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Declarative and nondeclarative memory in opposition: When prior events influence amnesic patients more than normal subjects

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Amnesic patients and normal subjects read the names of nonfamous persons. Then, after being told that all the names were nonfamous, subjects judged the fame of names on a mixed list of new famous names, old nonfamous names, and new nonfamous names. Finally, they took a recognition memory test involving old and new nonfamous names. In this way, declarative (explicit) memory and nondeclarative (implicit) memory were placed in opposition. That is, recollection that a name had been recently presented (and was therefore nonfamous) opposed the facilitatory effect by which prior presentation ordinarily increases the tendency to judge that name as famous. Normal subjects exhibited good recognition memory and no fame-judgment effect—that is, no difference in fame judgments for new and old nonfamous names. By contrast, for the amnesic patients recognition memory was poor, but a strong fame-judgment effect occurred—that is, amnesic patients judged old nonfamous names as famous. The results provide additional evidence that the fame-judgment effect is supported fully by nondeclarative (implicit) memory and is independent of the limbic/diencephalic brain structures damaged in amnesia.

Single encounters with verbal or nonverbal material can influence subsequent behavior independently of conscious recollection for the material. This phenomenon is evident as an improvement in the ability to identify or reproduce recently presented familiar or novel stimuli, including words, nonwords, simple line patterns, and figures (for reviews, see Schacter, Chiu, & Ochsner, 1993; Shimamura, 1986; Squire, Knowlton, & Musen, 1993; Tulving & Schacter, 1990). In addition, brief presentations of stimuli can alter judgments and preferences about the stimuli (Bonnano & Stillings, 1986; Johnson, Kim, & Risse, 1985; Kunst-Wilson & Zajonc, 1980; Lewicki, 1986; Mandler, Nakamura, & Van Zandt, 1987).

One interesting phenomenon is that normal subjects are more likely to judge either a famous or a nonfamous name as famous if the name has been encountered recently (Neely & Payne, 1983). Evidence that this effect is dissociable from other forms of memory comes from the finding that (1) dividing attention during the initial presentation of names markedly reduces recognition memory for the presented names without affecting fame judgments (Jacoby, Woloshyn, & Kelley, 1989); (2) delaying the fame-judgment test by 24 h, instead of administering it immediately after the study phase, increases the fame-judgment effect for nonfamous names, presumably because subjects are less able in the delayed test to recollect that the names have been presented earlier and are therefore less able to inhibit the effect (Jacoby, Kelley, Brown, & Jasechko, 1989); and (3) older subjects exhibit the fame-judgment effect to a greater extent than do young subjects, although the young subjects are better able to recognize the names that have been presented for study (Dywan & Jacoby, 1990).

In studies of memory involving normal subjects, there can be uncertainty about how to interpret dissociations that result from experimental manipulations (for discussion, see Dunn & Kirsner, 1988; Roediger, 1990; Schacter, 1992; Shimamura, 1990). Dissociations can result because different task conditions require different degrees of declarative memory, attention, or effort, or different degrees of source memory (i.e., memory for when and where an item has been learned). In such cases, a dissociation would indicate that two tasks are influenced differentially by particular factors. However, it is often

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difficult to determine what these factors are, and especially difficult to conclude that a particular factor (e.g., declarative memory) makes no contribution to a task at all.

Useful information about the nature of dissociations between kinds of memory has come from the study of human amnesia. Amnesic patients are severely impaired on conventional tests of recall and recognition that require conscious recollection of facts and events (i.e., declarative or explicit memory) (for recent reviews, see Schacter et al., 1993; Squire et al., 1993). The memory impairment is associated with bilateral damage to the medial temporal lobe or the midline diencephalon (Zola-Morgan & Squire, 1993). In contrast to their severe deficit on tests of declarative memory, however, amnesic patients perform entirely normally on many tests of priming, skill learning, and other forms of nondeclarative (or implicit) memory. Amnesic patients also exhibit a normal fame-judgment effect for both famous and nonfamous names (Squire & McKee, 1992).

