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Implicit mood-congruent memory bias in subclinical depression

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Abstract

The prior literature reports that the activation of conceptual processing is necessary, albeit insufficient, for the detection of implicit mood-congruent memory bias. The purpose of this research was to investigate the effects of self-referential processing on this bias in individuals with subclinical depression. Two groups of participants (subclinical depressed vs. non-depressed) were set a perceptive or conceptual implicit memory task involving adjectives that varied in terms of their emotional valence and the manner in which they had been encoded. Our main finding was that those individuals with subclinical depression recorded a bias in the conceptual task, but only when they had encoded the content in a more self-referential manner. The findings are consistent with the activation of cognitive self-schema during the processing of emotional information of a self-referential nature in subclinical depression.

Keywords: implicit memory; conceptual priming; self-reference; emotion; subclinical depression.

Implicit mood-congruent memory bias in subclinical depression

Recent years have seen an increase in the number of studies focusing on the major role implicit cognitive processes play in pathologies such as depression (Besche-Richard, 2013; De Raedt & Koster, 2010; Vázquez, Hervás, Hernangómez, & Romero, 2010). The cognitive theories of depression based on network or schema models indicate that bias in the automatic processing of negative information is a basic component of depression (Barry, Naus, & Rehm, 2006). In other words, a depressed individual tends to respond to and interpret events in a negative way, with the same tendency appearing in the retrieval of stored information (Beck, Rush, Shaw, & Emery, 1979). Therefore, a depressed individual's affectively mood-congruent information tends to be encoded and retrieved more readily than incongruent information.

The memory model of emotion proposed by Rehm and Naus (1990) places memory at the centre of the cognitive system, and attributes emotion a leading role in the encoding and retrieval processes. Within the cognitive system, self-schemas take centre stage in depressive disorders. Self-schemas may have a bearing on the efficient processing of information entering the system, whereby highly self-descriptive stimuli are processed more quickly than those that lack that quality (Kuiper & Derry, 1982; Ruipérez & Belloch, 1997). Self-schemas also play a leading role in the retrieval process, as they can be activated once again when the conditions of encoding are the same as those of retrieval (Barry, Naus, & Rehm, 2004).

This core notion suggests that depressive schemas could both maintain and even reinforce depression, as there may be an implicit and explicit activation of such schemas regarding new events. They might also take part in the organisation of the structure of

memory. It is precisely the evaluation of this cognitive structure that has become a topic of discussion. Indeed, two approaches have now been adopted for the evaluation of memory: one involving a specific methodology, which leads us to refer to explicit and implicit tasks, and another involving the evaluation of memory processes, which distinguishes between perceptual and conceptual processing.

As regards the first approach, the main distinction between explicit and implicit tasks is the type of instruction used in the retrieval of the encoded material. Thus, explicit memory tasks involve the intentional retrieval of previously learnt information. In other words, awareness of the learning process is required for the task to be successful (Roediger, 1990; Roediger & McDermott, 1993). In implicit memory tasks, however, the information acquired during a specific episode is retrieved incidentally, as this information is recalled in an involuntary manner (Butler & Berry, 200; Schacter, 1990).

In terms of the second approach, when we consider the mental processing a task requires, we note there are two types: perceptual processing and conceptual processing. With the former, emphasis is placed on the physical characteristics of the stimuli, whereas with the latter the emphasis is on concepts, elaborations, and associations (Roediger & McDermott, 1993). This distinction between perceptual and conceptual processing is not seen as a dichotomy, but rather as a continuum. This means that memory tests cannot be classified as wholly perceptual or wholly conceptual, but instead the processes required by each test need to be analysed (Budd & Carroll, 1994; Roediger, Srinivas, & Weldon, 1989).

The preceding distinctions between tasks and processes are extremely useful for understanding the memory bias that appears in depression. This is consistent with traditional analyses of depression and memory, which argue that intentional, controlled or explicit forms of memory are impaired, but not so unintentional, automatic or implicit ones (e.g., Bazin, Perruchet, Bonis, & Feline, 1994; Hartlage, Alloy, Vázquez, & Dykman, 1993). This bias normally appears, therefore, when explicit tasks are used in memory evaluation. Depressed individuals tend to recall more negative information related to depression than non-depressed individuals (Gotlib & Joormann, 2010; Phillips, Hine, & Bhullar, 2012; Ruiz-Caballero & Sánchez, 2001). Nonetheless, the studies that have found implicit memory bias in depression are neither numerous nor conclusive (Barry et al., 2004; Ellwart, Rinck, & Becker 2003; Fernández-Rey & Merino, 2002; Ruiz-Caballero & González, 1996).

