

# Part-list cuing in amnesic patients: Evidence for a retrieval deficit

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Part-list cuing—the detrimental effect of the presentation of a subset of learned items on recall of the remaining items—was examined in amnesic patients and healthy control subjects. Subjects studied two types of categorized item lists: lists in which each category consisted of strong and moderate items and lists in which each category consisted of weak and moderate items. The subjects recalled a category's strong and weak items in either the presence of or absence of the moderate items serving as retrieval cues. In healthy subjects, part-list cuing impaired recall of the strong items but not of the weak items; in amnesics, part-list cuing impaired recall of both types of items. Part-list cuing is often attributed to a change in the retrieval process from a more effective one when cues are absent to a less effective one when they are present. On the basis of this view, our results indicate that part-list cuing causes a stronger retrieval inefficiency in amnesic patients than in healthy people.

People showing the amnesic syndrome typically have intact working memory, unimpaired semantic memory, and normal procedural learning, priming, and classical conditioning. The central and most striking feature is difficulty in memory for newly acquired episodic material (Baddeley, 1997). Explanations of the amnesic syndrome using information processing accounts are based on the hypothetical memory stages of encoding, storage, and retrieval and/or their interactions, exploring the possibility of isolating the stage(s) at which the deficit occurs. Such an information processing approach to the problem bears implications for memory theory and can guide physiological research.

Current information processing accounts of the amnesic syndrome explain the syndrome mainly in terms of storage deficits and deficits that arise from problems in the encoding–retrieval interaction (for a review see Baddeley, 1997, or Mayes & Dawnes, 1997). Storage deficit proposals assume that amnesic patients show a deficit in the initial consolidation of episodic material into long-term memory. This deficit is assumed to arise mainly in the case of the consolidation of complex associations and less, if at all, in the consolidation of simple associations and information (Isaac & Mayes, 1999a, 1999b). Proposals empha-

sizing deficits in the encoding–retrieval interaction assume that amnesic patients have trouble encoding the features of material in such a way that cues directed toward feature representation can evoke the desired item directly. This difficulty is supposed to arise particularly for semantic feature representation (Cermak, 1997). Whereas this latter explanation of the amnesic syndrome takes possible problems in retrieval into account, there is greater emphasis on input than output. Indeed, most current explanations of the amnesic syndrome agree insofar as they do not attribute the syndrome to deficits located primarily at the retrieval stage of the recall process. This holds although originally the syndrome was assumed to reflect mainly a retrieval deficit (Warrington & Weiskrantz, 1974).

The agreement that retrieval problems do not play a major role in the amnesic syndrome rests mostly on studies that examined whether amnesics are excessively susceptible to interference effects. Neither Warrington and Weiskrantz (1978), investigating retroactive interference, nor Isaac and Mayes (1999a, Experiment 3), investigating proactive interference, found evidence for an interference susceptibility in amnesic patients. At first glance, these results suggest that amnesic patients do not show a retrieval deficit. As the literature on retrieval failures in healthy subjects shows, however, retrieval failures arise not just as a result of retroactive or proactive interference but may be caused by other sources as well. Failures in the retrieval of studied items, for instance, can arise if a subset of the learned items is retrieval practiced before test; such retrieval practice of related items typically impairs rather

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We thank the two anonymous referees for their comments on an earlier draft of the manuscript. We are also grateful to S. Kiener, C. Lohr, and L. Schiener for their help in collecting the data. Correspondence should be addressed to K.-H. Bäuml, Institut für Psychologie, Universität Regensburg, 93040 Regensburg, Germany (e-mail: karl-heinz.baeuml@psychologie.uni-regensburg.de).

than improves subsequent retrieval of the nonpracticed items (Anderson, R. A. Bjork, & E. L. Bjork, 1994; Anderson & Spellman, 1995; Bäuml & Hartinger, 2002; Smith, 1971). Of particular relevance for the present study, failures in the retrieval of previously studied items can also result if a subset of the learned items is presented as a retrieval cue at test. Although cuing is well known to be facilitatory under many conditions (see, e.g., Tulving, 1974), such part-list cuing typically does not enhance but rather impairs retrieval of the non-cue items (D. R. Basden & B. H. Basden, 1995; Roediger, 1973; Slamecka, 1968; Sloman, Bower, & Rohrer, 1991; for a review, see Nickerson, 1984).

Concluding from the results of the retroactive and proactive interference studies that amnesic patients do not show a major retrieval deficit thus relies on the assumption that we can generalize from findings on retroactive and proactive interference to other paradigms such as part-list cuing. Effectively, this means that we assume that these different forms of forgetting are mediated by the same mechanism. Such an assumption is in fact incorporated into previous memory models in which these forms of forgetting were explained in terms of strength-dependent competition (e.g., Rundus, 1973). Since then, however, strong evidence has been provided that this assumption is wrong and that retroactive and proactive interference on the one hand and part-list cuing on the other are mediated by different mechanisms.

