects were qualified by a significant Condition by Time interaction (F(1, 99) = 208.98, p < 0.001, $\eta^2 = 0.68$). Planned comparisons revealed that negative mood state ratings decreased significantly from pre (M = 5.43, SD = 1.32) to post (M = 4.16, SD = 1.21) emotion regulation instruction in the reappraise condition (F(1, 99) = 191.20, p < 0.001, $\eta^2 = 0.66$), whereas an increase in negative mood state from pre (M = 5.35, SD = 1.50) to post (M = 5.86, SD = 1.55) instruction occurred in the attend condition (F(1, 99) = 55.70, p < 0.001, $\eta^2 = 0.63$). Following Cohen (1988)'s benchmarks, these effects can be qualified as large. The negative mood state ratings did not differ between conditions prior to receiving the emotion regulation instruction (F(1, 99) = 0.62, p = 0.43, $\eta^2 = 0.01$), but significant differences occurred following the emotion regulation phase with a more negative mood state in the attend than in the reappraise condition (F(1, 99) = 129.90, p < 0.001, $\eta^2 = 0.57$). Figure 1 depicts the interaction effect.

The Role of Emotional Memory in Reappraising and Attending to Negative Cognitions

Results for the different regression models can be found in Table 2.

Mood State Changes in the Reappraisal Condition

The model including memory bias (model 1) explained a significant amount of the variance of residualized mood change scores, F(3, 93) = 2.90, p = 0.04, adjusted $R^2 = 0.05$. Inspecting the regression coefficients, the results showed that memory bias was associated with mood change in the reappraisal condition (β = 0.36, SE = 0.16, t = 2.20, p = 0.03). Retrieval of more negative relative to positive memories was related to lower reductions in negative mood following reappraisal instructions.

The models including memory specificity (model 2) and memory accessibility (model 3) as independent variables revealed that none of these memory processes explained a meaningful proportion of the variance in mood changes

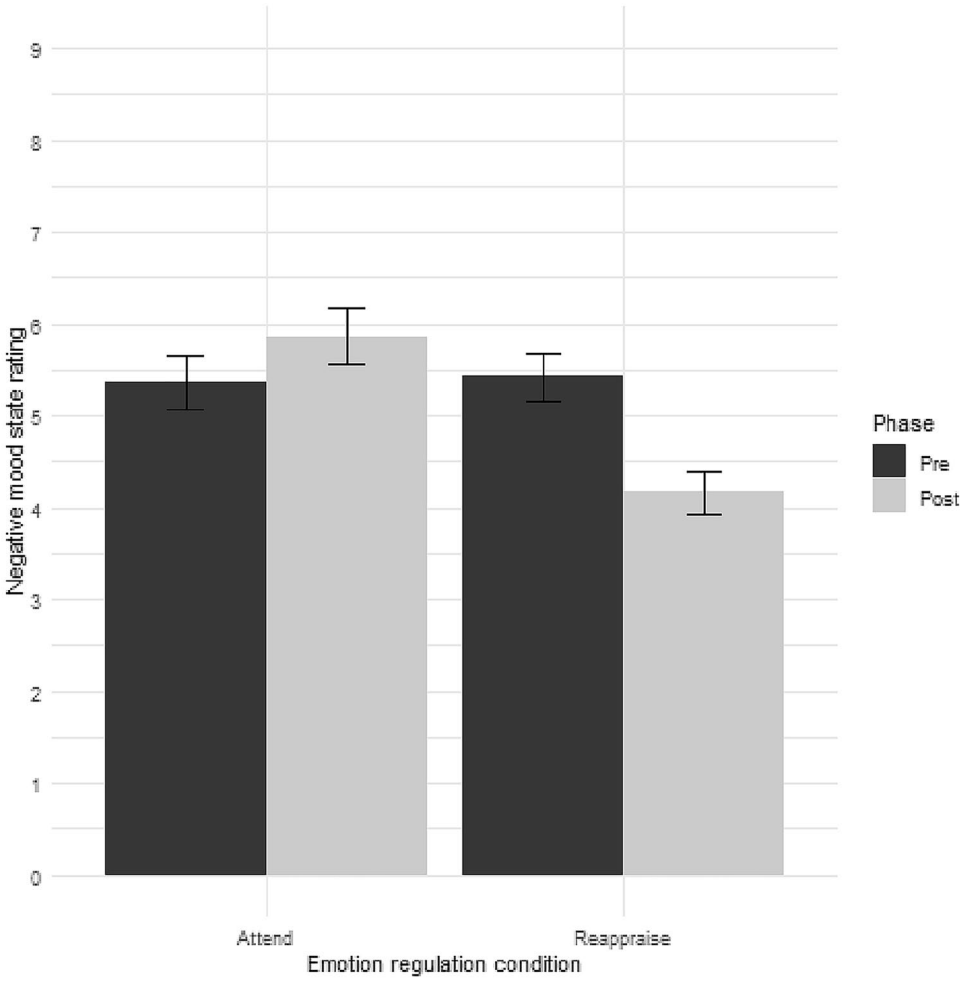

Fig. 1 Average negative mood state ratings with 95% confidence intervals for attend and reappraisal instructions during the emotion regulation task

