RUNNING HEAD: Mood-Congruent Memory in Depression

Mood-congruent True and False Memory: Effects of Depression

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Abstract

The Deese/Roediger-McDermott paradigm was used to investigate the effect of depression on true and false recognition. In this experiment, true and false recognition was examined across positive, neutral, negative, and depression-relevant lists for individuals with and without a diagnosis of major depressive disorder. Results showed that participants with major depressive disorder falsely recognized significantly more depression-relevant words than non-depressed controls. These findings also parallel recent research using recall instead of recognition and show that there are clear mood congruence effects for depression on false memory performance.

Key words: False memory, Depression, Mood congruence

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Mood plays an important role in regulating emotion, particularly in affective disorders. Research has demonstrated that mood states can both impair and enhance memory (Gray, 2001), decision-making (Arkes, Herren, & Isen, 1998), and attention (Joormann & Gotlib, 2007). In addition, Leppanen (2006) has shown that mood disorders (specifically depression) can be associated with differences in processing stimuli that are emotional in content. This is particularly true for stimuli congruent with current mood state (i.e., mood congruent effects; e.g., Bower, 1981; Watkins, Mathews, Williamson, & Fuller, 1992). For example, participants in a depressed or negative mood are more likely to recall or recognize negative words than those without depression or those in a positive mood.

Depression and negative mood states have also been linked to memory impairments (Blaney, 1986). Burt, Zembar, and Niederehe (1995) explored the association between depression and memory impairment and argued that reduced output could be due to either a lowered motivation to complete the memory task or a more conservative response bias (also see Williams, Watts, MacLeod, & Mathews, 1988). Thus, motivational factors may play an important role in the differences in true (and perhaps false) remembering. In addition, they proposed that differences in memory performance between participants with and without depression may be the result of differences in sustained attention, a notion similar to that proposed by Dalgleish et al. (2007) in which differences in executive functioning was used as an explanation for differences in autobiographical memory between participants with and without depression.

Many of the studies that have investigated mood and memory processes have typically focused on true memory (e.g., Dalgleish et al., 2007). However, some recent studies have begun to investigate the effects of depression on false memory (see Joormann, Teachman, & Gotlib, 2009; Moritz, Glascher, & Brassen, 2005; Torrens, Marche, & Thompson, 2008). A robust methodology for studying spontaneous (as opposed to suggested) false memories is the Deese/Roediger-McDermott (DRM) paradigm (Deese, 1959; Roediger & McDermott, 1995). Here, participants study word lists that converge on a common theme (also termed the *critical lure*). The critical lure is the most strongly associated word to each of the items in the list. For example, the words *success, exam, pass, loss, break, crisis, degree, fail, fault,* and *flop* are all semantically related to the unpresented word *failure* (the critical lure). When participants are later asked to remember the presented words, they not only correctly remember words that were on the list but also falsely recollect the unpresented, but thematically related, critical lure. Such false memories tend to occur automatically and without conscious awareness in adult participants (e.g., Park, Shobe, & Kihlstrom, 2004).

What limited research that does exist concerning the effects of mood on false memory does not provide a particularly consistent picture. For example, Storbeck and Clore (2005) found that participants in negatively induced moods were less likely to show false memory effects than participants in positively induced moods. In a mood induction study using a range of valenced material (positive, negative, and neutral) Ruci, Tomes, and Zelenski (2009) found a strong mood congruence effect for false recognition of critical targets. That is, participants were more likely to falsely recognize the critical lure if it was congruent with their induced mood. Torrens et al. (2008) found that dysphoric participants produced no more false memories for negative emotional information than nondysphoric students. Interestingly, Torrens et al. (2008) did find that students with dysphoria produced lower levels of false recognition for positive information than nondysphoric students. Moritz et al. (2005) used a variant of the DRM paradigm and found a nonsignificant trend for increased false recognition of negative lures in participants with

depression. In a more recent experiment, Joormann et al. (2009) found that participants diagnosed with major depressive disorder (MDD) falsely recalled more negative words and had poorer baseline recall of true words than non-depressed controls. In addition, using Chinese DRM word lists Yeh and Hua (2009) discovered that participants with depression produced higher levels of false recognition than non-depressed controls, regardless of valence (positive, negative, and neutral).