The finding that the fame-judgment effect is intact in amnesic patients means that this effect does not materially depend on declarative memory, and that it is independent of the brain system that supports conscious recollection and declarative memory. Dissociations involving the fame-judgment effect in normal subjects presumably reflect the fact that declarative memory (and limbic/diencephalic brain structures) is essential for recognition memory but does not contribute to fame judgments.

In the present experiment, we have explored further the nature of the dissociation between the fame-judgment effect and declarative memory by placing the fame-judgment effect in opposition to declarative memory (see Jacoby, Woloshyn, & Kelley, 1989, Experiments 2 and 3). Subjects saw the names of nonfamous persons, then were told that the persons were not famous, and then were asked to judge the fame of names on a mixed list of new famous names, old nonfamous names, and new nonfamous names. In this case, it has been shown that normal subjects do not exhibit the fame-judgment effect (Jacoby, Woloshyn, & Kelley, 1989), presumably because they can inhibit the tendency to judge a name as famous whenever they recollect that a name has recently been presented. In contrast, amnesic patients should be unable to inhibit the fame-judgment effect, because they cannot recollect recently presented names. Thus, the magnitude of the fame-judgment effect should be larger in amnesic patients than in normal subjects. Moreover, if the availability of declarative memory in this circumstance is the primary reason why normal subjects do not exhibit the fame-judgment effect, and if declarative memory ordinarily makes no contribution to the fame-judgment effect, then amnesic patients should exhibit a fame-judgment effect that is not measurably diminished. That is, the fame-judgment effect might be as large as in earlier studies of normal subjects and amnesic patients, in which declarative memory has not been placed in opposition to the fame-judgment effect (see Squire & McKee, 1992).

METHOD

Ten normal subjects and 12 amnesic patients were studied. The subjects initially read aloud 40 nonfamous proper names. The subjects were then told that all of the names they had just read were the names of nonfamous people, after which they made yes–no judgments about the fame of 30 of those names, together with 60 new famous and 30 new nonfamous names. Finally, the subjects took a yes–no test of recognition memory for 10 of the previously studied nonfamous names and 10 new nonfamous names.

Subjects

Amnesic patients. Twelve amnesic patients (8 men and 4 women) participated (Tables 1 and 2). Five of them (3 men and 2 women) had alcoholic Korsakoff's syndrome. All 5 had participated in either a magnetic resonance imaging (MRI) study (Squire, Amaral, & Press, 1990) or a quantitative computerized tomography (CT) study (Shimamura, Jernigan, & Squire, 1988), which revealed decreases in the volume of the mammillary nuclei, decreased tissue density within the thalamus, and frontal lobe atrophy. Two of the amnesic patients (N.A. and M.G.) had diencephalic lesions confirmed by MRI (for N.A.: Squire, Amaral, Zola-Morgan, Kritchevsky, & Press, 1989; for M.G.: unpublished observations). Patient N.A. became amnesic (primarily for verbal material) in 1960, following

Table 1
Patient Characteristics

Patient	Age (Years)	Lesion	WAIS-R	WMS-R Age: Attention	Verbal	Visual	General	Delay
A.B.	54	HF	104	87	62	72	54	<50
J.L.	72	HF	116	122	73	83	74	58
P.H.	70	HF	115	117	67	83	70	57
W.H.	69	HF	113	88	72	82	67	<50
L.J.	54	Unknown	98	105	83	60	69	<50
N.C.	48	Dien	90	62	80	60	69	<50
R.C.	75	Dien	106	115	76	97	80	72
V.F.	73	Dien	103	101	78	72	72	66
P.N.	64	Dien	99	81	77	73	63	53
J.W.	55	Dien	98	104	65	70	57	57
N.A.	53	Dien	109	102	67	89	68	71
M.G.	60	Dien	111	113	89	84	86	63
M	62.3		105.2	99.8	74.1	77.1	69.4	58.1

Note—WAIS-R, Wechsler Adult Intelligence Scale-Revised; WMS-R, Wechsler Memory Scale-Revised. The WAIS-R and each of the five indices of the WMS-R yield a mean score of 100 in the normal population with a standard deviation of 15. The WMS-R does not provide numerical scores for subjects who score below 50. Therefore, the four values below 50 were scored as 50 for computing a mean score. HF, hippocampal formation; Dien, diencephalon.

