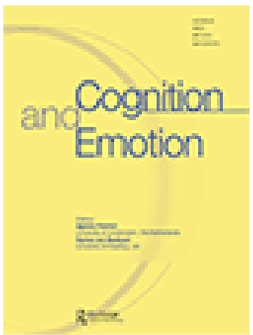

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Implicit memory bias in depression

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In this review I describe research conducted in my laboratory concerning implicit mood-congruent memory (MCM) bias in clinical depression. MCM is the tendency for depressed individuals to retrieve more unpleasant information from memory than nondepressed controls, and may be an important maintenance mechanism in depression. MCM has been studied frequently with explicit memory tests, but relatively few studies have investigated MCM using implicit memory tests. I describe several implicit memory studies which show that: (a) an implicit MCM bias does not appear to exist when perceptually driven tests are used; (b) implicit memory bias can be found when conceptually driven tests are used, but (c) not all conceptually driven tests show implicit MCM bias. I conclude that conceptual processing is necessary, but is not sufficient for demonstrating implicit memory bias in depression. Future studies should investigate specific components of conceptual elaboration that support implicit memory bias in depression.

Mood-congruent memory (MCM) refers to the tendency for individuals to recall information that is conceptually congruent with their mood. Interest in mood-congruent processes arose out of the work of Gordon Bower and his concern with mood-state dependent memory (e.g., Bower, 1981). Although mood-state dependent memory and MCM are related, in mood-state dependent memory the content of the material learned is not important, only the transfer of learning due to the consistency of mood at study and test. In MCM experiments, mood states at study and test may not be manipulated, but the emotional valence of the information is important. For example, MCM in depression refers to the tendency for depressed individuals to recall more negative or unpleasant material, relative to nondepressed controls.

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MCM appears to be a reliable phenomenon in depression. Studies conducted with pleasant and unpleasant words, and with autobiographical recollection have shown that depressives tend to show a more negativistic memory bias than controls (for a review, see Blaney, 1986). In explicit memory, this bias is often revealed by nondepressed participants recalling more positive information than depressives, rather than depressed individuals actually retrieving more negative information than controls. In this review I define MCM bias in depression as a more negative memory bias, which may also mean a lack of a positive memory bias relative to controls.

MCM appears to be so robust, some have proposed that it might be an important maintenance mechanism in depression. For example, Teasdale (1983) has observed that if unpleasant memories are more accessible to depressed persons, remembering these events might help maintain their depressed mood. In addition, Teasdale has suggested that this memory bias might contribute to the depressed individual's failure to engage in effective mood-repair activities. The findings related to MCM indicate that for depressives, unpleasant experiences should be more accessible for recollection. The greater accessibility of these memories might result in lowered expectancy for the success of certain coping activities, thus decreasing the likelihood that the depressed person will initiate mood-repair behaviours. For example, if a depressed person were invited to a social event, MCM would imply that unpleasant memories related to the event would be more accessible for recall. The retrieval of these experiences would likely lead to the depressed person anticipating that the social event would not help their mood state, and the event would probably be avoided. Thus, MCM might maintain the depressed mood state through several avenues.

Although MCM bias appears to be robust in depression, the vast majority of studies investigating MCM have used explicit memory tests. In explicit memory tests the instructions ''make explicit reference to, and require conscious recollection of, a specific learning experience'' (Schacter, 1987, p. 501). The way memory impacts our lives may not always be in an explicit fashion. Consider that many of the tasks of daily routine require memory but do not involve conscious or intentional recollection. For example, walking, driving a car, tying one's shoes, and buttoning one's shirt all require memory, but most do not attempt to recollect the events in which these activities were learned. In fact, as Roediger (1990) has pointed out, if we did attempt to engage in many of these activities by explicitly recollecting the learning experience, it would interfere with the performance of these tasks.

The daily activities that appear to be affected by memory in this way include more complicated behaviours such as social interactions. Clearly, while constructing sentences in conversation we do not attempt to remember our learning experiences of the meanings of the words we choose. Other complex social behaviours appear to be affected by implicit memory as well. Srull and Wyer (1979) showed that when participants were shown words with a hostile

connotation, later in an unrelated task participants tended to rate people as more hostile. Srull and Wyer did not ask their participants to attempt to retrieve the words that they saw earlier in making their judgements, but clearly the exposure to the hostile words showed an impact on their social decisions. Similarly, Smith and Branscombe (1988) found that exposing participants to various trait words later affected their trait judgements of somewhat ambiguous descriptions of behaviour. Thus, explicit memory tests probably do not capture how memory affects much of our everyday experience. As Mason and Graf have stated, ''we now know, explicit memory is only a small part—the conscious tip of the iceberg—of how memory for recent events influences us in our daily activities'' (1993, p. 8).

In the past 20 years, cognitive psychology has taken great interest in implicit or indirect memory tests. Implicit memory has been defined as ''memory for information that was acquired during a specific episode and that is expressed on tests in which subjects are not required, and are frequently unable, to deliberately or consciously recollect the previously studied information'' (Schacter, 1990, p. 338). With implicit memory tests no reference is made to the learning experience or the use of memory. Thus, retrieval on these tests may be viewed as unintentional (Richardson-Klavehn, Lee, Joubran, & Bjork, 1994). An example of one of the most commonly used implicit memory tests is word stem completion. After studying words a participant is provided with letter stems (e.g., fea____), and is asked to complete them with the first word that comes to mind. Letter stems are typically provided from words that the participant has studied (referred to as the studied or primed words), and from a set of words they have not studied (the unstudied or unprimed set). Participants reliably producing more words from the studied word set than from the unstudied set indicates evidence of implicit memory.