A key distinction between these different studies concerns the nature of the participants' negative mood state. For example, in the Storbeck and Clore (2005) and Ruci et al. (2009) studies participants' mood states were transitory, having been induced in the experimental context at the time of list learning. By contrast, participants in the Joormann et al. (2009) study had more longstanding depressive disorders, ones that existed prior to the experiment. The different effects observed across these studies may be linked directly to differences between participants who have longstanding mood disorders and those who mood state is transitory. Indeed, Joormann et al. (2009) suggest that depression is linked to an increase in "resting" activation levels of negative concepts in memory, enhancing accessibility of negative information in memory, something that can lead to increased spontaneous false recollection of mood-congruent information.

Watkins, Moberly, and Moulds (2008) propose that dissociations between mood induction and more longstanding mood disorders may be a result of different functional processing tendencies that are associated with the cognitive and emotional consequences of different mood states. That is, negative moods are associated with more item specific interpretation and processing of information, something that has been found to increase rates of true recollection and reduce false memories (e.g., Brainerd, Reyna, & Ceci, 2008; Howe, 2008). However, processing of material that is more relevant to the self is thought to be accomplished in a more global fashion (e.g., see Williams, 2006) where item specific processing is somewhat impaired, possibly due to reduced cognitive control. Such global processing, coupled with reduced item specific processing, may lead to increases in false recollection (e.g., Brainerd et al., 2008; Howe, 2008).

In the current article, we examined the effects of longstanding depression on true and false recognition of neutral, positive, negative, and depression-relevant materials. Recall tests (or other unstructured memory tests) are potentially more sensitive to the effects of mood states on memory, particularly for participants with MDD (Hertel, 2000). There is a greater cognitive load placed on memory processes with recall tasks and thus differences may be heightened between controls and participants with MDD. However, these differences may not reflect changes in memory processes *per se* as they may be based on changes in executive functioning or decreased motivation during the memory task itself. To avoid these possibilities, we used recognition measures to examine memory. This also allowed us to extend previous findings based on recall tasks (e.g. Joormann et al., 2009) and to make direct comparisons with some prior research (e.g., Ruci et al., 2009). As well, we chose recognition measures because they are frequently the index of choice when studying false recollection in the DRM paradigm because they are known to provide a more sensitive index of the automatic activation of false memories (e.g., see Gallo, 2006).

Theoretical and Methodological Issues When Examining False Memory and Depression

There are reasons to believe that participants with depression may be either more or less susceptible to false memories, particularly for depression relevant materials. For example, individuals with depression may have higher "resting" levels of activation for depression relevant themes and, when these concepts are presented, spread of activation to unpresented but related items might be enhanced such that both true and false recognition of depression-related words

may be increased (e.g., Bower, 1981). Indeed, accuracy may be compromised in individuals with depression due to deficits in cognitive control, deficits that can lower discrimination thresholds between the presented and nonpresented material (see Hertel, 2004). Conversely, false recognition rates may be lowered through heightened awareness of depression relevant words leading to more effortful, careful processing that lead to increased levels of accuracy (e.g., Ruder & Bless, 2003).