Faced with this variability of results, certain authors (e.g., Barry et al., 2004) have turned to the Transfer-Appropriate Processing (TAP) model (Morris, Bransford, & Franks, 1977; Roediger, 1990; Roediger & McDermott, 1993). According to this model, the basic requirement during the retrieval stage is to use the same processing conditions as those used during the encoding stage. In an analysis of the processes involved in both stages for detecting implicit memory bias, Watkins (2002) has posited the need for encouraging conceptual processing rather than its perceptual counterpart. In fact, this bias tends to appear in implicit conceptual tests, and not in implicit perceptual ones (Bazin et al., 1994; Denny & Hunt, 1992; Jenkins & McDowall, 2001; Mulligan, 2011; Watkins, Martin, & Stern, 2000b; Watkins, Vache, Verney, Muller, & Mathews, 1996). Nevertheless, certain authors (e.g., Ramponi, Handelsman, & Barnard, 2010; Ramponi, Nayagam, & Barnard, 2009) have not managed to identify implicit memory bias when

they have favoured the conceptual processing of emotional stimuli. These authors have concluded that the emotional valence of the stimuli did not have a preferential status in memory processes when implicit tests were used, although they did with explicit tests. As these authors report, it seems that the intentional or explicit retrieval of the specific episodic context within which the encoding has taken place is essential.

Nonetheless, although conceptual processing is a necessary condition, it is not sufficient (Bradley, Mogg, & Williams, 1994; Derry & Kuiper, 1981; Jenkins and McDowall, 2001; Watkins, 2002; Watkins, Mathews, Williams, & Fuller, 1992). For our part, we contend that a further requirement is the activation of self-referential processing for detecting implicit mood-congruent memory bias. As suggested by Clark, Beck, & Alford, (1999), when the material to be encoded is self-referential, it facilitates the automatic activation of self-schemas. In our opinion, self-schemas are precisely the ones that lead to more thorough processing, as they force the individual to consider the meaning of this material. The appearance of this self-referential material in a subsequent retrieval stage would again automatically activate self-schemas, allowing the retrieval of the encoded material (Baert, Koster, & Raedt, 2011; Gotlib, & Joormann, 2010; Wisco, 2009).

Nevertheless, few studies have explored this notion, and the results have not been fully consistent with it. Thus, in a study conducted by Watkins, Grimm, May, Krueger, & Whitney, (2000a) the self-reference conditions were directly manipulated in both the encoding and retrieval stages. The results were contradictory. No implicit memory bias was detected under the self-reference condition, but instead when the encoding task was undertaken under a condition of non-self-reference. We understand that these results are

due to the manner in which the actual self-reference process itself is handled, as we discuss at greater length in the discussion.

Our study has used a method for inducing a self-referential encoding of emotional material whereby the participants are required to rate the extent to which a series of qualifying adjectives of an emotional nature describe their current mood. We contend that this encoding task provides a reliable activation of the content stored in their self-schema. Accordingly, this content will be processed at a deeper level, and will therefore be more readily recalled in subsequent memory tasks.

Our aim, therefore, is to analyse the implicit memory bias toward negative self-referential content in participants with subclinical depression. Specifically, we predict the subclinical depressed group will exhibit a negative self-referent adjectives effect on the conceptual implicit task, but no on the perceptual implicit memory task. I was predicted that the non-depressed would evidence no mood-congruent implicit memory task.

Method

Participants

Two hundred and fifty students at Salamanca University volunteered to take part in the study (10.33% men, 89.67% women, average age = 19.63, *SD* = 1.14). Their ages ranged from 19 to 24. Two groups of subjects with subclinical depression vs. non-depression were formed on the basis of the scores recorded in the BDI screening questionnaire, in keeping with standard criteria (Hertel & Milan, 1994; Ramponi et al., 2009). Forty-five participants recorded a score of ≥ 14 in the BDI (*M* = 18.51, *SD* = 4.37), and were assigned to the subclinical depressed group. Ninety-seven scored ≤ 6 on the same questionnaire (*M* = 2.19, *SD* = 1.40), and they made up the non-depressed group. The make-up of the groups was not significantly different in terms of age and gender (see Table 1).

Table 1. Differences in demographic characteristics between groups.

