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Depression and Implicit Memory: A Commentary

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In this invited commentary, we review four studies in which the issue of whether depression affects priming on implicit memory tests was examined. We conclude that a depressive mood does not affect amount of priming on several implicit memory tests under conditions in which marked effects are shown on conscious recollection (explicit memory). The mood congruity effect (depressives remember depression-related words better than controls; controls remember other types of material better than depressives) also largely disappears on perceptual implicit memory tests. We speculate about reasons for discrepancies in the literature, relate the findings to some current theories of individual differences in memory, and suggest some directions for future research.

Implicit memory may be 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 or episode itself" (Schacter, 1990a, p. 338). This contrasts with traditional (explicit) measures of memory, in which subjects are explicitly instructed to recollect experiences from their recent past (Graf & Schacter, 1985). The term *implicit memory* is relatively new, but the topic—unconscious memories revealed by transfer of previous experience into ongoing behavior—has a long history in philosophy, psychology, and psychoanalysis (see Schacter, 1987). From one perspective, phenomena as diverse as Freudian slips and Ebbinghaus's studies of savings through relearning can be seen as reflections of what is now called implicit memory.

Implicit memory is typically reflected in a priming (or transfer) measure: Performance on some task is better after relevant prior experience than in the absence of the experience. About 10 different tasks have been used to study implicit memory (for reviews, see Richardson-Klavehn & Bjork, 1988; Roediger, & McDermott, in press; Schacter, 1987). For example, after studying the word *elephant* in a list of words, subjects might be asked to complete fragmented words ((e_e_h_n_), to produce words to three-letter stems (ele_____), or to identify words from brief (30 ms) presentations. In each case, the probability of producing the word *elephant* to the appropriate cue on the task would be enhanced by the prior exposure. Special interest has been attached to implicit memory measures because they frequently reveal patterns of performance as a function of subject variables or true independent variables that differ from those revealed by standard explicit memory measures such as recall or recognition.

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Modern interest in the study of implicit memory came about because measures of implicit memory are insensitive to various gross individual differences that do have large effects on explicit memory. Warrington and Weiskrantz (1970) reported a group of patients rendered amnesic by brain damage who showed poor performance (relative to controls) on free-recall and recognition tests but showed perfectly normal priming on the task of completing word stems. This outcome was startling, because amnesic patients receive their classification by showing catastrophic performance on most tests of learning and memory. Nonetheless, the finding of intact retention on implicit memory tests in amnesic patients has been verified in dozens of more recent studies (see Shimamura, 1986, for a partial review). Tulving, Hayman, and Macdonald (1991) recently reported preserved priming in a densely amnesic patient who is completely unable to consciously recollect information from long-term memory. Despite this complete failure of explicit retention on both recall and recognition tests, the patient nonetheless showed normal, long-lasting priming on implicit memory tasks.

Other populations besides amnesic subjects show the same pattern of deficient performance (relative to normal control groups') on explicit memory tasks but relatively intact performance on implicit tasks. For example, Light and Singh (1987) showed similar levels of priming in young and older subjects on a perceptual identification test, despite large differences in performance on explicit retention. Reviews of the literature confirm this general pattern: Healthy older subjects generally show intact priming on implicit memory tests relative to younger subjects (Graf, 1990; Howard, 1991). Even when slight changes are found on implicit tests in the aged, they are usually quite small compared with changes on explicit tests. The same generalization holds true for people with small, immature brains, that is, children. Although not much work has been directed at this age range, the initial findings show that little developmental change occurs in priming on such tasks as naming pictures over the ages during which performance on explicit tasks rapidly improves (e.g., Carroll, Byrne, & Kirsner, 1985; Greenbaum & Graf, 1989; Parkin & Streete, 1988). In a different domain, Hashtroudi, Parker, DeLisi, Wyatt, and Mutter (1984) showed

that subjects who were under the influence of alcohol also showed intact priming (relative to sober controls) on an implicit memory test, under conditions in which explicit retention was greatly impaired.

To summarize the foregoing, people with damaged brains, old brains, immature brains, and brains befogged by alcohol show normal levels of priming on implicit tests of retention while showing grave impairments on explicit tests. For these reasons, implicit memory tests seem insensitive to even powerful individual-differences factors.