Whereas retroactive and proactive interference are still supposed to be the result of an increased competition arising from the encoding of additional material (Bäuml, 1996; Mensink & Raaijmakers, 1988), the accounts of part-list cuing have fundamentally changed. The strategy disruption account (D. R. Basden & B. H. Basden, 1995; D. R. Basden, B. H. Basden, & Galloway, 1977), for instance, assumes that the presentation of cue items disrupts retrieval by forcing a serial recall order that is inconsistent with the subjective organization of the list. In accord with this view, smaller recall impairments were found if the presentation of cue items was consistent with subjects' preferred recall order than if it was strategy inconsistent.

Similarly, the incongruity principle (Sloman et al., 1991) claims that the retrieval of studied material may depend upon people using the same or a similar organizational framework during retrieval as they had used for learning. According to this principle, any sufficiently large incongruity between the retrieval framework suggested by part-list cues and the framework used to encode targets can induce retrieval failure. Varying the degree of incongruity between learning and test by presenting different types of cue items, Sloman et al. (1991) reported data that are consistent with this claim. Strategy disruption and the incongruity principle differ only in detail (see D. R. Basden & B. H. Basden, 1995, for a discussion). They both attribute part-list cuing to a change in the retrieval process from a more effective one when cues are absent to a less effective one when they are present (see also Raaijmakers & Shiffrin, 1981, for a related computational approach).

If interference and part-list cuing are mediated by different mechanisms, then the conclusion from previous studies that amnesics do not exhibit a major retrieval deficit might be premature. Although previous results clearly suggest that amnesics do not show excessive retroactive or proactive interference, these results do not imply that amnesics fail to show other forms of a retrieval deficit, like excessive susceptibility to part-list cuing. Thus, it might well be the case that amnesics exhibit a normal increase in competition arising from the encoding of additional material but are more susceptible to incongruencies between learning and test. Such a finding would further underscore the fact that retrieval failure can be caused by different mechanisms (Anderson, E. L. Bjork, & R. A. Bjork, 2000; D. R. Basden & B. H. Basden, 1995; Bäuml, 1997, 2002; Ciranni & Shimamura, 1999). If so, amnesics may show intact retrieval processes in some situations but may be impaired in others.

A part-list cuing experiment was designed to examine whether amnesic patients are more susceptible than healthy subjects to the negative effects of part-list cuing. The design of the experiment is closely related to that of recent experiments with healthy people on the effects of retrieval practice in which the role of item type in retrieval-induced forgetting was examined (Anderson et al., 1994; Bäuml, 1998). Amnesic and healthy control subjects studied an item list consisting of exemplars from different semantic categories. Half of the items of each category were so-called cue items, and the other half were non-cue items. The cue items were always moderately associated to their category cue; the non-cue items were either strongly or weakly associated to the cue. After study, subjects had to recall the non-cue items, either in the presence or the absence of the moderate items serving as retrieval cues. For each non-cue item, both its category name and its initial letter were provided as a retrieval cue. If the findings from interference studies generalize to part-list cuing, amnesic patients should show the same amount of part-list cuing as healthy subjects. However, if this generalization does not hold, different mechanisms likely underlie interference and part-list cuing. Amnesics may show normal retrieval in one type of situation but impaired retrieval in the other. Because part-list cuing is often attributed to a change in the retrieval process from a more effective one when cues are absent to a less effective one when they are present, such a result would indicate that part-list cuing causes a stronger retrieval inefficiency in amnesic patients than in healthy people.

## METHOD

### Subjects

Fifteen amnesic patients (10 male, 5 female) and 30 healthy subjects (18 male, 12 female) participated in the experiment. Patients were recruited through the Clinic for Neurological Rehabilitation at the University of Regensburg. Their average age was 45.2 years (minimum 16, maximum 80), and they had an average of 10.13 years of schooling. Patients' memory problems resulted from the following etiologies: cerebrovascular disease (7), head trauma (4), brain tumors

(2), hypoxia (1), and encephalitis (1). Their overall level of intellectual functioning as indicated by their scores on an abbreviated version of the Wechsler Adult Intelligence Scale–Revised (WIP; Dahl, 1976) averaged 106.73 (minimum 93, maximum 127). Patients' attentional capabilities were within the normal range and averaged 95.66 (minimum 85, maximum 121) on the Attentional Index of the Wechsler Memory Scale–Revised (WMS-R; Wechsler, 1987). By contrast, they exhibited marked deficits on a variety of explicit verbal memory tasks as reflected by an average Verbal Memory Index of 71.4 (minimum 52, maximum 84) on the WMS-R. For each individual patient, the score on the Attentional Index was at least 10 points above the Verbal Memory Index Score. None of the patients displayed aphasic symptoms as measured by a short form of the Token Test (Spellacy & Spreen, 1969). Patients had no history of alcohol or psychoactive substance abuse. Six of the amnesic patients displayed additional difficulties in planning and problem solving consistent with some frontal lobe damage. Such problems became apparent in clinical observation and were psychometrically assessed using the Tower of Hanoi or Wisconsin Card Sorting Test. The relevance of such problems for the present paradigm was separately assessed (see Results). Details on individual patients are presented in Tables 1 and 2, according to their assignment to experimental conditions. The patients in the two experimental groups did not differ with regard to demographic or psychometric variables. Patients for whom problem-solving difficulties were confirmed are identified in Tables 1 and 2.