Table 2
Performance of Patients on Standard Memory Tests

Patient	Diagram Recall	Paired Associates	% Word Recall	% Word Recognition	50 Words	50 Faces
A.B.	4	1-1-2	33	83	32	33
J.L.	1	0-0-0	40	93	31	20
P.H.	3	0-0-1	27	84	36	34
W.H.	1	0-0-0	40	84	29	24
L.J.	3	0-0-0	40	93	33	29
N.C.	3	1-0-1	23	71	31	37
R.C.	3	0-0-3	19	85	37	30
V.F.	8	0-0-0	27	91	27	31
P.N.	2	1-1-1	29	83	31	31
J.W.	4	0-0-2	29	90	29	34
N.A.	17	0-0-2	49	93	34	42
M.G.	0	0-0-2	33	71	30	34
M	4.1	.3-.2-1.2	32.4	85.1	31.7	31.6

Note—The diagram recall score is based on delayed (12-min) reproduction of the Rey-Osterrieth figure (Osterrieth, 1944; maximum score = 36). The average score for copying the figure was 27.9, a normal score (Kritchevsky, Squire, & Zouzounis, 1988). The paired associate score is the number of word pairs recalled on three successive trials (maximum score = 10/trial). The word recall score is the percentage of words recalled out of 15 across five successive study-test trials (Rey, 1964). The word recognition score is the percentage of words identified correctly across five successive study-test trials (yes-no recognition of 15 new words and 15 old words). The score for words and faces is based on a 24-h recognition test of 50 words and 50 faces (modified from Warrington, 1984; maximum score = 50, chance = 25). Scores for normal subjects for these tests can be found in Squire and Shimamura (1986). Note that N.A. is not severely impaired on nonverbal memory tests because his brain injury is primarily left unilateral.

a stab wound to the left diencephalic region with a miniature fencing foil (Teuber, Milner, & Vaughn, 1968). Patient M.G. became amnesic in 1986, following a bilateral medial thalamic infarction.

Of the remaining 5 patients, 3 (J.L., P.H., and W.H.) had marked reductions in the volume of the hippocampal formation bilaterally as indicated by MRI (Press, Amaral, & Squire, 1989; Squire et al., 1990; Polich & Squire, in press). Two of these patients (W.H. and J.L.) have been extensively described elsewhere (Kritchevsky & Squire, 1993). Patient P.H. had a 6-year history of 1- to 2-min "attacks" (with a possible epileptic basis) that were associated with gastric symptoms and transient memory impairment. In July 1989, he suffered a series of brief episodes, after which he was found to have a marked and persistent memory loss. One of the remaining patients (A.B.) is not available for MRI studies. Patient A.B. became amnesic in 1976, following an anoxic episode that occurred after a cardiac arrest. On the basis of the findings for 2 patients with similar etiologies (Patient L.M. in Press et al., 1989; and Patient R.B. in Zola-Morgan, Squire, & Amaral, 1986), it is likely that A.B. has damage to the hippocampal formation. Finally, Patient L.J. became gradually amnesic during a 6-month period in 1988 without a known precipitating event. Because the study concerned the overall performance of amnesic patients, the 12 patients were treated as a single group.

The 12 amnesic patients averaged 62.3 years of age at the time of testing and had 13.6 years of education. Their average Wechsler Adult Intelligence Scale-Revised (WAIS-R) Full Scale IQ was 105.2. Their individual IQ and Wechsler Memory Scale-Revised index scores are listed in Table 1. The scores for other memory tests are listed in Table 2. Note that the scores for the word recall test in Table 2 are above zero because, on this test of immediate recall, several items can be retrieved from immediate memory, which is intact in amnesia. Immediate and delayed (12-min) recall of a short prose passage averaged 5.1 and 0 segments, respectively (21 segments total; Gilbert, Levee, & Catalano, 1968). The mean score on the Dementia Rating Scale (Mattis, 1976) was 132.4 (maximum possible score = 144; range = 127-143). Most of the points were lost from the memory subportion of the test (mean points lost = 6.6). The average score on the Boston Naming Test was 55.2 (maximum possible score = 60; range = 47-59). Scores for normal subjects on these same tests are reported elsewhere (Janowsky, Shimamura, Kritchevsky, & Squire, 1989; Squire et al., 1990).

