

# The dissociation of explicit and implicit memory in depressed patients

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**SYNOPSIS** Twenty-three in-patients fulfilling DSM-III-R criteria for major depressive disorder were submitted to a standard cued recall test, and to a word-stem completion test devised to assess the effect of the initial presentation without the explicit retrieval of the words being necessary. Results show that depressed patients are impaired on the cued recall task in comparison with controls matched for sex, age, and educational level. However, the two groups do not differ in the word-stem completion task. This dissociation between explicit and implicit expressions of memory disappeared when patients recovered, although they were still hospitalized and under psychotropic medication. These results are examined in the light of the distinction between effortful and automatic processes.

## INTRODUCTION

Experimental investigations on the pathological impairment of human memory have traditionally focused on tests such as free recall, cued recall, and recognition, which require explicit recollection of items through some sort of directed controlled search into stored information. However, it has become clear over the last 10 years that memory effects can also be observed through changes in performance on identification or production tasks involving previously studied stimuli, without the explicit retrieval of these stimuli being necessary. For example, subjects are presented with a list of words and then instructed to complete a list of three-letter word stems with the first word that comes to mind (e.g. PICTURE is presented; PIC must be completed). In these conditions, a tendency to complete stems to form the previously displayed words rather than other words is commonly observed. Other similar tests include lexical decision (e.g. Carroll & Kirsner, 1982), perceptual clarification (e.g. Perruchet, 1989), tachistoscopic identification (e.g. Jacoby

& Dallas, 1981), homophone spelling (e.g. Jacoby & Witherspoon, 1982) or anagram solving (Perruchet & Baveux, 1989). In all these tasks, a directed search for specific episodic representation of the initial words is not required, since there is no need for explicit remembering of the earlier presentation; nevertheless, performance changes due to the initial words provides implicit evidence of some encoding in memory. Following Graf & Schacter (1985), the term *implicit memory* will be used here to designate the form of memory underlying such effects.

A result of particular interest is that patients who are characterized by a variety of neuropsychological deficits show implicit memory under conditions in which conventional, or *explicit* memory is poor or entirely absent. This task × subject interaction is an instance of what has been termed a *dissociation* (Tulving, 1985). The most striking evidence for a dissociation between implicit and explicit memory comes from studies on amnesic patients, which have demonstrated normal performance on the word-stem completion test (e.g. Warrington & Weiskrantz, 1974; Graf *et al.* 1984) or other implicit memory tests (e.g. Moscovitch, 1982; Cermak *et al.* 1985) with respect to control subjects. An, at least partial, preservation of

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implicit memory performance has also been found in various other brain-damaged patients (see review in Schacter *et al.* 1988). Likewise, most studies investigating the effect of amnesia-inducing drugs on healthy subjects report a preservation of implicit memory performance (Danion *et al.* 1989; Weingartner *et al.* 1992).

However, preservation of implicit memory must not be thought of as a regular concomitant to explicit memory impairment. For instance, there is evidence that most patients with Alzheimer's disease perform poorly on both explicit memory tests and a word-completion task (Salmon *et al.* 1988; Butters *et al.* 1990). Also, at least one amnesia-inducing drug, lorazepam, has been shown to affect implicit as well as explicit measures of memory (Sellal *et al.* 1992).

The present study is concerned with depressive disorders. The deficit of depressed subjects in various explicit memory tasks is well-documented (e.g. Weingartner *et al.* 1981; Calev *et al.* 1986; Beatty *et al.* 1990), but the evidence about a dissociation between performances on explicit and implicit tests of memory is controversial. Hertel & Hardin (1990) report that students' performance on a homophone spelling test is unaffected by depressive-mood induction. They also show that naturally-depressed college students perform as well as non depressed subjects on this task. However, as emphasized by Ellis (1990), results from studies on induced depressive mood or natural depression may hardly be generalized to severe forms of depression. To our knowledge, there are now four studies with severely depressed subjects (Danion *et al.* 1991; Denny & Hunt, 1992; Elliot & Greene, 1992; Watkins *et al.* 1992). Only two of them (Danion *et al.* 1992; Denny & Hunt, 1992) observed the expected dissociation between implicit and explicit performance. The other two reported that depression affected neither implicit nor explicit tests of memory (Watkins *et al.* 1992), or both categories of tests (Elliot & Greene, 1992).