Comparison subjects matched the patient group with respect to age and educational status. Some were healthy relatives of the neurological patients and some were hospital staff or were drawn from the community. Their mean age was 48.6 years (minimum 18, maximum 81), and they had on average 9.9 years of schooling. They had no history of alcohol abuse or other psychoactive substance abuse.

## Materials

Two types of lists were constructed, each consisting of four target categories, four nontarget categories, and three filler categories. In one type of list, referred to as the strong/moderate (SM) list, each of the target and nontarget categories consisted of three strong and three moderate items. In the other type of list, referred to as the weak/moderate (WM) list, each of the target and nontarget categories consisted of three weak and three moderate items. The filler categories in both lists consisted of two moderate items each. Two versions of each list were constructed, referred to as SM-a and SM-b and WM-a and WM-b. The items were drawn from several published taxonomic frequency norms (Battig & Montague, 1969; Mannheim, 1983; Scheith & Bäuml, 1995). The strong items were chosen to

have a rank order between 5 and 10 according to these norms, the moderate items to have a rank order between 15 and 20, and the weak items to have a rank order between 30 and 40. For each list, effort was made to minimize intercategory similarity and phonemic similarity between category names. Within the categories, no two instances began with the same letter, ensuring that each letter cue would be unique at test. Instances with strong a priori item-to-item associations were avoided. Overall, the material was constructed in a very similar manner to that in Bäuml (1998), where categorized item lists were used to study the role of item strength in retrieval-induced forgetting.

For all four item lists—SM-a, SM-b, WM-a, and WM-b—a long and a short version were employed. In the long version, the items from both the target and the nontarget categories were included; these long lists were presented to the healthy subjects. In the short version, only the items from the target categories, but not from the nontarget categories, were included; these shorter lists were presented to the amnesic subjects. Including the filler categories, the amnesic subjects therefore were presented 30 items ( $4*6+3*2$ ) and the healthy subjects 54 items ( $8*6+3*2$ ) per list. This difference in list length was introduced to provide a rough equation of acquisition across subject groups (see also Results).

## Design and Procedure

The two SM and the two WM lists were each presented to 12 patients (short version) and 20 control subjects (long version). Nine patients and 10 comparison subjects were presented the two SM lists and the two WM lists; the remaining 6 patients and 20 control subjects learned just one of the two types of lists (i.e., the two SM lists or the two WM lists; see Table 1 for details). For subjects who learned both the SM lists and the WM lists, the order of presentation of the two types of lists was counterbalanced. They learned the SM lists first and then, about 1 week later, the WM lists, or vice versa. Recall of the two SM and the two WM lists was tested under two different recall conditions, which were administered within the same session. If the one item list, say, SM-a, was tested under a part-list-cue (PLC) condition, the other, SM-b, was tested under a no-part-list-cue (NPLC) condition. The order of testing was counterbalanced, as was the assignment of the two lists to the two testing conditions. Within each session, the presentation of the first list was followed by a short distractor task and the test phase, in either the PLC or the NPLC condition. After a 15-min break, during which the experimenter engaged the subjects in conversations on unrelated topics, the presentation of the second list and test in the remaining recall condition followed.

**Table 1**  
Patients Assigned to the Strong/Moderate (SM) List

Subject	Etiology	Sex	Age	IQ	ATT	VM	DEL	D-F	D-B
SM1	Closed-head trauma	F	18	115	121	74	55	9	10
SM2	Thalamic infarct	M	71	106	108	52	57	9	7
SM3	Septal cyst	M	24	97	90	65	50	8	5
SM4 (F)	Subarach. haemorrhage	M	67	112	87	61	62	6	6
SM5	RCA aneurysm	M	54	109	96	78	67	9	7
SM6	Brainstem infarct	M	80	109	89	71	<50	6	5
SM7	B-cell lymphoma	F	49	100	88	54	60	7	5
SM8 (F)	Closed-head trauma	F	35	96	97	77	73	4	3
SM9 (F)	Subarach. hemorrhage	M	58	103	85	59	57	4	3
SM10*	Closed-head trauma	F	16	124	89	79	77	7	5
SM11*	Hypoxia	M	59	119	90	72	50	7	6
SM12*	Insular infarct	M	63	127	87	73	80	5	4
<i>M</i>	-	-	49.5	109.75	93.92	68.83	61.5	6.75	5.5

Note—ATT, Wechsler Memory Scale–Revised (WMS-R) Attentional Index; VM, WMS-R Verbal Memory Index; DEL, WMS-R Delayed Recall; D-F, Digit Span Forward; D-B, Digit Span Back. \*Patients were tested in either the SM or the WM condition, but not in both. (F), evidence of frontal lobe involvement.