Healthy control subjects. Ten healthy control subjects were tested (5 men and 5 women) who were either volunteers or employees at the Veterans Affairs Medical Center, San Diego, or were recruited from the University of California, San Diego, retirement community. This group of subjects averaged 64.0 years of age, had 14.7 years of education, and obtained WAIS-R subtest scores of 22.8 for Information (amnesic patients, $M = 21.2$) and 57.2 for Vocabulary (amnesic patients, $M = 55.8$). Their immediate and delayed recall of a brief prose passage (Gilbert et al., 1968) averaged 7.5 and 5.7 segments, respectively.

Materials

The pool of stimulus items consisted of 160 names of people, each composed of a first name and a surname. Eighty of those names were the names of people who had become moderately famous during one of three decades (the 1960s, 1970s, or 1980s). They were selected so that, on the average, they had a probability of approximately .50 of being identified as famous. The other 80 items were the names of nonfamous people taken from a local telephone directory. Each nonfamous name was selected to match one of the famous names with respect to the length of the last name, the gender of the first name, and the ethnic origin of the last name. Also, in order to reduce the likelihood that subjects would judge the nonfamous names as familiar, the 10 most common first names were not used. Consequently, the first names of the famous names were on the average more common than the first names of the nonfamous names [frequency of occurrence in print (Carroll, Davies, & Richman, 1971) = 17.5/million vs. 1.56/million, $t(158) = 4.15$, $p < .001$]. Examples of the famous names are Sheena Easton, Alan Greenspan, Moshe Dayan, and Elizabeth Dole; the nonfamous names that matched these four were Irene Haxby, Cecil Adenbrooke, Levi Wazal, and Marcella Hone.

Eight sets of 10 nonfamous names each were constructed, with the constraint that each set contain approximately equal numbers of names that were matched to famous names from each decade (the 1960s, 1970s, and 1980s). Each 10-name set served in the study phase (4 sets, 40 names), as new items in the test of fame judgment (3 sets, 30 names), and as new items in the test of recognition memory (1 set, 10 names). Eight different arrangements of the 10-name sets were prepared so that for every subgroup of 8 subjects, each 10-name set appeared four times in the study phase, three times as new items in the fame-judgment test, and once as new items in the recognition test. In the test of fame judgment, famous names always appeared together with their matched nonfamous names. The order of presentation of names was random, with the constraint that no more than three names of any one type appear consecutively in either the fame-judgment test (i.e., famous, new nonfamous, old nonfamous) or in the recognition test (i.e., new nonfamous, old nonfamous).

Procedure

The subjects first participated in a study session in which they saw 40 nonfamous names presented one at a time on a computer screen (2 sec per name, with a 2-sec pause between names). For the first and last name of each nonfamous name, the first letter was capitalized and the remaining letters were in lowercase. The study session was presented as a test of pronunciation. The subjects were instructed that they would see the names of people and that they should try to pronounce each name aloud as quickly and accurately as possible. There was an initial practice session in which 5 names were presented that did not appear elsewhere in the test, after which the subjects read aloud the entire study list of 40 names. Whenever a subject mispronounced a name, the examiner read aloud the correct pronunciation. The subjects mispronounced an average of 20.0% of names during the study phase (amnesic patients, 16.7%; control subjects, 24.0%). (Excluding mispronounced names from the data analysis did not alter the findings to be reported here.) To make the orienting task credible, each subject's voice was recorded with a tape recorder that was placed in plain view on top of the computer monitor. No further use was made of the recordings.

After the subjects completed the study phase, they were given instructions for the test of fame judgment. They were told that all of the names they had just read were the names of people who were not famous. They were then told they would next see a series of names one at a time and that some of these names would be the names of moderately famous people. They were asked to decide, as quickly and accurately as possible, whether a name was or was not the name of a famous person. Finally, the subjects were told that they were not required to know the circumstances of the named person's fame but only to decide whether each name was famous or not famous. The instructions and a subsequent brief practice session (i.e., five practice names that did not appear elsewhere on the test) took about 5 min.