Interestingly, recent research investigating false memory and the effects of expertise may tie in quite well with research on the effects of depression on memory. For example, Baird (2001) hypothesized that expertise would be correlated with the number and strength of associations between presented concepts in the domain of expertise but not elsewhere. What this implies is that experts may not only be better at remembering information from their domain of expertise, but may also be more prone to false recollection in that domain than individuals not as familiar with such concepts (i.e., novices). In terms of depression, if depressed participants are considered "experts" in their own mood and mental state, false memories may be more prevalent for depression self-relevant information than other types of information or than in participants who are not depressed. For example, Brennen, Dybdhal, and Hapidzic (2007) found that war survivors with posttraumatic stress disorder (PTSD) are more likely to falsely recall war related targets than war survivors without PTSD. More important for our purposes, they discovered that depression scores were more highly correlated with memory performance than was PTSD status. What this means is that depression is playing a role in the creation of false memories for words that hold personal emotional salience. That is, expertise in negatively valenced words and their associations in isolation is not enough to produce elevated false memories (war survivors without depression), but when coupled with depression, may play a key role in the occurrence of spontaneous false memories.

Consistent with some of this speculation, previous research has found that participants with depression make more (although not significantly more) false recognition errors with emotional words, particularly for depression-relevant words, despite learning emotional material as well as non-depressed participants (Moritz et al., 2005). Interestingly, Moritz, Voight, Arzola, and Otte (2008) examined word lists that possessed individual salience for participants. Specifically, they used materials that were rated as subjectively arousing and emotional to specific participants in the experiment. They found that both true and false memories increased when words had personal significance for individuals with depression but not those without depression.

Of course, not all studies have found similar results. Indeed, there are a number of reasons why we do not have as clear a picture of the effects of depression on false memory production as we might like. First, some of the discrepancies between studies investigating false memory and mood could have arisen because of the nature of the depressed population. For example, Torrens et al. (2008) used dysphoric student participants who were not diagnosed with a MDD whereas Moritz et al. (2005) used a sample of inpatients with a primary diagnosis of MDD and Joormann et al. (2009) used a sample of outpatients diagnosed with MDD. The current study used strict criteria when defining our participants with depression. Specifically, participants diagnosed with a MDD also had to score 20 or above on the Beck Depression Inventory (BDI). In addition, information was gathered on current subjective mood state, medication status, age of onset of depressive illness, and comorbid disorders. Participants with other primary diagnoses were excluded in order that any differences discovered between the group with depression and controls could be accounted for by depression and not another disorder.

Second, different studies have used different types of stimuli, something that may also

contribute to discrepancies in the findings. For example, Mortiz et al. (2008) argued that differences in false memory between participants with and without depression should be obtained with word lists that are personally relevant. Alternatively, Joormann et al. (2009) and Ruci et al. (2009) used a mixture of positive, negative, and neutral words lists that were not necessarily personally relevant to the participants. It may be that when studying memory processes in depression, it is important to use stimuli that are relevant to depression. For example, in the study conducted by Yeh and Hua (2009), participants with depression were more likely to falsely recognize words compared to control participants, regardless of valence. Although they did not discover a mood congruence effect, when participants were asked to rate the words for emotional intensity they discovered that participants with depression rated the positive words as having less positive intensity, but there were no differences in perceptions of the negative or neutral words. For mood congruence effects to appear, words may need to be specific to depression and not simply be negative. Thus, in the current experiment we used both specific depression-relevant word lists as well as lists that contained positive, negative, and neutral themes. Finally, a further modification from previous research (e.g., Joormann et al., 2009) was the inclusion of equal numbers of word lists from each category. This was done in order that one theme did not dominate the stimulus set thus biasing results towards that category. The current study also extends the work of Ruci et al. (2009) by including depression relevant word lists and using a population diagnosed with depression rather than participants whose mood was induced.

Method

Participants

Twenty-four participants with a primary diagnosis of MDD (according to DSM-IV) were recruited via voluntary mental health organizations (age range 18 to 58 years, *M* = 38.41, Female = 14, Male = 10). This diagnosis was based on assessments done prior to the study conducted by healthcare professionals (e.g., psychiatrist/G.P.). These diagnoses were reported by the participant and verified by the care-coordinator acting as link person for the research. In addition, participants included scored 20 or above on the BDI-II and were excluded if they had any comorbid disorders.