It is worth adding that in the two studies reporting a dissociation, the explicit/implicit nature of the memory task was confounded with another factor which may ultimately provide an alternative account for the observed findings; namely, whether retrieval cues were provided at test. No cues were given in the free recall task,

which served as an explicit measure of memory in both sets of studies, whereas subjects were shown some letters of each word in the implicit measures (word-stem completion and word-fragment completion tasks). This confounding is troublesome, because it is well known that the amount of deficit exhibited by depressed subjects in different *explicit* memory tasks is highly dependent on the amount of retrieval cues available to subjects. Differences between depressed and control subjects are greater in free recall than in cued recall (Cohen *et al.* 1982) whereas fewer or no differences are observed in recognition tasks in which the whole target word is displayed again (Miller & Lewis, 1977; Dunbar & Lishman, 1984; Calev & Erwin, 1985; Beatty *et al.* 1990; but see Golinkoff & Sweeney, 1989, for evidence for differences in both recall and recognition). Thus, the lack of difference between depressed and control subjects in word completion performance could be due to the presence of retrieval cues in the word completion task, rather than to the implicit nature of the instructions. (More developed arguments stressing the need for providing the very same retrieval cues for implicit and explicit memory tests may be found in Schacter *et al.* 1990; Merikle & Reingold, 1991).

This outline of the available literature stresses the need for further empirical evidence to assert whether or not clinical depression elicits a genuine dissociation between explicit and implicit memory. In the present study, performance of hospitalized depressed patients and matched control subjects were compared on two memory tasks differing only as regards instructions. After a study phase in which subjects read a list of words aloud, the subjects were shown the first three letters of these words with instructions stressing to complete stems either with the first word that came to mind (implicit, word completion task) or with one of the previously displayed words (explicit, cued recall task).

## METHOD

### Subjects

Sixty subjects participated in the study. They all went through the same procedure and each subject was tested individually. They were all native speakers of French and were unaware of the purpose of the study.

Table 1. *Demographic variables*

Subjects	N	Age years (s.d.)	Educational level	
			< 12 years N	> 12 years N
Patients	23			
Males	7	43.22 (13.07)	11	12
Females	16			
Controls	37			
Males	12	45.24 (14.41)	16	21
Females	25			

Twenty-three depressed in-patients (16 females, 7 males) fulfilling the DSM-III-R criteria for major depressive disorder were included in the study. Subjects presenting any major medical illness or any associated psychiatric disorders (drug abuse, alcoholism, personality disorder, mental deterioration) were excluded. The severity of the depressive mood was assessed through a rating scale of depression, the Montgomery and Åsberg Depression Rating Scale 21-item version (MADRS) with scores ranged from 46 to 27 with a mean of  $35.26 \pm 4.92$  (Montgomery & Åsberg, 1979), and two questionnaires: an inventory of depression the Beck Depression Inventory 13-item version (Beck *et al.* 1961), BDI scores ranged from 34 to 13 with a mean of  $21.30 \pm 6.30$ , and a questionnaire specifically designed to measure the severity of depression (QSD, see Bonis *et al.* 1991; the mean QSD score was  $12.3 \pm 2.34$ ). (It is usual to consider that scores higher than 27 in MADRS, 18 in BDI and 10 in QSD testify to major depressive disorder). Nineteen patients were receiving antidepressive drugs, 18 benzodiazepines, 6 neuroleptics, and 4 thymoregulators.

The control group comprised 37 subjects without any history of illness, somatic or psychiatric symptoms, matched for sex, age, and educational level (see Table 1).

### Material

The material was composed of 60 common words, of more than 5 letters in length. The affective load of words was controlled so that half of the words were negative (e.g. terror, murder) and half were positive (e.g. holiday, happiness). In order to fulfil the requirement for the word-stem completion task and the cued recall test, the stems (i.e. the initial three letters)

of each word were unique to the whole set of words, without diacritical marks, and could be completed to generate at least 10 common words. The selected words were in no case the most frequent of the possible words (according to the *Trésor de la Langue Française du CNRS*, Nancy, 1977).