**Table 2**  
**Patients Assigned to the Weak/Moderate (WM) List**

Subject	Etiology	Sex	Age	IQ	ATT	VM	DEL	D-F	D-B
WM1	Closed-head trauma	F	18	115	121	74	55	9	10
WM2	Thalamic infarct	M	71	106	108	52	57	9	7
WM3	Septal cyst	M	24	97	90	65	50	8	5
WM4	Subarach. hemorrhage	M	67	112	87	61	62	6	6
WM5 (F)	RCA aneurysm	M	54	109	96	78	67	9	7
WM6	Brainstem infarct	M	80	109	89	71	<50	7	5
WM7	B-cell lymphoma	F	49	100	88	54	60	7	5
WM8 (F)	Closed-head trauma	F	35	96	97	77	73	4	3
WM9 (F)	Subarach. hemorrhage	M	58	103	85	59	58	4	3
WM10* (F)	Open-head trauma	M	19	94	110	79	59	7	5
WM11*(F)	Encephalitis	F	22	93	105	84	50	7	5
WM12*(F)	Subarach. hemorrhage	M	43	97	93	82	74	3	5
<i>M</i>	-	-	45	102.6	97.41	70.58	59.58	6.67	5.5

Note—ATT, Wechsler Memory Scale–Revised (WMS-R) Attentional Index; VM, WMS-R Verbal Memory Index; DEL, WMS-R Delayed Recall; D-F, Digit Span Forward; D-B, Digit Span Back. \*Patients were tested in either the SM or the WM condition, but not in both. (F), evidence of frontal lobe involvement.

### Presentation Phase

Category instances were presented together with their category name (e.g., FRUIT–orange) printed on cardboard cards of about 20 × 12 cm size. Except for the first and last three items, the order of cards within each list was randomized across six subsequent blocks of four items (amnesics) or eight items (controls) each. Each block contained one randomly chosen instance of each target category (short version: amnesics) or one randomly chosen instance of each target and nontarget category (long version: controls). To reduce primacy and recency effects on subsequent recall, the first and last three cards of each set always consisted of randomly ordered filler items. One exemplar from each of the three filler categories was presented at the beginning of a list and the other exemplar at the end. Subjects were presented the cards successively for study. Each card was shown for 5 sec and read out to the subject by the experimenter. The presentation of an item list was promptly followed by 30 sec of backward subtraction by twos from a random three-digit number.

### Test Phase

Immediately following this task, a cued recall test was carried out. In the NPLC condition, subjects were given test sheets with the category name and the first letter of each of the three strong or weak items of a target category on it. The subjects were instructed that their task was to retrieve the exemplars, from any portion of the experiment, that corresponded to the cues. There was no instruction about guessing; thus guessing was neither encouraged nor discouraged. Subjects were given 45 sec to recall a page's three items, after which time the items of the next category were tested. In the PLC condition, the same testing procedure was used. However, immediately before the testing of a category's strong or weak items, subjects were presented the name of the category and the category's moderate items on a separate sheet of paper. Subjects were asked to read the items aloud and use them as retrieval cues for the subsequent recall of the non-cue items. Then the test sheet was presented. Both the category name and the three cue items were printed on the test sheets. Again subjects had 45 sec to complete a test sheet. Subjects were asked to say the remembered items out loud and the experimenter wrote them down for them.

## RESULTS

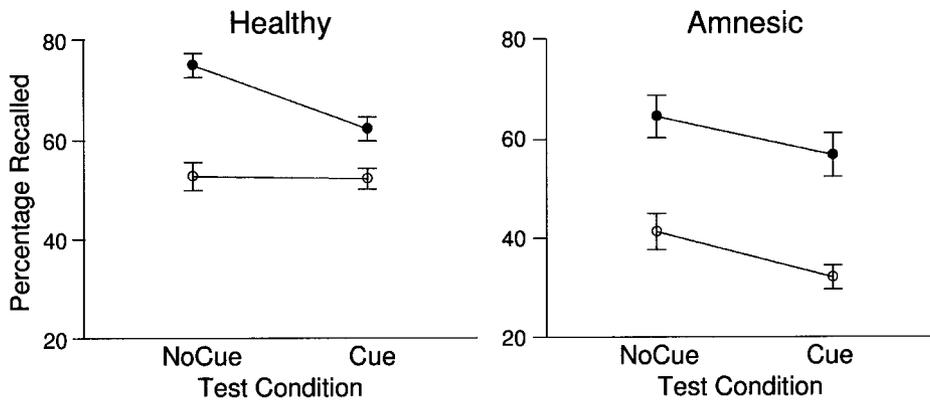
### Healthy Subjects

When tested without presentation of the moderate items as retrieval cues, high-frequency members of categories