Participants in the depressed group had mean BDI-II score of 27.9 (SD 5.4) and a mean subjective mood rating of 45.3/100 (SD 16.5). The subjective mood rating was ascertained by asking participants to mark on a scale from 0-100 how they would describe their current mental state where 0 represented the worst they have ever felt and 100 represented the best they had ever felt. Twenty-four age and gender matched controls also participated (range = 19-56, *M* = 35.82, female = 15, Male = 9). One male participant from the group with depression was matched with a female control of the same age. All others were matched on age and gender. Controls had a mean BDI-II score of 9.6 (SD 5.4) and a mean subjecting mood rating score of 70.9/100 (SD 18.1). All participants had English as a first language, gave written informed consent, and were fully debriefed at the end of the experiment.

Design, materials, and procedure

The experiment employed a standard DRM list-learning paradigm with recognition memory task. A 4(list: neutral, positive, negative, and depression-relevant) x 2(item: true, false) x 2(mood: depression vs. control) mixed design was used in which the first two factors were within-subject and the latter factor was between-subjects.

Participants were read a standard set of memory instructions and were then presented with 12 different 10-item DRM word lists, one at a time. Of these lists, 3 were neutral, 3 were positive, 3 were negative, and 3 were depression relevant[1]. Lists were taken from the Birkbeck word

association norms (Moss & Older, 1996) and from those used by Budson et al. (2006). In addition, critical lures were matched for word frequency (Bradley & Lang, 1999; Leech, Rayson, & Wilson, 2001). Moreover, all of the lists were equated on backward associative strength (BAS) and word frequency but varied in valence.[2] Using univariate analyses of variance (ANOVAs), there were no differences among lists in word frequency ($F(3, 60) = 1.80$, $p = .157$) or BAS ($F(3, 60) = 1.64$, $p = .19$). However, lists did differ on valence ($F(3, 60) = 34.84$, $p < .001$, ($_p^2 = .651$). Post-hoc tests showed that although there were no differences in valence between the depression ($M = 3.04$, $SE = .37$) and negative ($M = 3.33$, $SE = .36$) lists, both lists were significantly lower in valence than the neutral lists ($M = 4.77$, $SE = .45$; ps $< .01$) and the positive lists ($M = 7.43$, $SE = .33$; ps $< .01$). Finally, these latter two lists also differed, indicating that the positive lists were significantly higher in valence than the neutral lists ($p < .01$).

Each word in a list was associatively related to an unpresented critical lure and words were again presented in descending order of associative strength to the critical lure (see the Appendix for the complete set of word lists used in the current experiment). Word lists were presented in an auditory prerecorded digital format at a 2-second rate, with a 4-second pause between each list. Participants either heard each category of the 3 word lists (12 in total) in one of two orders: positive, depression-relevant, neutral, negative, or in the reverse order, for counterbalancing purposes.

When all word lists had been presented participants were given instructions for the recognition memory test. The recognition test was comprised of 72 words, 36 targets (3 from each list), 12 related words not presented (1 from each list), all 12 critical lures (1 from each list), and 12 unrelated unpresented words (3 neutral, 3 positive, 3 negative, and 3 depression relevant). Again, the related unpresented words were taken from position 11 of the original lists and served as distractor items along with the unrelated unpresented items. For the recognition task participants were required to make a yes/no judgment based on whether they thought the word was present on one of the previously heard lists. There were two orders for the recognition test counterbalanced across participants. The memory test was not timed and when completed, participants took the Beck depression inventory II (Beck, Steer, & Brown, 1996). Participants also completed a questionnaire regarding mental illness history and gave a subjective rating of their current mental state (or a scale that ranged from ‘worst I have ever felt’ to ‘best I have ever felt’).

