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Posthypnotic Amnesia for Recently Learned Material: Interactions with "Episodic" and "Semantic" Memory

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In two experiments, posthypnotic amnesia was suggested for a word list memorized during hypnosis. After an initial test of amnesia the subjects gave word associations (Experiment 1) or category instances (Experiment 2) to stimuli intended to elicit the critical (word list) items covered by the amnesia. The extent of initial amnesia observed was strongly associated with measured hypnotic susceptibility. Even among the most hypnotizable subjects, however, the dense amnesia did not prevent the critical items from being elicited by the semantic memory tasks, nor did it modulate the priming which these associations received by virtue of the prior learning experience. Moreover, production of the critical items did not, in general, remind the amnesic subjects of those items which they had previously learned, but could not now remember. Full memory was restored after the amnesia suggestion was canceled by a prearranged cue. Posthypnotic amnesia appears to represent a temporary dissociation of episodic features from memory traces, so that the subject has difficulty in reconstructing the context in which the target events occurred.

Posthypnotic amnesia refers to a person's subjectively compelling inability to remember the events and experiences that transpired while he or she was hypnotized. An important property of this impairment in memory is that it can be lifted or relieved by the administration of a prearranged reversibility cue (Kihlstrom & Evans, 1976). Therefore, the amnesia must ultimately involve retrieval rather than the encoding or passive storage of memory; further, reversibility indicates that the amnesia is not an instance of state-dependent retention, because it can be relieved without the reinduction of hypnosis. Under ordinary circumstances amnesia does not occur unless it has been specifically suggested to the hypnotized subject (Hilgard & Cooper, 1965). Despite the fact that the amnesia is induced and

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lifted by purely verbal procedures, it may be distinguished from the subject's simple failure to report things that he or she remembers perfectly well, or some other form of motivated suppression or neglect of memory (Kihlstrom, Evans, Orne, & Orne, Note 1).

The usual form of posthypnotic amnesia is rather selective in its effects (Kihlstrom, 1977; Kihlstrom & Evans, 1979b). The nature of this selectivity is demonstrated most clearly in four experiments on relearning and positive transfer performed in Hull's laboratory (reviewed by Hull, 1933). Coors had hypnotized subjects learn the path through a stylus maze, and Strickler used a set of paired associates. Upon awakening, the subjects in these two studies could not recall the material which they had learned; nevertheless, they showed considerable savings when required to relearn the same material posthypnotically. In somewhat the same manner, Life gave hypnotized subjects practice in complex mental arithmetic, and Patten presented nonsense syllables. After arousal from hypnosis the subjects did not remember the practice trials; yet in both studies they showed an advantage over control subjects when required subsequently to perform similar but not identical arithmetic and learning tasks outside of hypnosis. More recent experiments have shown similar kinds of effects. Williamsen, Johnson, and Eriksen (1965) found that subjects who were amnesic for a word list learned during hypnosis were able to decode degraded copies of the words more readily than control items; and they were not inhibited from employing the critical items as free associates to appropriate stimuli. Finally, Evans and Thorn (1966) found that some amnesic subjects were able to recall certain obscure facts, even though they did not remember having learned the information while hypnotized.

These results may be interpreted along the lines of Tulving's (1972) proposed distinction between episodic and semantic memory. In brief, the episodic–semantic distinction is similar to that which Bergson (1896) drew between remembrances and memoria (see also Reiff & Scheerer, 1959), and which Piaget and Inhelder (1973) have drawn between memory in the strict sense and memory in the wider sense. Episodic memories (remembrances or memories in the strict sense) refer to personal experiences, and carry as essential components some reference to the self and to a particular spatiotemporal context; semantic memories (memoria or memories in the wider sense) consist of knowledge—of the facts of the world, the meanings of words, rules of mathematical and logical operations, and highly overlearned skills. Of course, the boundary between the two types of memories should not be drawn too sharply (Reed, 1979; Schonfield & Stones, 1979; Schank & Abelson, 1977). All incoming stimuli must make contact with preexisting cognitive structures in order to be perceived (Craik & Lockhart, 1972; Neisser, 1967). Moreover, memories seem to lose their specific episodic referents as repeated similar

experiences collect and become absorbed into more generalized schemata.