(strong items) were better recalled than low-frequency members (weak items). On average, 75.1% of the strong items and 52.7% of the weak items were recalled. This strong–weak difference of 22.4% was statistically reliable [ $F(1,38) = 36.4, MS_e = 0.014, p < .001$ ]. The presentation of the moderate items as retrieval cues affected recall performance of the strong items only but not of the weak ones (Figure 1). Mean recall of strong items declined from 75.1% without cue items to 62.3% when cue items were provided. This part-list cuing effect of 12.8% was reliable [ $F(1,19) = 15.7, MS_e = 0.010, p = .001$ ], indicating that the presence of the cue items impaired the recall of the strong items. Mean recall of weak items was 52.7% when tested without cue items and 52.3% when cue items were provided. This slight decrease in recall performance of 0.4% was not reliable [ $F(1,19) < 1$ ], indicating that the presence of the cue items did not influence the recall of the weak items. The results of a two-factor analysis of variance (ANOVA) confirmed this pattern. There was a significant main effect of item strength [ $F(1,38) = 32.6, MS_e = 0.016, p < .001$ ], a significant main effect of cuing [ $F(1,38) = 10.9, MS_e = 0.008, p < .01$ ], and a significant interaction between item strength and cuing [ $F(1,38) = 9.5, MS_e = 0.008, p < .005$ ].

### Amnesic Subjects

Just as in healthy subjects, strong items showed higher recall performance than weak items when tested without the presentation of part-list cues. Mean recall of strong items was 64.6%, and that of weak items was 41.7%. This strong–weak difference of 22.9% was statistically reliable [ $F(1,22) = 17.2, MS_e = 0.018, p < .001$ ]. Unlike in healthy subjects, the presentation of the cue items had about the same effect on recall performance for strong and weak items (Figure 1). Mean recall of strong items declined from 64.6% without cue items to 56.9% when cue items were provided, the difference of 7.7% being marginally reliable [ $F(1,11) = 4.1, MS_e = 0.008, p = .068$ ]. Mean recall of weak items declined from 41.7% when tested with-



**Figure 1.** Recall performance and standard errors on a category-plus-first-letter cued-recall test as a function of item strength (strong ●, weak ○) and cuing condition (Cue = three item cues were presented; NoCue = no item cues were presented.)

out cue items to 32.6% when cue items were provided, the difference of 9.1% being reliable [ $F(1,11) = 5.7$ ,  $MS_e = 0.009$ ,  $p < .05$ ]. As suggested by the roughly identical amount of recall impairment found for the two types of items, the results of a two-factor ANOVA confirmed that part-list cues had about the same influence on the strong and weak items: There was a significant main effect of item strength [ $F(1,22) = 27.2$ ,  $MS_e = 0.025$ ,  $p < .001$ ] a significant main effect of cuing [ $F(1,22) = 9.8$ ,  $MS_e = 0.009$ ,  $p = .005$ ], and no significant interaction between item strength and cuing [ $F(1,22) < 1$ ].

### Comparing Performance of Healthy and Amnesic Subjects

The healthy and the amnesic subjects showed a comparable effect of item type when the item cues were absent but differed when the item cues were present. Whereas healthy subjects showed part-list cuing for strong items but not for weak items, amnesic subjects showed part-list cuing for both types of items with roughly the same amount of forgetting in the two cases. The results of a three-factor ANOVA with subject group, item strength, and cuing condition as factors supported this conclusion. This analysis showed a significant main effect of subject group [ $F(1,60) = 21.1$ ,  $MS_e = 0.019$ ,  $p < .001$ ], a significant main effect of item type [ $F(1,60) = 60.1$ ,  $MS_e = 0.019$ ,  $p < .001$ ], a significant main effect of cuing [ $F(1,60) = 20.5$ ,  $MS_e = 0.008$ ,  $p < .001$ ], a significant interaction between item type and cuing [ $F(1,60) = 5.0$ ,  $MS_e = 0.008$ ,  $p < .05$ ], and a significant three-factor interaction [ $F(1,60) = 4.3$ ,  $MS_e = 0.008$ ,  $p < .05$ ], indicating that the effect of cuing on item type varied reliably with subject group. The other interactions did not reach significance ( $p > .10$ ).

### Frontal-Lobe Versus Non-Frontal-Lobe Amnesics

In the previous analyses, we did not distinguish between our 6 patients showing evidence for frontal lobe im-