	Subclinical depression (n= 45)		Non depression (n= 97)		Statistic
Gender	Female	Male	Female	Male	
	84.1%	15,9%	84.5%	15.5%	$X^2 = .005$; $p = .946$
Age	M (*SD*)	M (*SD*)	M (*SD*)	M (*SD*)	
	19.71 (*0.19*)	19,10 (*0.43*)	19.79 (*0.12*)	19.71 (*0.29*)	$F(1,137) = 0.89$, $p = .347$

Materials

Clinical Measures. The Beck Depression Inventory (BDI: Beck, et al. 1979) is an instrument used to identify subclinically depressive subjects in experimental studies of depression. We use the Spanish version of the BDI, adapted by Sanz and Vázquez, (1998). The adaptation was based on a sample of 1393 university students, recording a high index

of reliability (Cronbach's alpha: 83). In line with this study, we obtained similar percentages in relation to the levels of severity of depression (e.g., Minimal depression 0-13: 82.4%; Mild depression 14-19: 14.4%; Moderate depression 20-28: 2%; and Severe depression 29-63: 1.2%).

Experimental material. We used 40 adjective-traits taken from prior research conducted by Vázquez et al., (see normative data in Jiménez, Vázquez, & Hernangómez, 1998; Nieto, Hervás, & Vázquez, 2006). The words were chosen because they were specifically related to depression issues, and not to anxiety. The adjectives were divided into two sets, each one comprising 20 adjectives (10 positive ones, such as lucky, optimistic, and 10 negative ones, such as miserable, desperate), and their lengths were compared by their number of letters in Spanish (set 1 = 8.55; set 2 = 8.45), subjective frequency of use (set 1 = 4.80; set 2 = 4.75, range from 0 to 10) and emotional valence of the word (set 1 = 6.78, set 2 = 6.93; range from 0 to 10). Two sets of adjectives were randomly formed; one for presentation at the encoding stage and the other for selection at the retrieval stage. The adjectives making up these sets were subsequently subjected to a pseudo-randomisation process to establish the position of the words, whereby four words with the same valence could not be presented one after the other.

Experimental Tasks

Study Task. In this task, we used the first set of adjectives as noted earlier. In order to favour self-referential encoding, application was made of the procedure used by Denny and Hunt, (1992), whereby the participants were asked to rate, on a Likert-type scale from 0 to 9, "to what extent does (this adjective, depressed, sad…) describe *my*

mood in recent weeks?". If the score for this question was > 6, it was considered a self-referential adjective.

Implicit Memory Task. For the implicit perceptual task, we used a "word fragment completion" task consisting of 40 fragments. Twenty of these fragments corresponded to adjectives presented at the encoding stage, with the other 20 adjectives not being presented. The vowels were removed to produce the fragments (e.g., "_B_T_D_", ABATIDO, meaning "dejected" in Spanish), following the procedure used by Denny and Hunt, (1992). The participants were asked to complete the fragment, which had only a single solution. The participants were given 20 seconds to complete each fragment presented; once the time had elapsed, the computer program displayed the next item.

For the implicit conceptual task, we used a "Semantic definition" exercise. The participants were presented with a total of 40 definitions. Twenty of these definitions corresponded to adjectives presented at the encoding stage, and the other 20 to adjectives that were not presented. In this task, the participants were asked to write down the word that fitted the definition shown. They were given the first letter of the target word, as performed by Watkins et al. (2000a). The definitions were taken from María Moliner's *Diccionario de uso del español* (Moliner, 2008). The participants had 50 seconds to complete each definition, and once the time had elapsed the software program displayed the next item.

Procedure

The participants were given a general briefing on the study when they arrived in the laboratory, and then they signed the corresponding informed consent. In an initial

data-gathering stage, the participants completed the BDI. They were then set the study and recall tasks, which were introduced as two clearly separate experiments. The aim accordingly was to draw a line between the encoding stage and the retrieval stage, changing the environmental context between these two stages (Mulligan, 2011; Northup & Mulligan, 2012). Between the encoding and retrieval stages, all the subjects filled in a questionnaire with personal and socio-demographic details. The study task was common to all the subjects, while one or other of the recall tasks was applied randomly. The sequence of the different experimental stages was controlled by ad hoc software created in Visual Basic.

Experimental design

The experimental design included 16 experimental conditions based on a combination of Group (subclinical depressed vs. Non-depressed), Task (Fragment vs. Semantic Definition), Word valence (Positive vs. Negative), Reference (Non-Self-reference vs. Self-reference). Group and Task were the between-subjects factor, and Word valence and Reference were the within-subjects factor.