If MCM is an important cognitive maintenance mechanism in depression, it could be argued that the way this bias impacts the behaviour and experience of depressed individuals is more through implicit or unintentional memory than through explicit processes. To return to my earlier example, when depressed individuals are invited to a social event such as a party, it seems unlikely that they would intentionally attempt to recall past experiences with parties. It is more likely that memories of unpleasant party experiences decrease outcome expectancy through implicit retrieval. A past party episode may come to mind, but it seems unlikely that the depressed person would consciously attempt to retrieve such experiences.

It could also be argued that many of the well documented negative thinking biases in depression (usually demonstrated through self-report questionnaires) are supported through cognitive mechanisms such as implicit MCM bias. For example, a cognitive distortion, such as overgeneralisation, could be seen as the result of a depressed person tending to retrieve more unpleasant events and thus making inaccurate negative generalisations about their life. Similarly, the

tendency for depressives to dwell on more negative than positive aspects of an experience (referred to by cognitive therapists as the *mental filter*), could be the result of a negative implicit memory bias regarding the event. For example, even though a depressed individual has had many positive interactions at a social event, they may report that they ''didn't have any fun'' at the occasion because they are dwelling on the one negative interaction that took place. It could be that the reason they are dwelling on this event is that it more easily comes to mind through implicit retrieval. In fact, to anticipate a bit, we have found that a conceptually driven implicit memory bias tends to correlate more with cognitive symptoms of depression than with mood or physical symptoms (Novo & Watkins, 2000). The preceding argument assumes that an implicit memory bias exists in depression. Thus, it is important to establish the existence of an implicit MCM bias, and the conditions in which it is most likely to occur. In brief, these are the issues I attempt to speak to in this review.

I believe that investigations of implicit memory bias in depression may provide important clues to the cognitive mechanisms that maintain depression. In this paper, I describe the various studies conducted in my laboratory that have investigated implicit MCM in depression. In these studies, all of the depressed group participants met DSM criteria for either major depressive disorder or dysthymic disorder. Nondepressed controls had Beck Depression Inventory scores under 6 and did not meet DSM criteria for any mood disorder. I discuss these studies in chronological order, beginning with our study using the perceptually driven implicit test of word stem completion (Watkins, Mathews, Williamson, & Fuller, 1992), in which we failed to demonstrate an implicit MCM bias, despite finding a bias in our explicit memory task. I then describe our initial test of MCM in a conceptually driven implicit memory test (Watkins, Vache, Verney, Muller, & Mathews, 1996), where we did find an implicit memory bias. In our third study we manipulated perceptually driven and conceptually driven processes in implicit memory (Watkins, Martin, & Stern, 2000b). Here we again failed to find any implicit memory bias in our perceptually driven tests, but did demonstrate implicit MCM in one of our two conceptually driven tests. Finally, I describe a study where we attempted to investigate specific aspects of conceptual processing that may be contributing to the implicit memory bias in depression (Watkins, Grimm, May, Krueger, & Whitney, 2000a). Although our findings were not as we predicted and were somewhat equivocal, implicit memory bias was shown in one of the two conceptually driven tests. Throughout this discussion I will review findings from other laboratories that speak to the issue of implicit memory bias in depression. The focus of my review will be on processes that appear to be involved both at study and test in the demonstration of implicit memory bias in depression. I will attempt to show that conceptual processing is necessary both at study and at test for implicit memory bias to be shown.

However, I will also present data supporting the proposition that conceptual processing is not sufficient for producing implicit memory bias in depression.

IMPLICIT MEMORY BIAS IN WORD STEM COMPLETION

The first question we attempted to answer in my laboratory was: Is there an implicit memory bias in depression? It will become clear that this question was simplistic, but my colleagues and I first attempted to investigate implicit memory bias in depression by using a word stem completion task (Watkins et al., 1992). As I described earlier, in word stem completion the participant is asked to produce the first word that comes to mind beginning with three or four letters. In this study our participants studied positive, depressive relevant (e.g., hopeless, guilty, foolish, inferior, etc.), neutral, and physical threat (e.g., suffocate, coronary, stab) words in an imaginal self-referent task. In this encoding task participants were provided with a study word and were asked to imagine themselves in a scene involving a referent of the word. After study, participants completed both an implicit and an explicit memory test, counterbalanced for order. Both tests used letter stems for retrieval cues and only differed in the instructions. In the implicit test the participants were told to produce the first word that comes to mind beginning with the letter stems and in the explicit test participants were instructed to attempt to produce words from the study list that began with the letters provided. In explicit memory, we found the expected MCM effect. However, we found that the explicit memory bias did not extend to all negative words, only the depression-relevant words. Physically threatening words did not show any differences between groups. Contrasting with the explicit memory findings, no implicit memory bias was found. In addition, no priming deficit was evident in depressed participants.

Denny and Hunt (1992) conducted a very similar study to ours but used free recall as their explicit test and word fragment completion as their implicit test. In word fragment completion the participant is provided with several letters of the word and blanks for the missing letters (e.g., p__c_f_l, for *peaceful*) and they are asked to produce the first word that comes to mind. Like our study, Denny and Hunt found the expected MCM bias in explicit memory, but no implicit memory bias. Although the theories of Beck (e.g., Beck, Rush, Shaw & Emery, 1979) and Bower (e.g., 1981) are silent with regard to predictions about implicit memory, both theories seem to imply that with depression or sadness, negative or mood-congruent information should be more activated and thus more accessible regardless of the retrieval task used (cf. Bower & Forgas, 2000). The findings of Denny and Hunt (1992) and Watkins et al. (1992) do not support this assumption, however. The contrasting results of implicit and explicit memory in these studies suggests that it is not simply that negative information is more activated in depressed mood, but that how this information is accessed also matters.