pairment and our 9 patients showing no such evidence (see Method), thus implicitly assuming that in the present sample frontal lobe impairment did not influence part-list cuing. The data support this assumption. When cues were absent, the nonfrontal patients recalled an average of 60.2% of the strong items and 39.3% of the weak items; when cues were present they recalled 53.7% of the strong items and 32.1% of the weak items. These data indicate part-list cuing effects for the strong and weak items with about the same size of effect for the two types of items (6.5% vs. 7.2%). The frontal patients recalled an average of 77.4% of the strong items and 44.4% of the weak items when cues were absent; they recalled 66.6% of the strong items and 34.7% of the weak items when cues were present. Again, these data show part-list cuing effects for both the strong and weak items, with about the same size of effect for the two types of items (10.8% vs. 9.7%). We computed a three-factor ANOVA to examine whether the pattern of results varied across the two patient groups: We found significant main effects of item strength [ $F(1,22) = 37.4$ ,  $MS_e = 0.077$ ,  $p < .001$ ], cuing [ $F(1,22) = 9.2$ ,  $MS_e = 0.082$ ,  $p < .01$ ], and patient group [ $F(1,22) = 5.0$ ,  $MS_e = 0.104$ ,  $p < .05$ ], but we did not find any significant interaction between the single factors (all  $ps > .25$ ). The effects of item type and cuing, therefore, did not vary reliably between frontal and nonfrontal amnesics.

### Further Data and Analyses

**Healthy subjects.** To provide a rough equation of acquisition between healthy and amnesic subjects, the amnesic subjects had been presented only half of the items the healthy subjects learned. The use of shorter lists in patients than in controls may have implications for the processes that mediate performance and thus might have affected our results. We therefore repeated the experiment for another 12 control subjects using exactly the same short-item lists as we had used for the amnesics in the present experiment. Consistent with the results reported above, we found forgetting for the strong items but not for

the weak ones. Mean recall of strong items declined from 81.3% when cue items were absent to 71.5% when cue items were present; mean recall of weak items was 70.1% when tested without cue items and 74.3% when cue items were provided. Although there were no significant main effects of item strength [ $F(1,11) = 1.3, MS_e = 0.016, p > .25$ ] and cuing [ $F(1,11) < 1$ ] in this experiment, the interaction between item strength and cuing was significant [ $F(1,11) = 5.0, MS_e = 0.012, p < .05$ ].

**Amnesic subjects.** Above we reported results for the described sample of 15 amnesic patients. Originally, 29 neurological patients with memory deficits had participated in our experiment. Because 14 of the patients also displayed considerable attentional deficits, these subjects were excluded from the data analysis. The inclusion of these subjects, however, would not have influenced the pattern of results. These subjects showed forgetting for both the strong and the weak items. Mean recall of strong items declined from 69.9% when cue items were absent to 54.7% when they were present; mean recall of weak items was 41.7% without cue items and 28.6% with cue items. In agreement with this pattern, we found a significant main effect of item strength [ $F(1,12) = 23.1, MS_e = 0.022, p < .001$ ], a significant main effect of cuing [ $F(1,12) = 13.1, MS_e = 0.011, p < .005$ ], and no significant interaction between item strength and cuing [ $F(1,12) < 1$ ].

## DISCUSSION

### Healthy People

The finding for healthy people that retrieval of high-frequency members of categories is impaired if other previously presented members of the same category are presented as a retrieval cue at test confirms findings from previous part-list cuing studies (D. R. Basden & B. H. Basden, 1995; Roediger, 1973; Slamecka, 1968; Sloman et al., 1991). The finding that retrieval of low-frequency members of categories is not impaired if related items are presented as cues demonstrates that such impairment does not always occur. The results indicate that the amount of part-list cuing that an item may suffer is a function of its associative strength to the category cue, with larger impairment in the case of strong associations to the category cue and smaller impairment, if any, in the case of weak associations.

The present result that part-list cuing causes forgetting of strong items but not weak ones is consistent with the current view that part-list cuing does not result from strength-dependent competition. In fact, strength dependence, as for instance claimed by Rundus (1973), predicts forgetting for both strong and weak items with proportionally larger amounts of forgetting for the weak items than for the strong ones (see Anderson et al., 1994, Appendix A), a prediction that sharply contrasts with our results. A more appropriate account of part-list cuing rests on the view that the retrieval of studied material depends upon people using the same or a similar organizational

framework during retrieval as they used for learning. Indeed, the presence of part-list cues appears to cause a sufficiently large incongruity between the retrieval framework suggested by cue items and the framework used to encode targets to cause retrieval failure (D. R. Basden & B. H. Basden, 1995; Sloman et al., 1991). Sloman et al. pointed out that in categorized lists incongruity could play a role if the interpretations subjects give to category labels are not fixed but are sensitive to the context in which the labels are presented. Following this line of reasoning, the present results suggest that it is mainly the preexperimentally strong category-item associations that are susceptible to changes in category label interpretations and much less, if at all, the preexperimentally weak category-item associations.

### Amnesic Patients

The results were different for the amnesic subjects. Whereas the healthy subjects showed effects of part-list cuing for the strong items but not for the weak ones, the amnesic subjects showed roughly equivalent effects of part-list cuing for the two types of items. On the basis of Sloman et al.'s (1991) incongruity principle, these results suggest that the change in retrieval process from a more effective one when part-list cues are absent to a less effective one when they are present is larger in amnesics than in healthy controls, at least for the weak items. Does this reduction in retrieval efficiency reflect more of a retrieval or more of an encoding problem?