Against this backdrop, there are now four sets of experiments of which we are aware that address the question of whether depression (either chronic or induced) affects priming on implicit memory tests. Given the resistance of these measures to reveal individual differences, discovering alterations in priming as a function of mood state would indeed be surprising and noteworthy. Three of the experiments in this area are reported in this issue (Denny & Hunt, 1992; Elliott & Greene, 1992; Watkins, Mathews, Williamson, & Fuller, 1992), and the other has been reported by Hertel and Hardin (1990). Three of these four sets of authors reached the conclusion that depression does not affect priming on implicit memory tests; however, Elliott and Greene (1992) concluded that depression affects both explicit and implicit tests. In the remainder of this commentary on these articles, we (a) summarize the evidence from the researchers who claim that depression has no effect on implicit memory tests, (b) consider possible reasons as to why Elliott and Greene reached an opposite conclusion, (c) discuss the interesting issue of whether mood-congruent memory occurs on implicit tests, (d) relate these findings to current theoretical issues, and (e) suggest some directions for future research.

Preserved Priming in Depressed Subjects

Table 1 lists the priming scores for the three experiments in which researchers reported equal priming for depressed and control subjects on implicit measures of retention (Denny & Hunt, 1992; Hertel & Hardin, 1990; Watkins et al., 1992). (We include here only cases in which subjects were rated as chronically depressed; however, note that Hertel and Hardin, 1990 [Experiments 1 and 3], also found no effect of mood state on primed homophone spelling when mood state was manipulated experimentally.) The scores in Table 1 represent priming, or the difference between studied and nonstudied proportions of target words produced on the various tasks. Where appropriate, the scores are separated according to different types of words used by the researchers. We have used the authors' descriptive labels for their words; however, the negative words of Denny and Hunt (1992) are generally the same type as the depression-related words of Watkins et al. (1992).

The results in Table 1 show that depression has no effect on the amount of priming in implicit memory tasks. In fact, averaging over conditions in the experiments (weighting each equally) produces virtually equal estimates of priming. This equal priming is especially impressive because each set of investigators showed large effects of depression on an explicit memory test; these tests included recognition (Hertel & Hardin, 1990), free recall (Denny & Hunt, 1992), and cued recall (Watkins et al., 1992). The dissociation produced by Watkins et al. (1992) between explicit and implicit memory as a function of chronic mood state is especially powerful because they used a design in which the overt cues (the first three letters of words) were held constant on both tests and only the instructions given to subjects were varied. Graf and Mandler (1984) provided a similar demonstration with amnesic patients; Schacter, Bowers, and Booker (1989) have recommended this design as a particularly effective way to distinguish explicit from implicit memory without the worry of other confounded factors. Watkins et al.'s results indicate that the dissociation between explicit and implicit memory in depressed subjects (relative to normals) meets this stringent test.

Table 1
Priming Scores in the Experiments That Showed No Effect of Chronic Depression on Implicit Memory

Task/words	Control	Depressed	Difference
Homophone spelling[a]	.10	.11	−.01
Word fragment completion[b]			
Positive words	.24	.22	.02
Negative words	.19	.23	−.04
Word stem completion[c]			
Positive words	.13	.09	.04
Neutral words	.13	.12	.01
Depression-related words	.07	.13	−.06
Physical-threat words	.15	.15	.00
M	.14	.15	

Note. Nonstudied baselines have been subtracted from performance to provide priming scores.
[a]Hertel & Hardin (1990, Experiment 3). [b]Denny & Hunt (1992). [c]Watkins, Mathews, Williamson, & Fuller (1992).

An Exception to Preserved Priming in Depressed Subjects

Elliott and Greene (1992) obtained results contrary to the foregoing conclusions. They found that depression affected performance on both explicit and implicit memory tests. These findings are especially puzzling because Elliott and Greene used two tasks that the other researchers also used, homophone spelling and word stem completion. These inconsistent results should give us pause in uncritically accepting the conclusion that depression does not affect implicit retention. We consider here two possible reasons why Elliott and Greene's results differed from the others, although neither seems likely to explain the discrepancy in results.

The Elliott and Greene (1992) study deviated from the others in that it did not include the usual procedure of testing subjects on both studied and nonstudied items to gain an estimate of baseline performance for priming. Rather, they used normative data from the literature to estimate baselines in both implicit memory tests. This procedure seems problematic to us under any circumstances, but especially so when the issue of interest is individual differences among subjects. There is no guarantee that the estimated baseline accurately characterized true baseline performance for either group of subjects; if the baselines differed between groups, then any difference in priming could be illusory. Denny and Hunt (1992), Hertel and Hardin (1990),

and Watkins et al. (1992) all used appropriate measures of baseline (nonprimed) performance for each group of subjects. In constructing Table 1, we subtracted these numbers from studied rates to determine priming.

On the other hand, base-rate differences probably do not entirely explain why Elliott and Greene's results differ from those of the others, because the other experimenters found little difference in baseline performance between depressed and control subjects. In addition, Elliott and Greene's differences in priming are too large to be explained totally by baseline differences. Therefore, although Elliott and Greene did not obtain baselines, this is probably not the source of the difference between their finding and those of the other experimenters.