These studies appeared to show that MCM depended at least in part on the type of retrieval task used. Although the theories of Bower or Beck did not predict these results, they fit nicely with the predictions offered by the original theory of Williams, Watts, MacLeod, and Mathews (1988). Following Graf and Mandler (1984), Williams et al. posited two distinct cognitive processes that may be differentially biased by different emotional states and disorders. An initial integration or priming stage is automatic and occurs because components of a stimulus are mutually activated. Because of mutual activation of the stimulus components, the stimulus becomes more integrated. The more integrated a stimulus is, the more likely the entire stimulus will be accessed if some of its components are activated. However, in Graf and Mandler's words, although an item may be more accessible because it is more integrated, it will not necessarily be more retrievable. According to Graf and Mandler, a word will only be more retrievable in explicit memory if it is more elaborated. Elaboration refers to the ''activation of a representation in relation to other associated representations to form new relationships between them and to activate old relationships'' (Williams et al., 1988, p. 170). Elaboration makes a word more retrievable because it provides more complete routes of access to the representation. Williams et al. proposed that mood-congruent processes in depression took place more at the elaboration stage than the more automatic integration stage (which they referred to as the priming stage). Results from explicit tests are said to be more reflective of elaborative processes, while implicit memory tests result from integration. Thus, the finding of MCM on an explicit memory test, but not on an implicit test, provides support for this approach.

However, there are alternative approaches to the implicit/explicit memory distinction offered by Graf and Mandler (1984). Roediger and McDermott (1992) provided an interesting commentary on the results of Denny and Hunt (1992) and Watkins et al. (1992). They observed that a transfer appropriate processing approach (TAP; Morris, Bransford & Franks, 1977, see also Blaxton, 1989, 1995; Roediger, 1990) would also predict this pattern of data. In brief, TAP theory states that if the cognitive processes activated at study are recapitulated at test, then a studied item will be more likely to be retrieved. Thus, when similar cognitive processes at study and test are activated, the transfer is ''appropriate'' and memory benefits. Although study and test tasks likely involve many component cognitive processes, TAP theory advocates have tended to emphasise the distinction between perceptual and conceptual processes. Thus, perceptually driven tasks are those in which perceptual processes are most important. For example, in the word stem completion test participants are responding to the perceptual features of the stems (e.g., fai____) rather than to their meaning. On the other hand, conceptually driven tasks are those that require participants to attend to the meaning of the cues presented, not their perceptual features. A free recall test is conceptually driven because the participant must meaningfully relate the test instructions to the study task. Thus, the

TAP approach argues that if conceptual processes are activated at study, then studied items will be more likely to be retrieved if the test also activates conceptual processes. However, if conceptual processes are activated at study but perceptual processes are required by the test, retrieval of study items will not be likely. In Denny and Hunt, and in Watkins et al. (1992), conceptual processing was activated at study but perceptual processing was emphasised at test.

Blaxton, Roediger, and colleagues have pointed out that virtually all explicit tests are conceptually driven, while most implicit tests used before 1990 were perceptually driven. Most implicit tests use degraded perceptual stimuli and the participant is asked to complete the cue without any reference to the study material. Thus, many implicit memory studies confound implicit and explicit memory with perceptual and conceptual processes. This confound was also evident in Denny and Hunt (1992) and Watkins et al. (1992). Roediger and McDermott (1992) stated that the results of these two studies were not surprising because MCM requires participants to retrieve different types of words based on their meaning. Because word stem completion is a perceptually driven test, MCM would not be expected because conceptual processes were not required. The critical insight here appears to be that MCM will only be found if conceptual elaboration takes place at study, and at test, and this is the hypothesis that the following studies tested. Note that one need only argue that the meaning of the stimulus must be accessed at both study and test, not necessarily that conceptual elaboration must be transfer appropriate.

Following Roediger and McDermott's approach, one would not expect an implicit MCM bias when perceptually driven tests are used. However, Roediger has pointed out that implicit tests need not be perceptually driven. One can create tests that are unintentional, but require the participant to activate conceptual processes (e.g., Blaxton, 1989). Roediger and McDermott (1992) predicted that if a conceptually driven implicit memory test is used, then MCM would be found. This is what we set out to investigate in our next project.

CONCEPTUALLY DRIVEN IMPLICIT MEMORY BIAS

In our next study (Watkins et al., 1996) we set out to answer the question: Is there a conceptual implicit memory bias in depression? The conceptual test we chose to use was free association. Through pilot work we chose a number of association cues that were moderately related to our targets. In the actual study participants were first randomly assigned to study one of two sets of target words we had created. Each set contained positive, negative, and neutral words. Participants studied the words using the imaginal self-referent task we used in the first study. After imagining each scene, participants were asked several questions about the scene. They were asked: (1) whether the scene was an actual scene from their past or an imagined scene, (2) whether they were the principal character of the scene, (3) to rate the vividness of the scene, and (4) to rate the

pleasantness-unpleasantness of the scene. Clearly, this encoding task required considerable conceptual elaboration. Following a filler task, participants were then administered the free association task which contained association cues that were related to target words from both studied and unstudied word sets. Priming was revealed by subtracting the number of unstudied targets from the number of studied targets produced. Priming was shown to be robust, and we found a significant interaction between group, priming, and valence, indicating an implicit MCM bias as predicted by Roediger and McDermott (1992). As can be seen in Figure 1, controls performance for positive words showed more than twice the priming results of depressed participants, and conversely the priming performance by depressed individuals was over twice that of controls for negative words. Thus, it appears that an implicit memory bias may exist in depression if conceptual processes are activated.