Because amnesics are often assumed to have difficulty storing and utilizing feature representation, most notably semantic feature representation, to guide their search for target material (Cermak, 1997), one could argue that our amnesic patients might have built up weaker category-item associations than our healthy people. Moreover, such a problem might have arisen particularly in the case of items with preexperimentally weak associations to their category label and less in the case of items with strong associations to their category label (Warrington, 1982). If amnesic subjects showed such an encoding deficit in the present experiment, however, we should have found *lesser* amounts of part-list cuing for the amnesics than for the healthy controls. Because the results for the healthy subjects suggest that stronger category-item associations are more susceptible to incongruities between learning and test than are weaker category-item associations, such an encoding deficit should have made our amnesics' retrieval processes fairly immune to possible negative effects of part-list cuing, particularly in the case of the weak items. Finding a larger amount of forgetting in amnesics than in controls thus indicates that the recall difference between healthy and amnesic subjects is more likely to reflect a retrieval deficit rather than an encoding deficit (see also Isaac & Mayes, 1999b, for evidence against major encoding problems in the present type of situation).

If incongruities between learning and test affect retrieval of amnesics more strongly than that of control subjects, why does such an effect occur mainly for the weak

items and not for the strong ones, as the present results indicate? Cermak, Verfaellie, Sweeney, and Jacoby (1992) reported evidence that in amnesics word completion performance is mediated to a larger extent by fluency factors than in healthy subjects. Moreover, this effect occurred mainly for high-frequency and less for low-frequency words. If this finding generalized to the present experiment, in which the target item's initial letter was provided as a cue at test, then at least for the strong items part of the recalled items might reflect fluency and not recollection performance. B. H. Basden, D. R. Basden, Church, and Beaupre (1991) reported evidence that part-list cuing affects recollection but not fluency performance. The difference in the role of fluency between healthy and amnesic subjects thus might explain why we observed a difference between healthy and amnesic subjects for the weak items but not for the strong ones.

### Part-List Cuing Versus Interference

The evidence arising from the present study that amnesics are more susceptible to part-list cuing than healthy subjects is not in conflict with previous results in which it was found that amnesics show normal retroactive and proactive interference (Isaac & Mayes, 1999a; Warrington & Weiskrantz, 1978). Rather, it is consistent with the view that interference and part-list cuing are mediated by different mechanisms (Anderson et al., 2000; D. R. Basden & B. H. Basden, 1995; Bäuml, 1997, 2002; Ciranni & Shimamura, 1999). On the basis of this view, the present results together with those from prior research indicate that there is more than just one form of retrieval failure and that amnesic patients may show a deficit with respect to one form of retrieval failure but show no deficit with respect to another.

This conclusion is also in accord with very recent results from our laboratory. We ran a retroactive interference experiment using largely the same material and procedure as those used in the present part-list cuing experiment.

There were only two major differences across experiments. First, in the retroactive interference experiment, there were no part-list cues at test; subjects were presented only the target items' category names together with the items' initial letter. Second, in the retroactive interference experiment, there was a longer retention interval between original learning and testing of the target items. During this interval, subjects were presented two interpolated lists: For half of the target item categories, six additional items from the same category were presented in these interpolated lists, three items per list. Eight healthy control subjects and 8 amnesic subjects took part in the study. Figure 2 shows the data. We replicated the results of the present study by finding significant main effects of item strength [ $F(1,14) = 37.3, MS_e = 0.024, p < .001$ ] and subject group [ $F(1,14) = 12.0, MS_e = 0.061, p < .01$ ]. More interestingly, we found a significant main effect of interpolation [ $F(1,14) = 5.4, MS_e = 0.010, p < .05$ ] but did not find any significant interactions between the single factors (all  $ps > .30$ ). The amount of interference, therefore, did not vary between healthy and amnesic subjects, neither for the strong nor for the weak items. This result supports the hypothesis entertained in the present study that amnesic subjects may show normal retrieval in interference situations but impaired retrieval in part-list cuing situations.

### Possible Alternative Explanations

Our conclusion that the difference in pattern between healthy and amnesic people is indicative of a retrieval deficit in amnesics rests on the assumption that the difference in results was not caused by any other factors. At first glance, a number of possible alternative explanations arise. One might be that some of our amnesic subjects showed frontal impairments. Indeed, frontal impairments can cause problems in both encoding and retrieval. Some of our patients in fact showed evidence of frontal lobe damage, and we compared their results with the results of those patients showing no indication of frontal impair-