These 60 words were randomly divided into 3 sets of 20 words, matched with regard to the mean number of letters, mean frequency of occurrence, number of positive and negative words, and proportion of nouns, verbs, and adjectives. Each word was typed on a (125 × 75 mm) card for presentation to the subjects. One set of words was used for the explicit memory task (cued recall), and the two others were used for the implicit memory task (word-stem completion).

### Procedure

In the initial (study) phase, the subjects were shown a list of 40 words; each word was displayed once. The subjects were instructed to read the words aloud; they were informed that the task would be followed by unspecified memory tasks. The 40 words consisted of two sets of 20 words randomly intermixed for each subject; each set was assigned to a memory task. One set was used for the subsequent cued-recall task, and was the same for all subjects. For the other set, part of the subjects (10 patients and 22 controls) studied the words whose the stems were presented as controls to the remaining subjects (13 patients and 15 controls) in the subsequent word-completion task, and vice-versa. Subjects were assigned to groups on a random basis.

As soon as the entire list had been read, all subjects were engaged in distractor tasks for about half an hour in order to prevent them from rehearsing the study list items.

Then subjects performed the implicit and explicit memory tests in immediate succession. Following common practice, all subjects performed the implicit memory test first. Thus, the implicit memory test was presented as a 'filler', distractor task, which minimized the potential influence of deliberate retrieval strategy on implicit memory performance. For the implicit memory test, the subjects were successively shown 40 word-stems in random order. They were instructed to provide the first word that

came to mind. The 20 word stems which could be completed with a word from the study list and the 20 word stems which could not be completed with a word from the study list were randomly intermixed.

For the explicit memory task, 20 word stems were shown to subjects. They were instructed to complete each stem with one of the words previously presented.

## RESULTS

### Cued recall tests

The subjects recalled a mean of 4.69 words of the 20 initially presented. As shown in Table 2, control subjects had higher scores than depressed patients (mean = 5.35 *v.* 4.04). An analysis of variance was performed with Groups (control *v.* depressed) as a between subject factor and Affective Value of words (positive *v.* negative) as a within subject factor. This analysis indicated that the difference between control and depressed subjects was significant ( $F(1,58) = 4.70$ ,  $P < 0.05$ ). Negative words were more frequently recalled than positive words (means = 5.71 *v.* 3.67,  $F(1,58) = 18.89$ ,  $P < 0.001$ ), but this effect did not differ between control and depressed subjects, as shown by the lack of interaction between Affective Value and Groups ( $F(1,58) = 1.18$ ,  $P > 0.10$ ).

### Word-stem completion

An analysis of variance was performed on the completion data with two between subject factors (controls *v.* depressed, List 1 *v.* List 2) and two within subject factors (positive *v.* negative words; old words *v.* new words). The effect of List being non-significant ( $F(1,56) = 1.76$ ,  $P > 0.10$ ), completion data were pooled on the two lists. As a whole, a sizeable effect of implicit memory was obtained: subjects correctly

completed the stems corresponding to old words nearly twice as often as the stems corresponding to new words (mean = 4.62 *v.* 2.54,  $F(1,56) = 55.84$ ,  $P < 0.001$ ). This effect of implicit memory did not differ between control and depressed subjects, as testified to by the lack of interaction between Groups and the old/new factor ( $F < 1$ ). In fact, depressed patients tended to complete more word stems by the previously displayed words than did control subjects (mean = 4.76 *v.* 4.57) but the difference did not reach significance ( $F < 1$ ).

All other main effects and interactions were non significant, except the interaction between Groups and Affective Value of words ( $F(1,58) = 4.66$ ,  $P < 0.05$ ). Control subjects tended to complete word stems more often by positive words than by negative words (mean = 3.73 *v.* 3.13) whereas the reverse was observed in depressed patients (mean = 3.48 *v.* 4.03). However, this effect is irrelevant with regard to implicit memory performance, which is our main concern here, insofar as it did not differ for old and new words (as testified by the non significant three-way interaction between Groups, Affective Value, and old *v.* new factors,  $F(1,58) = 1.78$ ,  $P > 0.10$ ).