The work of Bradley and Mogg also lends support to the contention that conceptual processes are important to an implicit memory bias in depression. In two studies (Bradley, Mogg, & Millar, 1996; Bradley, Mogg, & Williams,

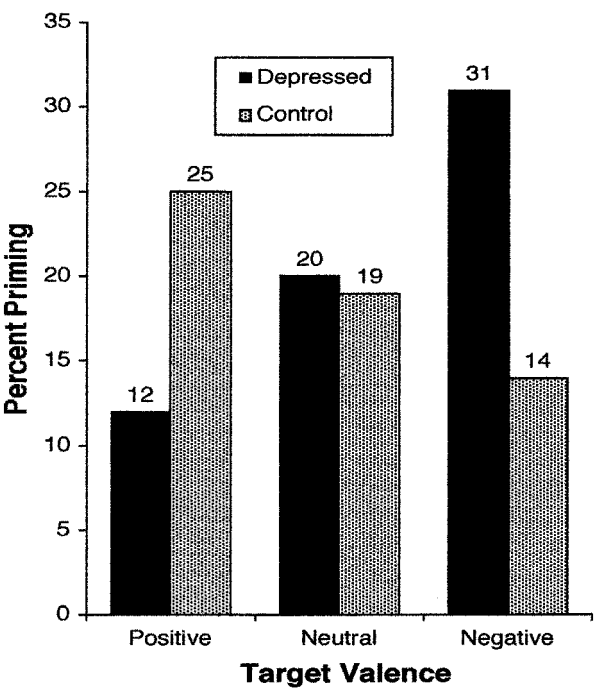

Figure 1. Per cent priming by group and valence in free association implicit test. (Adapted from ''Unconscious mood-congruent memory bias in depression'' by Watkins, Vache, Verney, Muller, and Mathews, 1996, *Journal of Abnormal Psychology*, *105*, p. 39. Copyright © 1996 by the American Psychological Association and adapted with permission from the authors.)

1995), they have demonstrated an implicit MCM bias in depression with a lexical decision task (see also Bradley, Mogg, & Williams, 1994 and Scott, Mogg, & Bradley, 2001, for similar results with nonclinical populations). In lexical decision, participants responding faster in identifying a stimulus as a word (versus a nonword) to studied than to unstudied words demonstrates implicit memory. These studies were intriguing because they demonstrated an implicit memory bias with both suprathreshold and subthreshold priming. In other words, some words were studied consciously, and others were presented too briefly for conscious identification (14 ms). Although one might question whether lexical decision should be viewed as a conceptually driven test (cf. Roediger & McDermott, 1993), it seems that in this task participants had to pay attention to the meaning of the word at some level in order to identify it as a word. This is because the nonwords that were used in their lexical decision task were pronounceable, and so the participant could not rely on perceptual features to make their decisions. Second, semantic variables are known to affect lexical decision (e.g., Neely, 1977). Third, in these studies Bradley and colleagues presented the primes in uppercase letters and the targets in the lexical decision task in lower case letters. The words from study to test were perceptually mismatched and thus it was unlikely that the priming was due to perceptual transfer. These studies lend more credence to the conclusion that conceptual processes are important to implicit memory bias in depression.

COMPARING PERCEPTUAL AND CONCEPTUAL PROCESSES IN IMPLICIT MEMORY BIAS

We were tempted to interpret these data as clear evidence that implicit MCM bias would be found if conceptual processes were activated but not with perceptual processes. However, there were several issues preventing us from making this strong conclusion. Although by now several studies had failed to find an implicit memory bias in depression using perceptually driven tests (Bazin, Perruchet, De Bonis, & Feline, 1994; Danion, Kauffmann-Muller, Grange, Zimmermann, & Greth. 1995; Ilsley, Moffoot, & O'Carroll, 1995), and our finding of a conceptually driven implicit bias was compelling, there are several problems with comparing results from different studies. It could be that different results were found because of different subject populations, or different experimental word stimuli used, or a host of other inter-study differences. Thus, we decided to directly compare perceptually driven and conceptually driven tests in the same study.

In our next project (Watkins et al., 2000b), we sought to investigate the boundary conditions of implicit MCM. By directly comparing the contribution of perceptual and conceptual processes, we hoped to show that conceptual processes were required to show an implicit MCM bias. In previous studies we

had not manipulated processing at encoding, all participants encoded the words through conceptual elaboration. In the present study we further tested assumptions of TAP by manipulating encoding within subjects. Participants studied positive and negative words either by counting the number of ascending and descending letters in a word (a structural or perceptually driven task), or by rating the recency of their experience with the word on a Likert type scale (a task requiring conceptual processing of the study word). Following two filler tasks, participants completed one of four different implicit memory tests. Each test contained cues for targets that had been studied and also for nonstudied targets. Two of the tests were chosen because of their perceptually driven nature, and two because they appeared to meet the criteria for conceptually driven tests. The two perceptually driven tests were word stem completion and word identification (sometimes known as perceptual identification). In word identification participants were exposed to each word for a very short duration (33 ms), followed by a mask, and then the participant was asked to read the word. In this task, participants often complained that they did not see the word, but still were able to read more studied than nonstudied words showing the effect of implicit memory (Feustal, Shiffrin, & Salasoo, 1983; Jacoby & Dallas, 1981). The two conceptually driven implicit tests we used were free association and semantic definition. The free association task was identical to the one described previously, except that we limited the number of associations participants produced to each cue to three, rather than giving them a time limit for each cue as before. Semantic definition was a somewhat novel task that we adopted from the semantic priming literature (e.g., Bowles & Poon, 1985; Brown, 1979, 1981). In this task we provided participants with a definition and the first letter of a word, and asked them to produce a word that began with the letter provided and that fit the definition. Although this task contains a perceptual component (first letter of the target word), priming with perceptually encoded words was not reliable in this task, and so transfer was primarily determined by conceptual processes. Definitions of both studied and nonstudied words were administered to our participants. We found that this measure produced good priming for conceptually studied words. Both free association and semantic definition are conceptual because the participant must attend to the meaning, not merely the perceptual features, of the cues. Table 1 shows examples of cues for the four different implicit tests for the target ''confident''.