A priming index was used as dependent variable. The priming index was obtained by subtracting the proportion of items resolved in the set of words studied from the percentage of items resolved in the set of words not studied. This means that higher values in the priming index indicate a greater memory of words studied than of those not studied.

It is reasonable to assume that, depending on their emotional state, participants with subclinical depression consider more negative adjectives to be self-referential than positive ones. These differences in the encoding phase could in themselves explain any

difference in the retrieval tasks. In other words, they could explain why the sub-clinical depressed complete a greater number of items with a negative valence than with a positive one. Accordingly, we have calculated the priming by using the proportion of items resolved rather the number.

Results

An ordered sequence of ANOVAS was conducted to verify whether the implicit memory biases in the group of subclinically depressed appeared solely in the recall of self-referential adjectives in the conceptual task. A four-way ANOVA *Group* x *Task* x *Word valence* x *Reference* was first performed to analyse whether the between-subjects Group factor interacted with all the other factors. In other words, our initial aim was to check whether the effect of these variables on the priming index differed between the two groups. The analysis revealed a significant effect of interaction, Group x Task x Word valence $F(1, 512) = 16.37$, $MSE = 0.839$, $p < .001$, partial $\eta^2 = 0.031$, as well as the significant effects of interaction, Group x Word valence x Reference $F(1, 512) = 20.51$, $MSE = 1.051$, $p < .001$, partial $\eta^2 = 0.039$, together with the significant effects of interaction, Group x Task x Word valence x Reference $F(1, 512) = 8.99$, $MSE = 0.461$, $p = .003$, partial $\eta^2 = 0.017$.

As expected, the Group classification variable interacted with all the other independent variables. In order to analyse these differences in greater detail, we then conducted a three-way ANOVA (*Task* x *Word valence* x *Reference)*, separately for each group.

Regarding the depressed group, the ANOVA revealed a significant effect of interaction, Task x Word valence x Reference $F(1, 165) = 9.51$, $MSE = .34$, $p = 0.002$, partial $\eta^2 = 0.055$. According to our hypothesis, individuals with subclinical depression recorded a higher priming index in negative self-referential adjectives in the semantic definition task compared to positive self-referential ones (see Table 2). By contrast, no differences were observed between negative and positive non-self-referential adjectives (see right-hand panel in fig 1). What's more, there were differences between self-referential and non-self-referential adjectives in terms of both positive and negative ones. In turn, the word fragment completion task did not reveal any significant differences between the variables (see left-hand panel in fig. 1).

Table 2. Mean (and Standard Deviation) of the proportions of the priming index as a function of Task, Group, Word Valence and Reference.

		Word Valence			
		Negative		Positive	
		Self-reference	Non-Self-reference	Self-reference	Non-Self-reference
Task	Group	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)	*M* (*SD*)
Fragments	Subclinical Depression	0.01 (0.18)	-0.06 (0.14)	0.03 (0.23)	0.07 (0.14)
	Non depression	0.16 (0.38)	0.13 (0.20)	0.15 (0.18)	0.09 (0.16)
Definition Semantic	Subclinical Depression	0.25 (0.16)	0.08 (0.14)	-0.10 (0.30)	0.18 (0.16)
	Non depression	0.11 (0.45)	0.11 (0.17)	0.21 (0.17)	0.13 (0.16)