Results[3]

The recognition results were subjected to two 4(list: neutral, positive, negative, depression-related) x 2(group: depressed, control) ANOVAs, one for true recognition and one for false recognition. Again, for false recognition, we used the traditional analyses associated with false memory illusions, namely, false recognition rates for the critical lures (there were no differences of any interest for the related unpresented items and both the critical lures and the related unpresented items are shown in Table 1). For true recognition, there was a main effect for list, $F(1, 46) = 5.96$, $p < .02$, ($_p^2 = .213$, and a marginal List x Group interaction, $F(1, 46) = 2.94$, $p < .052$, ($_p^2 = .041$. An analysis of simple main effects revealed that there was a significant effect of list for participants with depression ($F(1, 46) = 3.193$, $p < .045$, ($_p^2 = .31$), but not for control participants. That is, for participants with depression, negative and depressed word lists tended to be remembered better than neutral and positive lists (see Table 1). Additional post-hoc tests ($p < .05$) showed that control participants correctly recognized more neutral ($M = .81$) and negative ($M = .82$) items than participants with depression ($M_{neutral} = .59$, $M_{negative} = .65$). For false recognition, there was a main effect for list $F(1, 46) = 6.96$, $p < .01$, ($_p^2 = .240$, and a List x Group

interaction, $F(1, 46) = 3.65$, $p < .048$, ($_p^2 = .07$. Simple main effects analyses revealed again that there was a significant effect of list for participants diagnosed with depression ($F(1, 46) = 10.02$, $p < .01$, ($_p^2 = .30$.) Post-hoc tests ($p < .05$) showed that participants with depression falsely recognized more depression-relevant lures ($M = .75$) than controls ($M = .47$) (see Table 1). There were no significant differences between unrelated or related unpresented recognition rates between the two groups (see Table 1).

Discussion

These results show that depression, in and of itself, does not have a consistent positive or negative impact on episodic memory. Rather, these effects are material dependent. Specifically, although non-depressed participants correctly recognized significantly more neutral and negative items than depressed participants, correct recognition was no worse for depressed than non-depressed participants for positive or depression-relevant items. It would seem that for correct recognition, depression does not result in poorer memory for depression related information.

The results also make it clear that false memory rates are neither increased nor decreased across the board as a consequence of depression, but rather, like true memory, depend on the type of material being activated in memory. Indeed, like the expertise effect in false recollection, the current findings show that participants with depression falsely recognized significantly more depression-relevant critical lures than non-depressed participants, but otherwise, were no more susceptible to false memory illusions that controls when studying positive, neutral, or negative DRM lists.

These findings are consistent with previous research. Specifically, Moritz et al. (2008) found that participants with depression demonstrated higher levels of true and false recognition for words that produced higher ratings for emotional salience and Joormann et al. (2009) reported higher levels of false recall for negative words with participants diagnosed with MDD. Participants with depression in the current study evidenced lower false recognition for negative items although they did produce higher levels of false recognition for depression relevant words - words that could be said to hold higher levels of personal salience to them. This discrepancy between studies may be due to the use of different memory tests, where different processing styles are adopted during recall tests as opposed to during recognition tests. We propose that one such processing difference, a mood repair strategy, may have been involved in the lowered levels of negative false recognition. Participants may not find this strategy particularly effective in asks such as recall that are more effortful than recognition tests and hence, it may not be evidences as often (or at all) when memory is assessed using recall.

When considered together, these results are consistent with Joormann et al.'s (2009) claim that participants with depression exhibited decreased accuracy with depression relevant materials. That is, although participants with depression did not exhibit lower rates of correct recognition for depression-relevant words than control participants, they did exhibit higher rates of false recognition for depression-relevant words. Indeed, when we compute traditional measures of net accuracy found in the false memory literature (i.e., the ratio of true memory to true memory plus false memory; see Brainerd et al., 2008) for depression-relevant materials, it is clear that participants with depression are significantly less accurate ($M = .47$) than their non-depressed counterparts ($M = .62$) ($t[46] = 2.44$, $p = .023$).