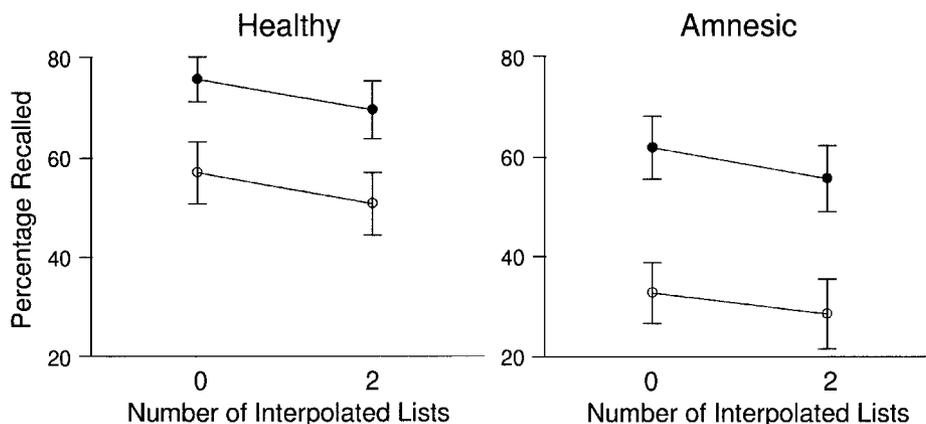


Figure 2. Recall performance and standard errors on a category-plus-first-letter cued-recall test as a function of item strength (strong ●, weak ○) and interpolation condition (0 = no item lists were interpolated; 2 = two item lists were interpolated).

ment. The results did not differ between the two groups of patients, which indicates that possible frontal lobe impairments did not affect the pattern of part-list cuing. This finding is consistent with results from other studies as well. Jetter, Poser, Freeman, and Markowitsch (1986), for instance, showed that problems in retrieval in frontal lobe patients only arise for much longer retention intervals (24 h) than used in the present study (1 min) and show up for free recall but not for cued recall. Kissler, Bäuml, and Rockstroh (2002) examined the extent to which schizophrenic patients show part-list cuing. Schizophrenic patients are known to exhibit executive dysfunctions that point to frontal lobe dysfunctions (e.g., Kolb & Whishaw, 1983). Using the same experimental setup as in the present study, Kissler et al. found exactly the same part-list cuing pattern in schizophrenia patients as in healthy subjects. These results converge on the view that the present results for amnesics are not attributable to frontal lobe impairment.

As another alternative explanation, the present results might have been caused through consolidation deficits in our amnesic patients. In a recent series of experiments Isaac and Mayes (1999a, 1999b) reported evidence of consolidation problems in amnesic patients. However, there is good reason to argue that the present results were not caused by consolidation deficits. As demonstrated in the studies by both Carlesimo, Sabbadini, Loasses, and Caltagirone (1997) and Isaac and Mayes (1999b), consolidation deficits usually arise only in the case of more complex associations than those used in the present study, and, if nevertheless existent, manifest in free but not in cued recall tests.

A further alternative explanation can be rejected. Although the amnesics showed the same difference as the healthy subjects in recall level between strong and weak items in the no-cue control condition, for both types of items they showed slightly lower recall levels than the controls. Could this difference in recall level have caused the difference in the part-list cuing effect? Notice that the results from the controls indicate that negative part-list cuing effects are greater at higher recall levels and decrease for lower recall levels. This finding suggests that the lower recall level found for the amnesics should not have led to an overestimation but rather to an underestimation of the effect, if anything. We also split the healthy subject group into good rememberers and poor rememberers according to whether their weak item recall was above or below mean recall. In the no-cue control condition, the poor rememberers now showed about the same weak item recall as the amnesics (amnesics 42%, healthy 38%). However, the healthy subjects still did not show any evidence of a negative cuing effect and even showed a slight positive effect of cuing.

### Part-List Cuing Versus Retrieval-Induced Forgetting

This study shows that in healthy subjects strong but not weak items show negative effects of part-list cuing. This

role of item strength in part-list cuing is reminiscent of results shown in previous studies on retrieval-induced forgetting. Using largely the same material and procedure as used in the present study, these previous studies demonstrated that retrieval practice on half of the items of a category caused later forgetting of the category's nonpracticed strong items but not of the category's nonpracticed weak items (Anderson et al., 1994; Bäuml, 1998). This pattern of results is assumed to be caused by retrieval inhibition (Anderson et al., 1994; Anderson & Spellman, 1995). According to this proposal, retrieving an item can cause inhibition of other items if these other items interfere with the retrieval of the to-be-practiced item. Because strong items are supposed to interfere more strongly than weak items, they are assumed to be subject to stronger inhibition than weak items.

The fact that item strength plays the same role in part-list cuing as in retrieval-induced forgetting is not inconsistent with the view that the two forms of forgetting are mediated by different mechanisms. As already argued, both incongruity and retrieval inhibition can explain the item strength result. If the proposal of different mechanisms is really right (D. R. Basden & B. H. Basden, 1995), then the question arises of whether amnesics show the same pattern of item strength effects in retrieval-induced forgetting as in part-list cuing. If item strength played the same role in retrieval-induced forgetting as in part-list cuing for healthy people but a different role for amnesics, then this would strongly support the view that the two forms of forgetting are mediated by different mechanisms. We are addressing this issue in ongoing research.

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(Manuscript received August 16, 2001;  
revision accepted for publication April 8, 2002.)