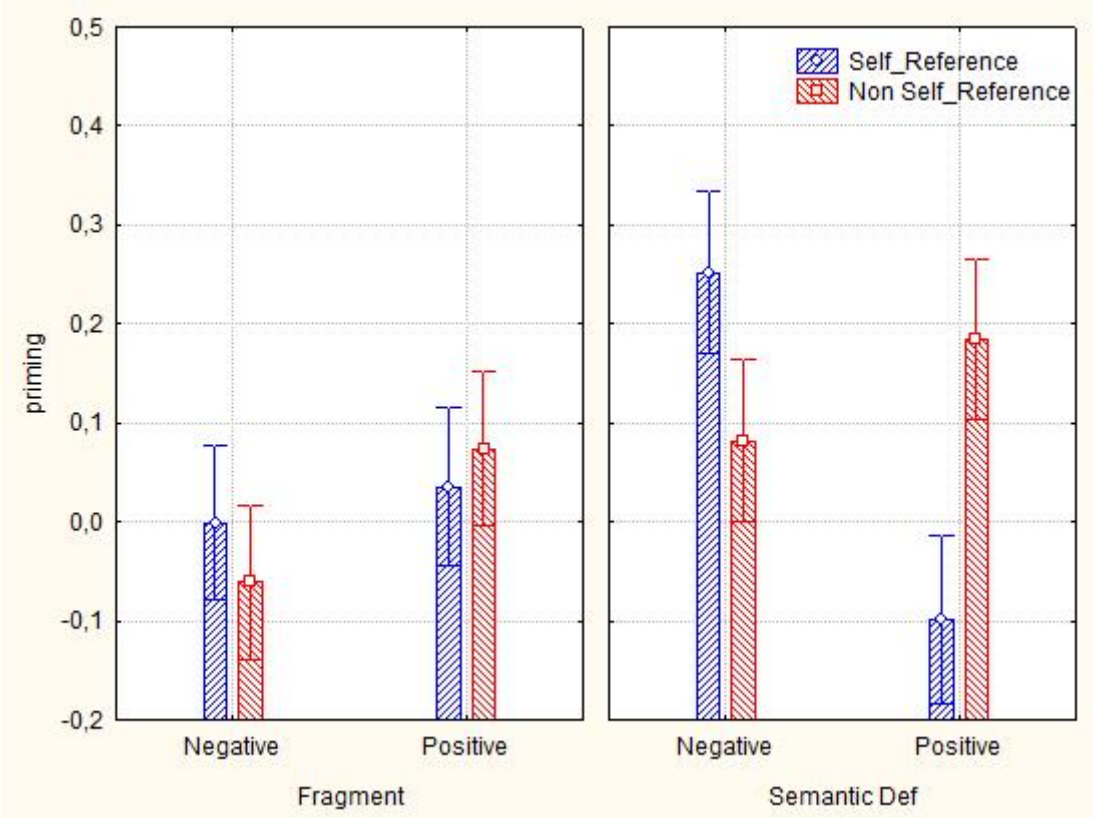

Fig. 1 Mean percentage of facilitation scores (priming) as a function of Task, Word Valence and Reference, for the subclinical Depressed Group.

Concerning the non-depressed group, the ANOVA did not reveal any significant interaction effects, $F(1,347) = 2.10$, $MSE = .12$, p = ns.

Discussion and Conclusions

The results here corroborate the need to activate conceptual processes, and not perceptive ones, in the detection of implicit memory biases. When we have used retrieval tasks that involved perceptual processing (e.g., word fragment completion), we have not obtained implicit memory biases that are mood-congruent, in line with other studies (Danion, Kauffmann-Muller, Grange, Zimmerman, & Greth, 1995; Denny & Hunt, 1992; Ilsley, Moffoot, & O´Carroll, 1995; Watkins et al., 1992). By contrast, when we have prompted the activation of conceptual processes, in both the encoding and retrieval

phases, we have indeed detected those biases, as have other prior studies (e.g., Watkins et al., 1996; Watkins et al., 2000b).

Our results extend beyond the relevance of conceptual processing in the detection of implicit memory biases. Indeed, our main finding indicates that those biases were observed for the adjectives that each participant chose as being more self-referential or self-descriptive during the encoding phase. Accordingly, the approaches adopted by prior studies indicating that conceptual processing is activated when the participants turned their attention toward the meaning of the word, and thereby inferring that there was a profound elaboration of the material presented, could be an insufficient explanation of this process.

The scientific literature contains few and fairly inconclusive studies on self-referential processing for the detection of implicit memory biases. Among the few studies published, Watkins et al. (2000a) have not found these self-referential effects on implicit memory in people with depression. Following a detailed analysis of this study, we have noted that although the retrieval task they used was similar to the one used here, namely, semantic definition, this was not the case for the encoding task. We posit that in order to activate the self-referential process at the time of encoding, the use of the imagination of 20 or more situations on the basis of their respective words is an extremely abstract process, and might not lead to the activation of the participant's cognitive self-schemas, as required for generating a mnesic trace of that emotional material. We understand this is also the reason other scholars have not reported any effects of emotion on implicit memory tasks.

In sum, this study has found that self-referential processing is an important aspect in the detection of implicit memory biases that are mood-congruent. Our study's main conclusion, therefore, is that the activation of a conceptual processing of affective material seems to be a necessary, albeit insufficient, condition for the appearance of such biases. The key aspect is that such affective material should describe the individual's own mood. In other words, when the incoming information is self-descriptive it fits some self-schema so as to receive automatic processing. This means that the self-referential information arising from the activation of self-schemas biases the memory of mood-congruent information.