The finding in this experiment that there were significant differences between participants with depression and controls for some types of word lists but not others supports the growing consensus that global memory deficits are not associated with depression. Rather, depression may be associated with more specific, perhaps material sensitive, differences (e.g., depression relevant

specific). The present findings further refine this idea because differences in depression relevant materials were confined to false memories. If it is correct that true recollection is driven by conscious and controlled episodic memory processes, whereas false recollection is driven by nonconscious and automatic semantic memory processes (e.g., see Howe, 2005; Kimball & Bjork, 2002), then our results show that it is the automatic activation of semantically related but unpresented information that exhibits strong mood congruence effect in depression. Although participants with depression may (or may not) exert conscious control over episodic recollective processes, such effects do not extend to the automatic activation of semantically similar, depression relevant information.

Our findings are consistent with recent theories of spontaneous false memories in which the key mechanism producing memory illusions is the automatic spreading of activation through highly interconnected associative networks. Theories such as associative-activation theory (e.g., Howe, Wimmer, Gagnon, & Plumpton, 2009) and activation-monitoring theory (e.g., Roediger, Balota, & Watson, 2001) both rely on spreading activation through associative memory networks in their accounts of false memory creation. For example, in associative-activation theory, activation from concepts contained in the list spreads to related, unpresented concepts in memory as well as to higher order theme nodes that integrate and represent the possible meanings associated with the concepts that have become activated (see Howe & Derbish, 2010; Howe & Wilkinson, 2011). As it turns out, in addition to the importance of backward associative strength, the fewer the number of possible themes available for a given list, the more likely it is that false memories will emerge (Howe & Derbish, 2010). What the current study adds to these theories is that apparently, the higher the "resting" activation levels are for relevant concepts in memory, the more likely it is that false memories will emerge. That is, consistent with Joormann et al.'s (2009) suggestion, depression may be linked to an increased resting activation level for depression-relevant concepts, something that in turn leads to enhanced availability and accessibility of this information in memory. What this does is make it more probable to observe elevated levels of spontaneous false recollection of depression related concepts.

In addition, longstanding depression in which participants may be seen as "experts" in depression-related information does increase the likelihood that such information will be activated and incorrectly output during the recollective process. This ties in well with the work of Watkins et al. (2008) and suggests that participants with depression may be impaired at item specific processing, particularly for depression relevant words. This may be due to reduced cognitive control, one result of which is increased false memories for depression relevant concepts, something that does not occur for participants in a transitory negative mood states. In fact, it may be that participants with depression have "expertise" in the associative thought processes among depression-relevant concepts, increasing the probability that such concepts will become automatically activated. Such automatic activation is more difficult to inhibit than the activation associated with material presented episodically (the list items themselves) (e.g., see Kimball & Bjork, 2002). Moreover, because poor working memory is associated with increased recollection of automatically activated critical lures (Peters, Jelicic, Verbeek, & Merckelbach, 2007), and previous research has shown that there are depression-associated deficits in working memory (Joormann & Gotlib, 2008), it may not be surprising to see that longstanding depression is associated with higher rates of false recollection for depression-related concepts.

Together with other recent studies, it has become clear that regardless of whether memory is measured using recall (Joormann et al., 2009) or using recognition (as used in the experiment reported here), longstanding depressive mood states can lead to higher rates of false recollection.

These higher rates of false recollection occur particularly for depression-relevant information, a phenomenon similar to that observed for memory illusion in expertise. Regardless of its source, increased activation of depression-relevant material in memory, along with possible decreases in cognitive control (e.g., memory monitoring), leads to overall declines in net accuracy when attempting to discriminate what has happened from what has not. As the activation of these non-occurring concepts is unconscious and automatic, any therapeutic intervention must necessarily circumvent such nonconscious processing. The good news is that because these effects may be restricted to mood-congruent concepts (i.e., depression-relevant concepts), participants/clients with depression do not necessarily have global memory deficits and may in fact have very good memory for negative events that have actually occurred. However, this may represent a double-edged sword – the ease with which true memories of negative or depression-related experiences come to mind may also increase with the ease with which false recollections become confused with reality.