Immediately after the practice session, the subjects saw 120 names one at a time. Thirty of the names were nonfamous names that had appeared on the study list. Ninety of the names (60 famous and 30 nonfamous) had not appeared previously. For each subject, the 60 famous names (of the 80 names available) selected for the fame-judgment test were the names that matched the 60 nonfamous names on the test. Each name remained on the computer screen until the subject made a decision. The subjects indicated their judgments by pressing keys on the computer keyboard. A keypress with the index finger of one hand indicated a judgment of "famous." A keypress with the index finger of the other hand indicated a judgment of "not famous." Pressing the space bar caused the next name to appear. The *famous* judgment key was assigned to the preferred hand for half the subjects and to the nonpreferred hand for half the subjects. The decision and the response time for each name were recorded by the computer.

The 20-name recognition memory test began immediately after the fame-judgment test. The subjects were given a list of 10 nonfamous names from the study list that had not appeared in the fame-judgment test, together with 10 new nonfamous distractor items. The names were typed in two columns on a single page. The subjects were asked to place a "Y" (for "yes") in front of each name that they recognized from the study list, and an "N" (for "no") in front of each name that they did not recognize from the study list.

RESULTS

The principal finding was that the amnesic patients differed from the control subjects in their likelihood of judging nonfamous names as famous. Whereas the control subjects were equally reluctant to judge either new or old nonfamous names as famous, the amnesic patients were more likely to judge old nonfamous names as famous, compared with new nonfamous names (Figure 1). The probability of judging a new name as famous was similar for the control subjects (famous = 49.5%, nonfamous = 7.7%) and the amnesic patients (famous = 57.7%, nonfamous = 8.3%). Prior exposure increased the probability that amnesic patients would judge a nonfamous name as famous (from 8.3% to 21.7%) but did not affect the judgments of control subjects (from 7.7% to 4.7%).

Statistical analysis confirmed these impressions. The control subjects and the amnesic patients did not differ in the proportion of fame judgments for either new famous names [$t(20) = 1.09, p > .10$] or new nonfamous names [$t(20) = .53, p > .10$], but the two groups did differ for old nonfamous names [$t(20) = 2.51, p < .05$]. For nonfamous names, a two-way (group × new/old) repeated measures analysis of variance (ANOVA) revealed a significant effect of prior study [$F(1,20) = 10.7$, $MS_e = 47.6, p < .01$], no overall effect of group [$F(1,20) = 2.7$, $MS_e = 320.5, p > .10$], and a significant interaction [$F(1,20) = 9.7$, $MS_e = 47.6, p < .01$]. Finally, the amnesic patients judged old nonfamous names as famous

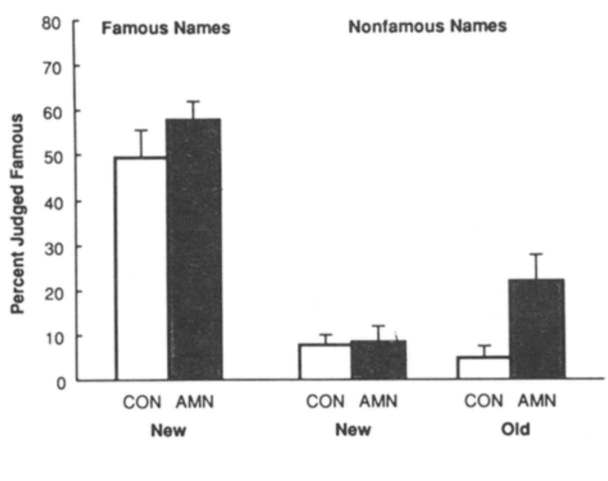

Figure 1. Percent of new famous names judged famous and percent of nonfamous names judged famous, depending on whether or not the names had been presented previously (old vs. new). (AMN, amnesic patients, $n = 12$; CON, control subjects, $n = 10$. Error bars indicate the standard error of the mean.)

more frequently than new nonfamous names [$t(11) = 4.51, p < .01$], but the control subjects did not exhibit this effect ($t < 1.0$).