### Correlations between explicit and implicit measures of memory

Correlations were computed between the number of words recalled in the cued-recall test and the number of stems completed in line with the previously studied words in the word-stem completion test. Pearson's  $r$  was 0.307 and 0.339 for normal and depressed subjects respectively. Neither of these values reached conventional significance level. The correlation was also assessed on the pooled sample, given that the individual values reported above did not differ significantly ( $t < 1$ ; McNemar, 1969, p. 158). The overall Pearson's  $r$  was 0.31, a moderate but reliable value ( $P < 0.02$ ).

Table 2. Cued recall and word completion performances of depressed and control subjects

	Depressed ( $N = 23$ )	Controls ( $N = 37$ )	$F/P$
Cued recall	4.04 (2.36)	5.35 (2.21)	$F[1-58] = 4.70$ $P < 0.03$
Word completion	4.76 (2.50)	4.57 (2.89)	$F < 1$

Standard deviations are given in parentheses.

## DISCUSSION

Patients with severe depression, as assessed by both self- and non-self-ratings, are affected to the same extent as matched control subjects by the prior exposure to words in a word completion task which did not involve the explicit recollection of the initial words, although they were

significantly impaired in an explicit test of memory. These results lead to the conclusion that the deficit in memory exhibited by depressed patients is not found in all memory tests; some implicit memory tasks (here stem completion) may be unaffected. This dissociation between implicit and explicit measures of memory replicated the earlier results of Danion *et al.* (1991) and Denny & Hunt (1992). The use of the same physical retrieval cues for the two memory tasks in the present study ensures that the dissociation was not due to the differential amount of the retrieval cues available to subjects, but rather to the explicit or implicit nature of the retrieval operations elicited by the instructions.

A difficulty inherent to comparative studies of psychiatric patients and normal control subjects is that there are a number of factors confounded with the psychiatric disorder itself. In the present study, as well as in Danion *et al.* (1991) and Denny & Hunt (1992), all the depressed patients and none of the controls were hospitalized. Moreover, in the present study, all the depressed and none of control subjects were being treated with psychotropic drugs (a subgroup of patients in Danion *et al.* was also treated; Denny & Hunt did not provide any information on this point). It could be argued that the performance of depressed subjects is not directly linked to the depressive episode itself, but rather to hospitalization conditions or medication.

In order to address this argument, most of the depressed patients ( $N = 20$ ) enrolled in the reported experiment were submitted to a second experimental session just before the end of their hospitalization. This second session consisted in a replication of the whole initial session (i.e. study and test phases). The only change pertained to the study and test words, which were all different from the original list, although chosen according to the same criteria. Most of the control subjects ( $N = 30$ ) were also submitted to the second session. The mean interval between sessions was approximately 4 weeks for both depressed and control subjects. The rationale for this procedure is that, at the time of the second session, most of the factors initially confounded with the depressive syndrome were still present: patients were still hospitalized, and they were still under psychotropic medication (antidepressants, 16; benzodiazepines, 11; neuroleptics, 7; thymoregulators, 8). However,

the overall level of their depressive mood had improved radically, as testified to by their scores on the psychiatric rating scales (MADRS,  $8.6 \pm 5.12$ ; BDI,  $7.4 \pm 4.11$ ; QSD,  $5.10 \pm 3.75$ ). If the results pattern of the depressed patients reported above is related to the depressive disorder itself and not to the correlated factors, it should not reappear in the replication session. The results were in line with this prediction. As in the first session, patients and control subjects were comparable with regard to their implicit memory performance. However, they were statistically indistinguishable with regard to their explicit memory performance ( $F < 1$ ). In other words, the dissociation reported above between implicit and explicit memory in populations of depressed patients and control subjects disappeared when patients had made clinical improvement, although they were still hospitalized and under similar psychotropic medication. This result is consonant with the earlier observation of Danion *et al.* (1991), who reported no significant differences between subgroups of treated and non treated depressed patients.