Table 2 Regression models to test the effect of three different emotional memory processes on emotion regulation processes

	Reappraisal			Attend		
	Estimate (SE)	t	p	Estimate (SE)	t	p
Model 1						
Intercept	− 2.54 (0.88)	− 2.90	0.01	0.76 (0.91)	0.83	0.41
Valence	0.36 (1.16)	2.20	0.03	− 0.16 (0.17)	− 0.93	0.35
BDI	− 0.02 (0.02)	− 1.16	0.25	0.01 (0.02)	0.48	0.64
STAI	0.03 (0.01)	1.94	0.06	− 0.00 (0.01)	− 0.24	0.81
Model 2						
Intercept	− 0.64 (0.59)	− 1.08	0.28	− 0.26 (0.61)	− 0.43	0.67
Specificity	− 0.64 (0.65)	− 0.99	0.33	0.65 (0.66)	0.99	0.33
BDI	− 0.01 (0.02)	− 0.72	0.47	0.00 (0.02)	0.26	0.80
STAI	0.02 (0.01)	1.68	0.10	− 0.00 (0.01)	− 0.08	0.94
Model 3						
Intercept	− 0.46 (0.62)	− 0.74	0.46	− 0.10 (0.62)	− 0.17	0.87
RT Negative	− 0.00 (0.00)	− 1.04	0.30	0.00 (0.00)	1.47	0.14
RT Positive	0.00 (0.00)	0.11	0.91	− 0.00 (0.00)	− 1.66	0.10
BDI	− 0.02 (0.02)	− 0.97	0.33	0.01 (0.02)	0.82	0.42
STAI	0.02 (0.01)	1.81	0.07	0.00 (0.01)	0.01	0.99
Model 4						
Intercept	− 1.64 (1.02)	− 1.61	0.11	0.21 (1.05)	0.20	0.85
Valence	0.35 (0.16)	2.14	0.04	− 0.15 (0.17)	− 0.90	0.37
Specificity	− 0.67 (0.64)	− 1.05	0.30	0.67 (0.66)	1.01	0.31
RT Negative	− 0.00 (0.00)	− 1.15	0.25	0.00 (0.00)	1.55	0.12
RT Positive	0.00 (0.00)	0.15	0.88	− 0.00 (0.00)	− 1.69	0.10
BDI	− 0.02 (0.02)	− 1.27	0.21	0.02 (0.02)	0.90	0.37
STAI	0.02 (0.01)	1.75	0.08	0.00 (0.01)	0.13	0.90

Adjusted R^2 values can be found in the main text

BDI Beck Depression Inventory - second edition, *STAI-T* trait version of the State Trait Anxiety Inventory, *RT* Reaction Time, *SE* Standard Error

scores (model 2: $F(3, 96) = 1.57$, $p = 0.20$, adjusted $R^2 = 0.02$; model 3: $F(4, 95) = 1.43$, $p = 0.23$, adjusted $R^2 = 0.02$).

Examining unique contributions of different memory indexes (model 4), only memory bias reached significance ($\beta = 0.0.35$, $SE = 0.16$, $t = 2.14$, $p = 0.04$), but the amount of variance explained by this model was not significant: adjusted $R^2 = 0.056$, $F(6, 93) = 1.98$, $p = 0.08$.

Mood State Changes in the Control Condition

Regression models in the attend condition showed no significant associations between residualized change scores of mood and memory bias, memory specificity, or memory accessibility. Also, none of the models explained a significant amount of variance of the residualized mood change scores: model 1, $F(3, 96) = 0.33$, $p = 0.81$, adjusted $R^2 = 0.00$, model 2, $F(3, 96) = 0.36$, $p = 0.78$, adjusted $R^2 = 0.00$, and, model 3, $F(4, 95) = 0.75$, $p = 0.56$, adjusted $R^2 = 0.00$. Also, the level of variance explained in model 4 was not significant (adjusted $R^2 = 0.00$, $F(6, 93) = 0.82$, $p = 0.55$) and no significant unique associations were found.

Discussion

This study examined whether memory bias, memory specificity, and emotional memory accessibility are related to the effectiveness of reappraising negative self-referent cognitions in a subsequent emotion regulation task. Results showed that memory bias accounted for a significant portion of variability in negative mood changes when reappraising negative self-referent cognitions. Specifically, when individuals were able to retrieve more positive as opposed to negative memories, reappraisal of negative cognitions was more successful in reducing negative mood state. This finding suggests that the emotional content of long-term memories modulates the effectiveness of cognitive emotion regulation strategies such as reappraisal. When individuals exhibit a negative bias and/or lack of a positive bias in emotional long-term memory (e.g., when suffering from depression), this may set the stage for unsuccessful downregulation of negative emotions when using reappraisal. Alternatively, when individuals have a positive memory bias or are able retrieve memories that are incongruent with the negative

emotional experiences, reappraisal may be more effectively implemented to reduce the distressing impact of negative cognitions. This finding is consistent with the idea that individuals can use certain memories (e.g., autobiographical memories) to generate or regulate emotions and also control the way in which information is interpreted and affect their mood (Gross, 2007). However, it should be noted that memory bias explained a rather small proportion of the variance in negative mood change, indicating that other memory-related factors (e.g., vividness or emotional intensity of the memory) and other variables (e.g. attention or interpretation biases, history of treatment with exposure or cognitive behavioral therapy) may play a role in the regulation of emotions and should be considered in future work.