A second possible reason for the discrepancy is the severity of depression in patients, which varied widely across the studies. Hertel and Hardin's (1990, Experiment 3) depressed subjects would not be classified as severely depressed; they used undergraduates who scored higher than 9 on the Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Elliott and Greene (1992) used moderately to severely depressed patients, who scored higher than 17 ($M = 27.3$) on the Hamilton Rating Scale for Depression (Hamilton, 1967), on which scores of 18 to 24 are usually considered to represent moderate depression and scores of 25 or higher to represent severe depression (Shaw, Vallis, & McCabe, 1985, p. 380). However, the other two groups of experimenters also used patients who were moderately to severely depressed. Watkins et al.'s (1992) subjects all scored higher than 19 on the BDI ($M = 27.5$). Similarly, Denny and Hunt's (1992) depressed subjects scored higher than 15 on the BDI ($M = 29.6$). (On the BDI, scores of 17 to 26 are generally considered to represent moderate depression and those higher than 26 to represent severe depression [Beckham & Leber, 1985, p. 986]). Therefore, difference in the severity of depression does not seem to be the reason for the discrepancy between the results of Elliott and Greene and those of the other researchers. Differences in medication also do not explain the discrepancies in the results: both Elliott and Greene and Watkins et al. reported that their subjects were not medicated when tested.

It may be that Elliott and Greene's (1992) conclusion—that depression affects priming on implicit tests—is the correct one, but further research under better controlled conditions is needed to document this point. In our judgment, the consistent results from the other experiments showing intact priming in depression more likely depict the true state of affairs.

Mood-Congruent Memory

An interesting issued addressed by Denny and Hunt (1992) and by Watkins et al. (1992) is whether the mood-congruent memory phenomenon is exhibited in implicit memory as it is in explicit memory. Mood-congruent memory refers to the finding that normal (nondepressed) subjects tend to remember positively valenced words better than negatively valenced words, whereas the opposite is true for depressed subjects (Blaney, 1986). Denny and Hunt (1992) and Watkins et al. (1992) impressively confirmed this effect in free recall and cued recall, respectively. Indeed, Watkins et al. also showed that depressed people's superior recall of negative information does not extend to all words of negative valence, but only to those that refer to depression-related events. Control subjects actually remembered more negative words that referred to physically threatening events than did depressed subjects in their experiment. Interestingly, these differences in retention as a function of type of material all tended to disappear on the implicit memory tests of word fragment completion and word stem completion, tests that Roediger and Blaxton (1987) called "data-driven" or "perceptual" tests. Depressed and control subjects in Denny and Hunt's and Watkins et al.'s experiments did not show any statistically reliable difference in priming as a function of word type, leading both groups of researchers to conclude that these implicit tests, unlike explicit tests, were insensitive to manipulations of material.

The conclusion that there is no mood-congruent memory effect on these perceptual tests is probably accurate, but the pattern of data shown in Table 1 does seem to show a hint of the effect. Note that there are 2% and 4% advantages for control over depressed subjects in priming on positive words in the two relevant conditions; more impressive, depressed subjects have 4% and 6% advantages in priming on depression-related words. None of these differences is statistically significant with the small samples of subjects used, but the results may hint that a small mood congruity effect exists in these implicit memory tests. Nonetheless, the conclusion seems safe that mood congruity has a much more powerful effect on explicit memory tests than it does on perceptual implicit tests.

Theoretical Alternatives and Future Directions

The main theoretical framework used to interpret the effects of depression on memory is some sort of resource allocation theory. Depressed subjects are assumed to have fewer cognitive resources to devote to effortful cognitive tasks such as remembering and therefore to perform worse on explicit tests (e.g., Ellis & Ashbrook, 1988; Williams, Watts, MacLeod, & Mathews, 1988); they also display less initiative (Hertel & Hardin, 1990). Implicit memory tests are believed to be more automatic or to require fewer cognitive resources and so to remain intact. However, this latter assumption requires careful definition. Surely implicit memory tasks themselves are not automatic by the usual criteria suggested by Posner and Snyder (1975), Neely (1977), and Hasher and Zacks (1979), among others. Completing word fragments, to pick but one example, is surely an effortful process by anyone's definition. However, the resource allocation theories may draw an apt picture of the situation if it is assumed that the benefit of priming on the implicit memory task is automatic, but not the task itself. Interestingly, similar theories concerning reduced cognitive resources that manifest themselves on some tests but not others also guide much of the research on age-related impairments in cognitive performance (e.g., Craik, 1977; Rabinowitz, Craik, & Ackerman, 1982). Old people (like depressed people) are assumed to have reduced cognitive resources and therefore to show disproportionate deficits in performance on effortful explicit memory tasks, such as free recall, but little or no deficit on measures of more automatic processes, such as priming, in implicit memory (Howard, 1991).