Following Roediger and McDermott (1992), we predicted that there would be no evidence of MCM in the perceptually driven tests. Conversely we predicted that an implicit MCM bias would be demonstrated in both conceptually driven tests, but only with words that were conceptually encoded. Our data analytic approach was to analyse perceptually encoded and conceptually encoded words separately, which allowed us to compare new items to each type of previously processed item (i.e., the priming effect for perceptually processed words in one analysis, and the priming effect for conceptually processed words in another

TABLE 1
Examples of implicit test cues for the target "Confident"

Perceptually driven		*Conceptually driven*	
Word stem completion	*Perceptual identification*	*Free association*	*Semantic definition*
Complete this stem with the first word that comes to mind: con_____.	Subjects see a word flashed very quickly on the computer screen (33 ms), and are asked to identify the word.	Produce three one-word associations to this cue: Assured	What word fits the following definition? A belief in oneself, one's abilities, and the likelihood of success. c_____.

Source: Watkins et al. (2000b).

analysis). As we predicted, the interaction between priming, group, word valence, and test was not statistically reliable for perceptually encoded words ($F < 1.0$). Regardless of the implicit test used, we found no evidence for a reliable implicit MCM bias when words were studied with respect to their perceptual features. However, when participants were forced to attend to the meaning of the word during study, a different pattern emerged. The priming × group × word valence × test interaction for conceptually studied words was shown to be statistically reliable. To interpret this interaction, we then conducted priming × group × word valence analyses for each implicit memory test. Our predictions were supported for the perceptually driven tests. No reliable implicit MCM bias was found in word stem completion or in the word identification test (Fs < 1.0). In fact, the pattern of priming means for conceptually encoded words in the word identification test was mood-incongruent. In a similar study using word identification following either perceptual or conceptual processing tasks, Hertel (1994) also failed to find any evidence of implicit MCM with clinically depressed individuals.

Our findings with regard to the conceptually driven tests were mixed. In the semantic definition test, the group × priming × word valence interaction was statistically reliable, indicating an implicit MCM bias with conceptually encoded words as we had predicted. Figure 2 shows this finding and reveals a rather robust mood-congruent effect with conceptually encoded words. In this figure, the priming results for perceptually encoded words are shown on the left side of the graph, and those for conceptually studied words are shown on the right. However, contrary to predictions—and in direct contrast to Watkins et al. (1996)—no MCM bias was found in the free association test (group × priming × word valence: $F < 1.0$). In fact, the priming means did not show the slightest conformity to a mood-congruent pattern. This result presented a significant

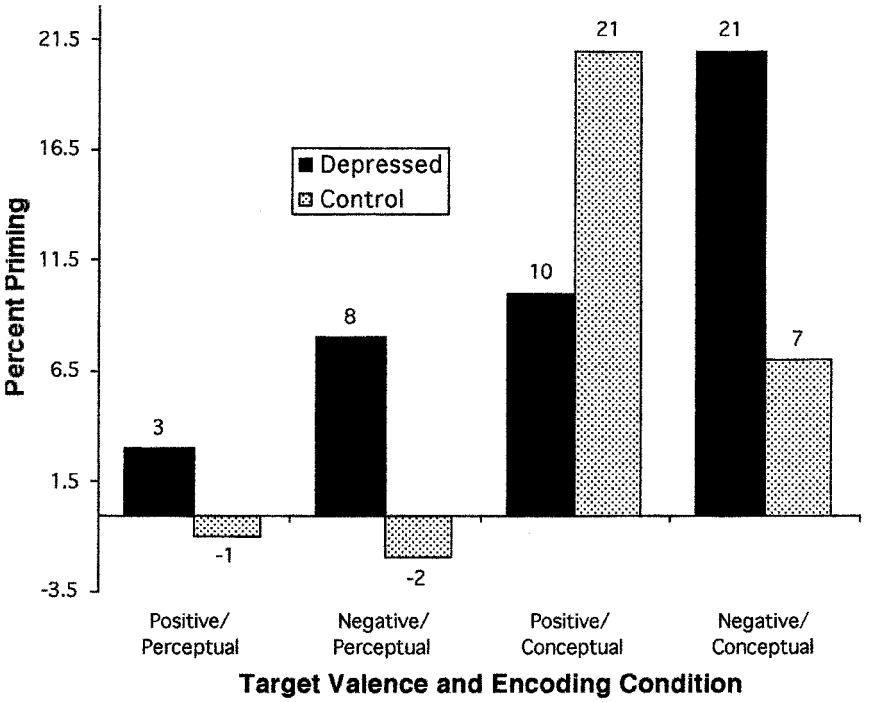

Figure 2. Per cent priming by group, valence, and encoding condition in semantic definition implicit test. (Adapted from "Unconscious memory bias in depression: Perceptual and conceptual processes" by Watkins, Martin, and Stern, 2000, *Journal of Abnormal Psychology*, *109*, p. 286. Copyright © 2000 by the American Psychological Association and adapted with permission from the authors.)

interpretation challenge—as our earlier finding with almost an identical implicit measure seemed so strong.