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Appendix: Word lists used in the current experiment (critical lures in *italics*)

Neutral

Fruit	*Chair*	*Needle*
Apple	Table	Thread
Vegetable	Sit	Pin
Orange	Leg	Eye
Pear	Seat	Sewing
Banana	Couch	Sharp
Berry	Desk	Point
Cherry	Sofa	Prick
Basket	Cushion	Thimble
Juice	Sitting	Haystack
Salad	Stool	Thorn

Positive

Admire	*Excel*	*Gentle*
Like	Good	Giant
Respect	Brilliant	Soft
Envy	Achieve	Kind
Beauty	Best	Caring
Her	Exceed	Lamb
Idol	Win	Man
Love	Better	Ben
Them	Correct	Mild
Admiral	Elite	Quiet
Adore	Excess	Smooth

Negative

Mislead	*Hell*	*Thief*
Lie	Devil	Steal
Error	Satan	Robber
Trick	Evil	Crook
Deceive	Damned	Burglar
Follow	Sin	Money
Mistake	Lucifer	Cop
Path	demon	Bad
Wrong	Heaven	Rob
Annoy	Soul	Jail
Away	Judgment	Gun

Depression relevant

Depression	*Failure*	*Alone*
Sad	Success	Single
Anxiety	Exam	Isolated
Sadness	Pass	Abandoned
Anger	Loss	Solitary
Down	Break	Apart
Low	Crisis	Lonesome
Blackness	Degree	Separate
Boredom	Fail	Quiet
Disaster	Fault	Detached
End	Flop	Solo

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Footnotes

[1]Although norms exist for neutral, positive, and negative DRM lists, depression-relevant lists have not been previously rated. For the purposes of the current experiment, we created these depression-relevant lists using standard word association norms (Moss & Older, 1996) to ensure their compatibility with other DRM lists. In addition, a separate group of 68 non-depressed participants rated these new words in terms of their relevance to depression, as the average person would rate them. The rating scale had seven options ranging from very irrelevant to very relevant (to depression). The final depression relevant word lists (see Appendix) were chosen when 70% or more of the participants rated the critical targets and at least 6 of the ten words in the lists as very relevant to depression. Care was taken to ensure there was minimal overlap between the concepts in the separate lists.

2 Not all of the words on the various lists were available in all of the different sets of norms for valence, word frequency, or backward associative strength. Indeed, although the majority of the words could be rated across list type, a minority could not. The analyses we report are for those words where norms were available.

[3]Signal-detection analyses were also conducted. The recognition results were the same regardless of whether raw scores or signal detection measures (*d(* and C) were used in the analyses. As there were no differences in the outcome of these analyses, and because we wanted to make contact with other studies in the literature, we report the untransformed analyses.

Table 1. Mean proportions for true (T), false (F), related unpresented (RU) and unrelated unpresented (UU) recognition rates (SDs in parentheses).

Word list	*True(T)/False(F) Related unpresented (RU) Unrelated unpresented (UU)*	*Depressed*	*Non-depressed Control*	
Positive	T	.57 (.23)	.73 (.24)	
	F	.38 (.37)	.44 (.35)	
	RU	.13 (.30)	.05 (.12)	
	UU	.19 (.29)	.28 (.30)	
Neutral	T	.60 (.32)	.81 (.19)	*
	F	.69 (.36)	.58 (.35)	
	RU	.19 (.26)	.02 (.09)	
	UU	.02 (.09)	.13 (.22)	
Negative	T	.65 (.20)	.82 (.12)	*
	F	.52 (.30)	.53 (.30)	
	RU	.22 (.29)	.16 (.17)	
	UU	.19 (.29)	.13 (.22)	
Depression	T	.69 (.26)	.72 (.23)	
	F	.75 (.25)	.47 (.26)	**
	RU	.30 (.30)	.11 (.22)	
	UU	.08 (.20)	.16 (.33)	

** p = .02*
***p = .05*