There is an alternative interpretation of our findings that questions the implicit nature of the biases detected. Based on the so-called experimental contamination effect, participants may have realised that the material requested in the retrieval task was the same as that used in the study task. If participants are aware of this relationship they might use intentional retrieval strategies. Such strategies would compromise the intentional retrieval that should guide the implicit memory tasks (Butler & Berry, 2001; Mulligan, 2011). This alternative interpretation should assume that intentional memory occurs in the retrieval of negative self-referential adjectives in comparison to positive ones; perhaps as a result of the greater processing the former undergo in the processing phase. Yet intentional memory should then have also favoured the access to positive self-referential adjectives in contrast to positive non-self-referential ones, an outcome that has not been obtained in our study.

This study has certain limitations. As with other studies that assess memory biases (Gotlib, Kasch, Trail, Joormann, Arnow, & Johnson, 2004; Romero, Sánchez, &

Vázquez, 2014), our participants were mainly women. This imposes a limitation on the extrapolation of our findings, even though we do not find any significant differences here that may be attributed to gender. Another limitation involves controlling for the effect of contamination. In other words, it is possible that during recall a subject may explicitly retrieve the adjectives encoded beforehand. However, we consider this to be a remote possibility, as the study and retrieval stages were presented as two different tasks. This means it is fairly unlikely that the subjects linked the two stages of the experiment.

Strictly speaking, this research has implications for understanding the cognitive processes linked to subclinical depression, but not to clinical depression. Nevertheless, the latest scientific literature does not consider depression to be a uniform category at either cognitive or clinical level (see Besche-Richard, 2013, for a review). This notion of a continuum in depressive symptomatology is especially important when studying the role of cognitive biases, which seem to have a different impact depending on the severity of the depression (Beck, 1976). Accordingly, the studies by Everaert (Everaert, Koster, & Derakshan, 2012; Everaert, Duyck, & Koster, 2014) have provided evidence on how different cognitive biases (e.g., involving attention, interpretation and memory) interact, intensifying and consolidating the actual depressive symptomology itself.

All this advises diversifying the research throughout the entire continuum (i.e., non-depressed at-risk, subclinical, clinical, and remitted depression), instead of restricting it to the most severe cases. The biases in cognitive processing vary depending on the individual's experience, when an increase in feelings of depression or recurrent negative thoughts may alter basic cognitive processes such as memory or emotion. As such, the interrelations among biases might be stronger as the number of depressive episodes

increases (Teasdale & Barnard, 1993). Therefore, like Everaert, Duyck, and Koster (2015), we contend that the assessment of biases in cognitive processing, especially of emotional content, may predict changes in the severity of the symptoms of subclinical depression; a key aspect for understanding clinical depression.

Implicit memory biases that are mood-congruent are known to be an important cognitive mechanism that impacts upon the behaviour and experience of subclinical depressed individuals (Hervás & Vázquez, 2006). Everaert et al. (2014) provide evidence on how different cognitive biases (e.g., involving attention, interpretation, and memory) interact and intensify, consolidating the actual depressive symptomology itself. These biases, moreover, may partially explain a major cognitive component that reinforces depression, namely, rumination. The finding that rumination is related to the conceptual formation of unpleasant memories and thoughts is one of the main outcomes of the studies by Nolen-Hoeksema (Nolen-Hoeksema, 1991; 2000; Nolen-Hoeksema, Morrow, & Fredrickson, 1993), whose research also indicates that rumination enhances the operation of cognitive biases. Thus, dysphoric participants who were induced to ruminate endorsed more negative interpretations of hypothetical situations, generated less effective problem-solving strategies (Lyubomirsky & Nolen-Hoeksema 1995), and increased their recall of negative autobiographical memories (Lyubomirsky, Caldwell, & Nolen Hoeksema, 1998).

Based on the findings reported in our study, we may infer that the consolidation of the rumination process is reinforced by access to negative content, provided it is self-referential. Accordingly, we contend that effective therapies for subclinical depression

should focus on modifying negative self-referent aspects, especially in the first stages of cognitive processing, where the interaction and intensification of the cognitive biases are not so firmly consolidated (Beevers, 2005). This would help to reduce implicit memory biases, which have proven to be predictive of depressive symptoms over time (e.g., Beeney & Arnett, 2008). There is no doubt that this research would ultimately lead to more effective therapies for subclinical depression and other emotional disorders.

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