There are several procedural differences between the method used by Watkins et al. (1996) and the method in our more recent study (Watkins et al., 2000b). First, in Watkins et al. (1996) we used an encoding task which involved much more conceptual elaboration than the recency rating task used by Watkins et al. (2000b). Second, in the free association task, Watkins et al. (1996) required the participants to produce as many associations related to the cue as possible in 30 s, but in Watkins et al. (2000b) participants were limited to three associations per cue. It is possible that in our more recent study participants were more concerned with quickly producing three associations to proceed to the next trial and thus finish the study more quickly. This may have resulted in less conceptual elaboration of the association cue than was the case in Watkins et al. (1996). If this is true, it is possible that words produced in the former study were

more meaningfully related to the association cues than in Watkins et al. (2000b). Although the free association task clearly falls into the conceptually driven category, it could be argued that the free association task used in this study required less conceptual processing than that used in Watkins et al. (1996). General priming data appeared to support this suggestion. Overall priming levels for free association in the Watkins et al. (1996) study were 19.17%, but dropped to 7.82% for conceptually encoded words in the more recent study (Watkins et al. (2000b). Others have questioned the conceptually driven nature of free association. For example, after experiencing similar difficulties with their free association test, Weldon and Coyote (1996) suggested that free association might actually tap lexical access more than conceptual processing. Thus, it is possible that although conceptual processes affected our free association test, it required less conceptual processing than the semantic definition test.

The dissociation between our conceptual tests highlights the fact that it is unlikely that all conceptually driven tests ''are created equal''. The TAP approach as derived by Roediger (e.g., Roediger & McDermott, 1993), tends to emphasise the form of the initial processing of the test cues. In this regard both free association and semantic definition are clearly conceptually driven because participants must attend to the meaning of the cues. However, in each memory task there are several cognitive operations, each of which may or may not require conceptual processing. In both free association and semantic definition tests the participant is required to attend to the meaning of the retrieval cues. However, in the free association test the participant is not required to attend to the meaning of the word produced whereas in the semantic definition test they are. For example, in the free association test when a participant produces associations to the cue ''Assured'', they need not be overly concerned with the meaning of the words they produce. However, for semantic definition, the participant is administered a definition and the word they produce must be appropriate for the definition. For example, when participants see the definition ''A belief in oneself, one's abilities, and the likelihood of success'', the meaning of the word they produce must be attended to. In this regard TAP theory would appear to benefit from some fine-tuning of the component processes that different implicit tests may require. A starting point would be to define component processes involved in the initial attention to the retrieval cue, and processes involved with target production.

To reiterate the findings of Watkins et al. (2000b), we found no evidence for implicit memory bias in the perceptually driven tests, and an implicit MCM bias in one of the two conceptually driven tests, but only with conceptually encoded words. Although an argument could be made about the conceptually driven nature of the free association test, it clearly meets the specifications as defined by Roediger (Roediger & McDermott, 1993). Further, a levels-of-processing effect was demonstrated on this measure, which is one of the defining characteristics of conceptually driven tests. My conjectures above regarding the

conceptually driven nature of free association are *post-hoc*, and many other interpretations are possible. Not only did this study show a dissociation between perceptually driven and conceptually driven tests, there was also a dissociation between the two conceptually driven implicit tests. Thus, conceptually driven processing does not ensure MCM bias. As Colin MacLeod observed (personal communication, May 1999), conceptual processing appears to be necessary, but not sufficient for producing implicit memory bias in depression. Questions remained as to what specific conceptual processes were required to produce implicit MCM bias.

SELF-REFERENCE AND IMPLICIT MEMORY BIAS

In re-evaluating the findings from Watkins et al., (2000b), we discovered that we had inadvertently used personal pronouns in 42% of the definitions in the semantic definition test. It is possible that our semantic definition test actually activated self-referent processing. Was self-referent processing the specific conceptual process supporting implicit memory bias in depression? In Watkins et al. (2000b), our encoding task was not only conceptual, but self-referential as well. Furthermore, if one implicit test was more self-referential than the other, the TAP approach would predict more transfer of learning to that test. Could it be that we inadvertently manipulated self-referent processing in our two conceptual tests? This is the idea we sought to test in our most recent study (Watkins, et al., 2000a). Several studies have suggested that in explicit memory, self-referent processing is more likely to produce MCM (e.g., Mathews & Bradley, 1983). Could this be the case with implicit memory as well? In our most recent study we attempted to investigate the question, Are self-referent processes required to demonstrate implicit MCM bias in depression?

In this study we attempted to manipulate self-reference at both study and test. Participants encoded positive and negative words by imagining themselves involved in a situation with the referent of the word (self-reference), or rating which of six cartoon drawings of somewhat ambiguous situations best fit the word. After completing two filler tasks, participants were assigned to one of two implicit tests. The tests were very similar to the semantic definition task used in Watkins et al. (2000b) in that we provided participants with definitions and the first letter of the target appropriate to the definition. However, the definitions were provided in more of a sentence completion format and we attempted to manipulate self-reference between the two implicit tests. In the self-referent test every definition included a personal pronoun, for example, ''When others are thankful for my contribution I may feel a_____ by them'' (*appreciated*). In the other-referent condition all of the sentences made reference to an ambiguous character named Peter, for example, ''When Peter receives thanks for his contribution he may feel a_____''. We elected to make this a between-subjects variable because we felt that exposing both types of cues to the same subject

might cause some leaking of self- and other-referent processes across trials. Following TAP theory, we predicted that implicit MCM would be found only in the self-referent test, and only with words encoded with reference to the self.