Response times for correct fame judgments are shown in Table 3. Amnesic patients were somewhat slower than normal subjects at making their responses, but not significantly so [$F(1,20) = 2.81, MS_e = 2,280,694, p > .10$]. Normal subjects rejected old nonfamous names faster than new nonfamous names, but this difference was not significant (1,389 vs. 1,469 msec; $t < 1.0$). In earlier, similar studies, this comparison reached significance for young subjects (Jacoby, Woloshyn, & Kelley, 1989, Experiment 2, 174 msec; Experiment 3, 248 msec) but not for older subjects (Dywan & Jacoby, 1990; 75 msec). In those studies, it was supposed that young normal subjects could use their recollection of the recently presented nonfamous names as a ready basis for rejecting old nonfamous names as famous but that older subjects were not as able to rely on this method. Although our older subjects were able to reject old nonfamous names as famous, our data are consistent with the earlier findings in that our control group of older subjects, like the elderly subjects studied by Dywan and Jacoby (1990), did not reject old nonfamous names significantly faster than new nonfamous names. Finally, the amnesic patients exhibited little difference in response times for old and new nonfamous names (2,181 vs. 2,214 msec; $t < 1.0$). The results for response times were the same when the analyses were based on median response times for each subject.

Scores on the recognition memory test (expressed as percent hits plus correct rejections $\pm$ *SEM*) indicated that the control subjects performed much better than the amnesic patients [controls, 80.5% $\pm$ 3.3%; hits = 77.0%, false alarms = 16.0%; amnesics, 62.1% $\pm$ 3.2%; hits = 45.0%, false alarms = 20.9%; $t(20) = 4.0, p < .01$].

There was no significant difference in the fame-judgment scores for the 6 amnesic patients who scored the highest on the recognition test and the 6 who scored the lowest. The 6 who scored the highest had a 15.6% fame-judgment effect (percent of old minus new nonfamous names judged famous), and the 6 who scored the lowest had an 11.1% fame-judgment effect [$t(10) = 0.7$].

DISCUSSION

Normal subjects and amnesic patients were shown nonfamous names, told that they were not famous, and then asked to judge the fame of a list of famous names, old nonfamous names, and new nonfamous names. In earlier studies, on which the present study was based, normal subjects did not exhibit the fame-judgment effect (Jacoby, Woloshyn, & Kelley, 1989, Experiments 2 and 3), apparently because they were able to use explicit (declarative) memory to censor the tendency to judge old nonfamous names as famous. This censoring effect was mitigated by dividing attention during the study phase (Jacoby, Woloshyn, & Kelley, 1989, Experiment 2), by dividing attention during the fame-judgment test (Jacoby, Woloshyn, & Kelley, 1989, Experiment 3), by increasing the delay between study and test to 24 h (Jacoby, Kelley, et al., 1989, Experiment 1), and by testing elderly subjects (Dywan & Jacoby, 1990). In each case, a significant interaction was obtained between the magnitude of the fame-judgment effect and the experimental manipulation.

In the present study, amnesic patients exhibited the fame-judgment effect, but normal subjects did not. Normal subjects could engage declarative memory strategies and attribute old nonfamous names to the recent study list. Amnesic patients exhibited the fame-judgment effect, presumably because they could not recollect the names that had been studied. In addition, they also presumably could not recollect as well as normal subjects the instruction that all the initially presented names were nonfamous. To our knowledge, this is the first case in which prior events have been found to influence amnesic patients to a greater extent than they influence normal subjects (for brief mention of what appears to be an identical experiment with amnesic patients, see Cermak & Verfaellie, 1992). A numerical (nonsignificant) advantage for amnesic patients, in comparison with normal subjects, has been observed previously in circumstances in which declarative memory strategies could be expected to reduce the performance score (Musen, Shimamura, & Squire, 1990; Squire & McKee, 1992).