Jacoby (1991) has proposed that the distinction between ex-

plicit and implicit measures of retention more properly corresponds to intentional uses of memory (those under conscious control) and automatic uses of memory (where conscious control is not exercised). Obviously, the results presented in Table 1 fit well with this characterization. Jacoby also proposed a new method (a process dissociation procedure) of distinguishing automatic from intentional uses of memory, one that should be of general usefulness. It may prove especially apt for investigating problems such as the effects of depression on memory, where debate centers on just these issues.

The findings reported in Table 1 can actually be interpreted quite reasonably within several other theories of the relation between explicit and implicit retention. For example, Roediger (1990) proposed that most common implicit memory tests rely on perceptual processes, because performance on these tests is greatly affected by the match of perceptual features (e.g., auditory or visual presentation) but not by variations in the amount of meaningful processing. On the other hand, most popular explicit tests are greatly affected by variations in meaning but little affected by changes in perceptual variables such as modality. In short, most implicit tests can be classified as perceptual in nature (including word fragment and word stem completion), whereas most explicit tests are conceptual or meaning based. Under these assumptions, the results in Table 1 make sense. The reduction in cognitive resources in depression generally impairs the meaningful, elaborative processing that supports conscious recollection, but leaves intact the perceptual processing that supports priming on perceptual implicit memory tests.

The mood congruity results reported by Denny and Hunt (1992) and Watkins et al. (1992) are also in good agreement with this position. The tests those authors used—word fragment and word stem completion, respectively—are perceptual implicit tests, and they reveal no effect of type of material (positive or negative) for either normal or depressed subjects, despite the power of this variable on explicit tests.

Roediger and Blaxton (1987) demonstrated that there are distinct types of implicit memory tests; although most of the ones in common use seem largely perceptual, other implicit tests could be devised to tap meaningful (conceptual) processes. Blaxton (1989) showed that priming on conceptual implicit tests could be dissociated from priming on perceptual tests. Schacter (1990b) and Tulving and Schacter (1990) reviewed neuropsychological underpinnings for such a distinction.

Several conceptual implicit memory tests are now being actively investigated. The procedure is similar to that used in the perceptual implicit tests in that subjects are exposed to words or phrases during a study phase and then are given ostensibly unrelated tasks during a later part of the experiment. They may be asked to answer general knowledge questions ("What animal did Hannibal use to help him cross the Alps?"), to produce instances belonging to a category ("African animals") for 30 s, or to produce free associations to a weakly related concept (e.g., *tusk* or *grey*). At least some of these tests have shown intact priming in amnesic patients (Shimamura, 1986) and all have shown effects of conceptual variables that have little or no effect on perceptual implicit tests (Blaxton, 1989; Hamann, 1990; Rappold & Hashtroudi, 1991; Roediger & Challis, 1992; Srinivas & Roediger, 1990). Because of these considerations, conceptual implicit memory tests may provide an interesting opportunity for the study of memorial processes in depression. We predict that priming on these tests will be intact in depressed people (i.e., will occur at the same level as for normal subjects), but that the mood congruity effect will be found on these tests. That is, because conceptual implicit memory tests reflect meaning-based processes (unlike word fragment or word stem completion), they will show the mood congruity effect obtained on meaning-based explicit memory tests such as free recall.

To make a more general point, the study of the relation between explicit and implicit memory in depressive states is proceeding along the same paths as have been followed with other populations and other variables: Researchers select one test (or at most, two) believed to be an exemplar of each class of test (explicit or implicit) and compare the tests across the variables of interest. Greatest interest is attached to differences obtained between tests, which are then usually attributed to differences between explicit and implicit memory processes. Although this research strategy has produced many interesting findings, researchers tend assume that what is found with one measure (or, at most, two measures) of memory of each type generalizes to all explicit or implicit tests. This assumption seems unlikely, because we know from much prior work that explicit memory tests can be dissociated as a function of experimental variables (Tulving, 1983, Chapter 11), and the same already appears true for implicit memory tests (see Roediger, Srinivas, & Weldon, 1989, for a review of dissociations between implicit tests of retention). For these reasons, for the domain of depression (or other individual-difference variables), we advocate a research strategy in which performance is examined on a variety of implicit memory tests after various study manipulations have been made that differ in their information-processing requirements.

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