Our results were not as predicted, and were somewhat equivocal. We followed the data analytic approach of Watkins et al. (2000b) in analysing results for the two levels of encoding separately. For words encoded in the other-referent condition, an implicit MCM bias was found regardless of the type of test used, Group × Valence × Priming: $F(1, 98) = 3.95$, $p < .05$. In other words, an implicit MCM pattern was found in both of the implicit tests (self-referent and other-referent), for words that were studied with respect to the ambiguous cartoon characters. Figure 3 shows this finding by collapsing the results from the two implicit memory tests. We did not predict these results because we felt that other-referent encoding would not support an implicit memory bias. However, this result is consistent with the theory that conceptual processing is required to demonstrate implicit MCM. Results from the self-referent encoded words were equivocal. The group × valence × priming × test interaction failed to reach significance, $F(1, 98) = 2.21$, $p = .14$. Here the trend of the result was a mood-incongruent pattern in the other-referent test and a mood-congruent trend in the

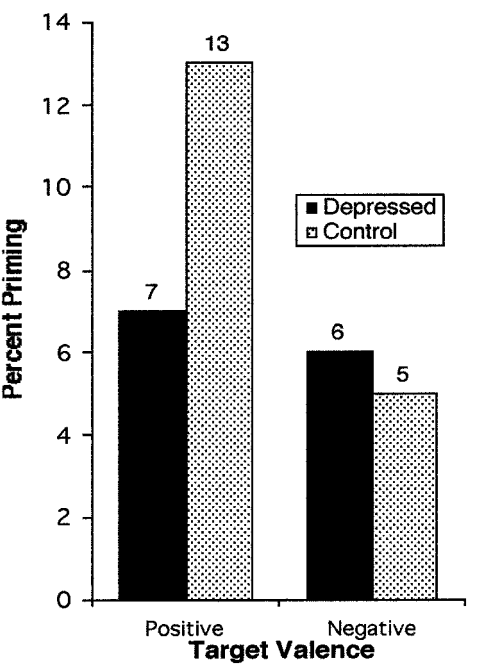

Figure 3. Per cent priming by group and valence for other-referent encoded words in sentence completion implicit test.

self-referent test. Although this pattern conforms to TAP predictions, clearly the most interpretable result comes from the other-referent encoded words, a finding we did not predict.

One potential problem with this study might have been that our self-reference manipulation was not strong enough. It is unclear exactly how participants made their judgements in the other-referent encoding task. Because they were relating words to an ambiguous cartoon character, it could be argued that the way they made this decision was by applying the character to themselves. However, if this were the case, both encoding conditions should have revealed the same result, which was not the case. Future researchers might want to make a clearer self and other reference manipulation, both at study and at test. It is also possible that the other-referent encoding condition was less constrained and so allowed for more mood-congruent elaboration.

It is now known that explicit processes can be involved with implicit tests (Jacoby, 1991; Jacoby, Lindsay, & Toth, 1992; Jacoby, Toth, & Yonelinas, 1993), and it is possible that participants were explicitly recollecting study materials during the implicit test. For example, it is possible that on items where a word did not immediately come to mind fitting the sentence, participants developed a strategy to consciously search words that they had learned from the study task. This could also be a problem with the two other studies that demonstrated implicit MCM. However, memory awareness interview data in all of these studies does not support this interpretation. They showed that participants rarely reported using conscious recollection (usually under 5%), and about half of the participants did not realise that they had even produced words from the study task. Although the *process dissociation* approach developed by L. L. Jacoby (e.g., 1991) may make estimates that are too conservative regarding the contribution of unconscious processes (Cowan & Stadler, 1996; Dodson & Johnson, 1996; Graf & Komatsu, 1994), this technique appears to be the best available for evaluating the relative contribution of conscious and unconscious processes to retrieval performance. Recent methodological developments in the process dissociation methodology (e.g., Jacoby, 1998; Stern, Sagerser, Becic, & McBride, 2001), should improve estimates of unconscious processes. Use of the process dissociation framework in future work on implicit memory bias should be informative.

CONCLUSIONS

Is there an implicit memory bias in depression? As with many things, the answer appears to be ''it depends''. If implicit measures that rely on perceptual processes are used, the answer seems to be ''no''. I am not aware of any study of clinically depressed individuals that has found an implicit memory bias when perceptually driven tests are used. I should state, however, that priming means in