We mentioned above that two studies failed to observe a dissociation between implicit and explicit measures of memory in depressive disorders. How can this discrepancy be explained? Watkins *et al.* (1992) obtained no reliable difference between depressives and normals in both explicit and implicit tests of memory. Nevertheless, explicit measures exhibited a trend toward the expected difference. Its failure to reach significance in this as well as in similar studies may be accounted for by the limited power of the statistical tests, due to the small number of available clinical subjects.

The results of Elliot & Greene (1992) are more difficult to encompass within a conclusion framed in terms of dissociation, insofar as they reported an effect of depression on two explicit tests of memory (cued recall and free recall), but also on two implicit tests (word-stem completion and homophone spelling). The latter result is puzzling, given the usual resistance of implicit measures to reveal group differences. In a recent commentary on this study, Roediger & McDermott (1992) pointed out that all the test items used for implicit measures were displayed in study phase, in contrast with the standard procedure, in which both studied and unstudied items are used. Roediger & McDermott worried

about one consequence of this departure from the standard procedure, namely that it makes impossible the estimate of baseline performance for an accurate assessment of the amount of priming. They noted also that this feature probably does not entirely explain the target result. However, the atypical Elliot & Greene procedure may have another, more serious consequence. While performing an implicit memory task, subjects may make use of the explicit remembering of the study list if they discover that some of the to-be-produced items have been previously displayed (Schacter, 1987). Although this contamination of implicit measures by explicit remembering is possible in any implicit memory tasks, its probability presumably reaches a maximum whenever, as in the Elliot & Greene procedure, the studied words provide a convenient response in *all* cases. In this perspective, the implicit memory impairment of depressed subjects in the Elliot & Greene study could be accounted for by the fact that at least a sample of their subjects handle the tests of implicit memory as tests of explicit retrieval.

Overall, the available empirical evidence is consonant with the conclusion that all the components of the memory processes are not impaired in depressive disorders: implicit memory is spared, although patients may have no conscious awareness of this preserved capacity. The dissociation observed in depression is closely similar to the dissociation observed in most neurological disorders, and especially in amnesic patients (see Introduction). In this area of research, some investigators prefer an interpretation positing that implicit and explicit memory dissociation testifies to a fundamental duality of the underlying brain systems (e.g. Schacter, 1992).

However, the results can also be interpreted within other theories of the relation between explicit and implicit retention. Regarding depression, the main theoretical framework used to interpret the dissociation between implicit and explicit measures of memory refers to the concept of attentional resources. Previous work have demonstrated that depressed patients are primarily impaired in memory tasks that involve elaborative, effortful processing (e.g. Hasher & Zacks, 1979; Weingartner *et al.* 1981; Cohen *et al.* 1982; Roy-Byrne *et al.* 1986; Tancer *et al.* 1990; Watts *et al.* 1990). The fact that depressed

patients perform like normal control subjects in implicit memory tasks is congruent with the large body of evidence showing that implicit memory primarily taps automatic processes (e.g. Jacoby *et al.* 1993; but note that some data indicate that implicit memory performance is not independent of the amount of attention paid to the stimulus e.g. Nissen & Bullemer 1987; Priestley & Mayes 1992). As pointed out by Roediger & McDermott (1992), a similar interpretation guides much of the research on age-related memory impairments in healthy subjects. In both cases, reduced cognitive resources of subjects (depressed or aged) are invoked to account for the dissociation between the (impaired) performance in effortful explicit memory tasks and the (spared) performance on implicit memory tests involving more automatic processing.

A last point warrants discussion. Implicit and explicit measures of memory reliably correlated across subjects in our data. Even though the correlations were of moderate strength, this finding, which replicates earlier results (e.g. Perruchet & Baveux, 1989) runs counter to any conclusion focusing exclusively on the concept of dissociation. Potential theoretical interest in dissociations may have led investigators to overshadow aspects of results supporting other conclusions, and recent research demonstrates that some earlier evidence for dissociation between implicit and explicit measures may have been overstated (e.g. Perruchet & Amorin, 1992). Some systems or processes underlying performance in implicit and explicit memory tests are undoubtedly different, as the major result of this study further testifies. But some components are probably involved in both categories of tests. Clarifying this issue needs future work devised to assess reliably whether implicit memory is spared or not for every pathological syndrome comprising a deficit in explicit memory.

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