In the two studies most similar in design to the present one, attention (full vs. divided) was manipulated during either the study phase or the fame-judgment test (Jacoby, Woloshyn, & Kelley, 1989, Experiments 2 and 3). In the first of the two studies, subjects in the full-attention condition had a higher baseline score than did subjects in the divided-attention condition; that is, 31% as opposed to 17% new nonfamous names were judged famous. (The corresponding probabilities for old nonfamous names were 19% and 27%.) The authors suggested that subjects in the divided-attention condition were cautious about endorsing names as famous. However, the same effect did not occur in the second experiment when attention was divided during the fame-judgment test (probability of new

Table 3
Mean Response Times (and Standard Error) for Correct Fame Judgments (in Milliseconds)

Group	Famous Names New		Nonfamous Names New		Nonfamous Names Old	
	M	*SE*	*M*	*SE*	*M*	*SE*
Control subjects	1,559	130	1,469	138	1,389	130
Amnesic patients	1,898	149	2,214	457	2,181	382

nonfamous names judged famous in the full-attention condition = 18%; in the divided-attention condition, 14%; for old nonfamous names, 13% and 28%). Accordingly, it is more likely that subjects in the full-attention condition sometimes scored anomalously high than that subjects in the divided-attention condition scored particularly low. The results of this second experiment match our own findings most closely.

It is also worth noting a possible difference between our results for normal elderly subjects and those reported by Dywan and Jacoby (1990). Whereas our normal subjects avoided the fame-judgment effect, presumably by using conscious recollection, their subjects seemed less able to do so. However, in their study, the magnitude of the fame-judgment effect (14% new nonfamous names judged famous; 20% old nonfamous names judged famous) was small, and it was not clear that it was significant. It may also be relevant that our subjects were a little younger than the subjects studied by Dywan and Jacoby (1990) (64 years vs. 71 years) and had more years of education (14.7 years vs. 12.3 years).

The crucial aspect of the data from the present study was the significant interaction of group (control, amnesic) and condition (new, old). A related finding was the significant interaction between the fame-judgment effect and recognition memory performance. That is, the amnesic patients judged more nonfamous names as famous than did the normal subjects, but they recognized fewer nonfamous names as having been presented previously [$F(1,20) = 20.7$, $MS_e = 150.3$, $p < .001$].

These results provide strong confirmation for the idea that two distinct kinds of memory are operating in the fame-judgment and recognition memory tasks. Indeed, the magnitude of the fame-judgment effect for amnesic patients (8.3% new nonfamous names and 21.7% old nonfamous names judged famous) was similar to what it was for normal subjects and amnesic patients in our previous study (Squire & McKee, 1992: control subjects, 9% nonfamous new names and 17% old nonfamous names judged famous; amnesic patients, 14% and 28%, respectively). Thus, declarative memory fully inhibited the fame-judgment effect in normal subjects but did not measurably influence the performance of amnesic patients.

The finding of a statistical interaction provides support for the view that memory consists of multiple separate systems, each with distinct brain organizations (Schacter, 1992; Squire, 1987, 1992a, 1992b; Tulving & Schacter, 1990). A process view of memory phenomena supposes that a single underlying engram or representation can be expressed in multiple ways (Blaxton, 1989; Jacoby, 1988; Masson, 1989; Roediger, 1990). In the present case, such a view would require that one process, not available to amnesic patients, ordinarily inhibits fame judgments and that another process, which is available to amnesic patients, underlies the fame-judgment effect. We suggest that these processes are better understood as reflecting the operation of two different brain systems. The system that supports declarative memory is composed of limbic/diencephalic brain structures and the multiple cortical association areas with which these structures interact. The system supporting the fame-judgment effect consists of areas of neocortex that support the phenomenon of priming (Moscovitch, 1992; Squire, 1992a; Squire et al., 1992; Tulving & Schacter, 1990). Any particular cortical area important for word priming (e.g., right posterior visual cortex in the case of word-completion priming, Squire et al., 1992) might also be one of the sites important for declarative memory for the same words. However, declarative memory involves many more sites and additionally requires that these sites interact with limbic/diencephalic structures in a process that begins at the time of learning.

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