This finding extends prior work suggesting that emotion regulation impacts the retrieval of positive and negative memories (Rusting & DeHart, 2000). These studies have shown that participants who are asked to focus on negative events tend to retrieve negative memories, while participants who are asked to reinterpret those events (reappraisal) engage in mood-incongruent (positive) retrieval of memories. Taken together, these results indicate that there is a bi-directional effect between emotional long-term memory and reappraisal effectiveness. That is, emotional memory may facilitate or hamper reappraisal effectiveness which may, in turn, consolidate certain memories.

This study did not find evidence for a link between reappraisal effectiveness and both specificity and accessibility of autobiographical memories. Thus, the effectiveness of reappraisal in reducing negative emotions elicited by negative cognitions seems to depend on the emotional content but neither on the specificity nor ease with which emotional memories are retrieved. This finding is remarkable because prior research suggests that lower specificity of memory and higher accessibility to negative memories are linked to both depressive symptoms and reappraisal (Joorman & D'Avanzato, 2010; MacLeod & Campbell, 1992; Raes et al., 2007). Clearly, our study does not provide definite answers on the potential contribution of these memory processes since such effects may be different depending on the nature of the population tested.

The findings generated by this study may provide some insights that could help to increase reappraisal effectiveness in psychological interventions. Psychological therapies and emotion regulation training procedures (Hofmann et al., 2009; Watson & Purdon, 2008) often rely on a person's ability to use reappraisal. Our findings suggest that, in improving the effectiveness of reappraisal interventions, clinicians may need to assess and take into account a person's memory bias. Memory bias may jeopardize immediate and long-term effects of reappraisal techniques such as thought-challenging exercises. This opens up possibilities for memory training procedures (Daches et al., 2019) to target memory bias and facilitate reappraisal techniques during psychological interventions.

The present study has several limitations that point to future research directions. The first limitation is related to the emotion regulation task used in this study. Though the reappraisal task was modeled after prior work (Ochsner et al., 2002; Vanderhasselt et al., 2013), the task variant with verbal self-referent stimuli used in this study had not been validated in previous research. Future research should replicate the present findings and validate the current task variant. Moreover, though the 'attend' instruction of the task was similar to the instruction given to participants in prior work (Vanderhasselt et al., 2013), participants may have engaged in other emotion regulation strategies (e.g., repetitive thinking) than intended (which may explain the increase in negative mood state). Therefore, future research may benefit from including additional control conditions (e.g., distraction, suppression) to elucidate how emotional memory processes modulate the effects of different emotion regulation strategies. Second, as in prior work (Joormann & Siemer, 2004), the memory accessibility task did not record the specific memories that were recalled in response to the positive or negative cues. As a result, it was not possible to verify the emotional content of the retrieved memories in response to the cues. Third, the present student sample reported generally low depressive symptom levels which limits the generalizability of the findings to clinical levels of symptomatology and to non-student samples. Future work should replicate the findings in clinical and diverse community samples to document how emotional memory is involved in (re)appraisal of negative self-referent cognitions. A fourth limitation concerns the self-report measures used to determine the effects of the emotion regulation conditions. Similar to prior work (Vanderhasselt et al., 2013), this study measured (changes in) mood state during the emotion regulation procedure by directly asking participants to report on their experienced mood state. Such self-report measures may be influenced by demand effects and lack of emotional awareness. Therefore, future research could examine if memory processes are related to individual differences in indirect psychophysiological (e.g., corrugator activity, eye-gaze changes) responses to reappraisal and examine the concordance with subjective emotional experience. Finally, the focus of this study was limited to reappraisal processes while various other emotion regulation strategies (e.g., distraction, suppression, dampening of positive emotions, etc.) may be linked to memory processes (Joormann & Vanderlind, 2014). Future research should therefore explore the role of long-term memory in the effectiveness of other emotion regulation strategies.

Conclusion

This study provides initial evidence of the role of long-term memory bias in determining reappraisal success. Specifically, the tendency to retrieve negative memories, instead of positive ones, may interfere with the benefits of creating alternative interpretations of negative self-referential cognitions. Given that long-term memory has not been studied in relation to reappraisal before, future research is needed to better understand the cognitive mechanisms of emotional regulation.

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Declarations

Conflict of Interest Inés Nieto, Ernst H.W. Koster, and Jonas Everaert declare that they have no conflicts of interest.

Ethical Approval Ethical approval was obtained from the faculty ethical committee at the Faculty of Psychology and Educational Sciences (Ghent University).

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (national and institutional). Informed consent was obtained from all individual participants included in the study.

Animal Rights No animal studies were carried out by the authors for this article.

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