both of our studies using word stem completion were in the mood-congruent direction (Watkins et al., 1992; Watkins et al., 2000b). This also seems to be the case in other studies that have investigated implicit memory bias in depression with this test (Bazin et al., 1994; Danion et al., 1995; Ilsley et al., 1995; see also Denny & Hunt, 1992, with word fragment completion). However, none of these studies found anything close to a statistically reliable implicit memory bias, so the conclusion that there is no implicit memory bias in depression when perceptually driven tests are used, seems to be fairly safe. On the other hand, our research has shown that implicit MCM can be demonstrated if conceptually driven tests are used. In three studies we have demonstrated a conceptually driven implicit memory bias (Watkins et al., 1996, Watkins et al., 2000b). It should be noted that in Watkins, Martin, and Stern, implicit memory bias was found only in the semantic definition test, and only when words were studied conceptually. Thus, it appears that conceptual processing is necessary at study and at test for implicit MCM to occur. However, twice we have used conceptually driven tests and have failed to show a statistically reliable memory bias. In fact, the free association test used by Watkins et al. (2000b) showed no evidence of mood-congruence. Although I have attempted to offer some explanations as to why we failed to find MCM on these occasions, these explanations are *post-hoc* and currently have no direct empirical support. One account of these varying results is simply that the implicit memory bias in conceptually driven tests is inconsistent. The priming methodology is fraught with many pitfalls, and it appears that other laboratories have found this effect to be somewhat fickle as well (cf. Scott et al., 2001). When one is dealing with priming effects between 10% and 20%, it seems that sources of error variance could easily affect the outcome on these measures. In this regard, I believe the field would benefit from the development of more sensitive priming measures, and more standardised valenced word sets. Concerning the latter issue, we have found across studies several positive words that were more easily primed for depressives than controls (e.g., cherished, fulfilled, needed, and relieved; Whitney, Watkins, & May, 2000). Although it might lower the generalisability of the MCM effect, using standard word sets that produce reliable memory biases should assist researchers investigating specific processes involved with MCM. Despite the inconsistency of findings, this should not detract from the conclusion that conceptual processes seem to be required for implicit MCM bias to be demonstrated in depression. Thus, it appears that conceptual processing is necessary, but is not sufficient for implicit memory bias in depression to occur.

Although TAP theory has been a helpful framework for explaining mood-congruent patterns in depression, several of our findings were not predicted by the TAP approach. TAP theory would likely benefit from further distinctions within the conceptual processing domain. As Roediger and McDermott (1993) point out, the distinction between perceptual and conceptual processes ''is likely too rough'' (p. 118), and further refinement of the theory and of component

processes of study and test tasks would appear to improve the predictive power of TAP.

An overview of the data from my laboratory supports the idea that as conceptual elaboration increases at study and test, implicit MCM bias in depression is more likely to be observed. The practical relevance of these findings is highlighted by the work of Nolen-Hoeksema, who has demonstrated that rumination is an important cognitive component of depression (e.g., Nolen-Hoeksema, 1991, 2000; Nolen-Hoeksema, Morrow, & Fredrickson, 1993; for a review see Nolen-Hoeksema, 1987). It seems appropriate to conclude that by definition, rumination involves the conceptual elaboration of unpleasant thoughts and memories. As a depressed person ruminates on unpleasant information, they are engaging in mood-congruent conceptual elaboration. Not only does this make the information more available to both explicit and implicit retrieval, elaborating this information in a mood-congruent fashion should also serve to enhance explicit and implicit retrieval of information related to this material. Retrieval of additional unpleasant information might only provide the subject material for more rumination. Recent evidence has suggested that mood may not affect memory in the direct way suggested by seminal cognition and emotion theories (e.g., Bower, 1981). For example, McFarland and Buehler (1998) found that when participants attended to their induced mood in a reflective manner, a mood-incongruent recall pattern resulted. However, when attention to mood was in a ruminative fashion, the expected mood-congruent result was found. This result implies that individual differences and aspects of the depressed state that promote conceptual elaborative processing will also promote implicit and explicit MCM. The identification of these factors by future research would appear to be important to issues of prevention and intervention for depression.

Further, the approach of Fox, Russo, and Dutton (this issue) may be helpful in interpreting the data from my laboratory. The failure to disengage attention from negative concepts may be a useful explanation for the tendency of depressives to elaborate on mood-congruent information. Whatever the case, it appears fairly clear that the processing of meaningful aspects of stimuli at both study and test is necessary for implicit memory bias to be observed. This pattern of conceptual elaboration may not be the case with other emotional disorders however. A number of studies have demonstrated an implicit MCM bias with anxiety disorders using word stem completion, a perceptually driven implicit memory test (e.g., MacLeod, & McLaughlin 1995; Mathews, Mogg May, & Eysenck, 1989). One interpretation of the implicit memory results in anxiety is that mood-congruence is limited to perceptual processing, or at least to pre-attentive conceptual processing. It appears that mood-congruent biases do not occur at all levels of cognitive processing in depression, and different emotional states show mood-congruence at different levels of cognitive processing. Successful

cognitive theories of the emotional disorders will have to take this pattern of results into account.

I began this review by suggesting that an implicit memory bias might be a more important maintenance mechanism of depression than an explicit memory bias. It appears, however, that explicit memory biases are more consistently demonstrated in the literature (Blaney, 1986). It could be that the apparent implicit/explicit memory bias differences in consistency are due to methodological differences, rather than to differences between implicit and explicit memory *per se*. This is an issue that must be left to future research. But as the results stand to date, the more consistent bias appears to be in explicit conscious recollection, rather than in implicit unintentional retrieval. If MCM bias is an important maintenance mechanism in depression, the greater consistency of explicit memory bias findings leads to the suggestion that an explicit memory bias may be more important to the maintenance of depression than an implicit bias. This proposal is consistent with the approach of Williams et al. (1988, Williams, Watts, MacLeod, & Mathews, 1997), in that conscious, strategic mood-congruent elaboration is the more likely culprit underlying negative thinking biases in depression. I would submit that the studies reviewed here show that mood-congruence in depression is not limited to conscious elaboration, but clearly, conceptual elaboration is necessary for either explicit or implicit MCM bias to occur. The interpretation that conscious mood-congruent elaboration is the more important maintenance mechanism in depression may be good news for depression practitioners. Because psychological treatments largely use conscious intervention techniques, it would appear that an explicit MCM bias would be more amenable to treatment than an implicit memory bias. Whatever the case, research has yet to determine if memory biases directly contribute to the maintenance of depression, and if so, whether direct intervention with memory bias alleviates depression.

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