Thus the episodic–semantic distinction probably does not refer to two different sets of memories, but rather to the fact that memories are organized with respect to both semantic and episodic schemata. Under ordinary circumstances, either organizational framework can facilitate remembering, though one may be more efficient than the other for a particular recall task: in order to locate missing car keys, one can try to reconstruct where they were last seen and what transpired between that time and the present (capitalizing on episodic organization), or one can draw on one's knowledge that missing car keys are very often to be found in the trunk lock (capitalizing on semantic organization). From this point of view the experiments described earlier appear to suggest that the memories covered by posthypnotic amnesia have been dissociated from episodic schemata, but not from semantic ones. In the studies by Hull's (1933) students and by Williamsen et al. (1965), the subject was able to capitalize on specific knowledge or generalized skills whose hypnotic acquisition he or she could not remember; Williamsen et al. showed that amnesic subjects could still employ the constituent items of an unremembered word list as free associates; and Evans and Thorn (1966) demonstrated that some amnesic subjects could remember facts but not the circumstances under which they were learned. In brief, the amnesic subjects could recollect the critical information as knowledge, but not as history.

The two experiments described in this paper continue to explore the relation between semantic and episodic memory schemata in posthypnotic amnesia. Hypnotized subjects were taught a list of familiar words, followed by suggestions for posthypnotic amnesia. After an initial recall test of amnesia, an attempt was made to gain access to the critical memories by means of either a word-association (Experiment 1) or category-instances (Experiment 2) task. This was followed by a second recall test of amnesia, cancellation of the amnesia suggestion, and a final recall test of memory. In principle, of course, the method represents a laboratory model of the practice frequently encountered in the consulting room, where a clinician uses free associations to help a patient recover memories which he or she has repressed or otherwise forgotten. Clinical lore has it that the production of memory-relevant associations may lead to the recovery of the critical memories themselves. In other terms, the method represents an attempt to gain access to episodic memories by means of semantic schemata.

The experiments address the episodic–semantic memory distinction in three ways.

(1) Does learning a list of words facilitate the production of those same

words in a "semantic memory" task involving free associations or category instances? Observation of "priming" in the semantic memory domain (Loftus, 1973; Meyer & Schvaneveldt, 1973; Rosch, 1975) suggests that the list learning procedure might produce a similar carry-over effect.

(2) If so, does amnesia for the learning experience modulate this influence in any way? Subjects for whom the learning task is in awareness may deliberately capitalize on the prior learning or deliberately avoid giving list items as free associates; or, alternatively, the inhibition of episodic recall in amnesia may generalize to the semantic memory task.

(3) In the event that amnesic subjects produce the critical material on the semantic memory task, will this remind them that they recently learned these same words? Such a reminder effect would be consistent with a conception of amnesia as a deficit in gaining access to the material covered by the amnesia, a difficulty which can be circumvented by employing another access route.

EXPERIMENT 1

The first study was patterned after that of Williamsen et al. (1965). As noted earlier, these investigators found that posthypnotic amnesia for a recently memorized word list did not interfere with the production of the list items as responses on a word-association task expressly designed to elicit these words. Two other findings, however, were more ambiguous. First, it was found that the items from the memorized word list were elicited at their normative frequency. Insofar as the prior memorization of the list might have been expected to enhance the probability of eliciting the list items on the word-association task, then, the amnesia appeared to eliminate the carry-over effect from the prior learning to subsequent word-association performance. However, the normative stimulus-response probabilities involved were quite high to begin with, so that a ceiling effect may have obscured any enhancement which may have occurred. Second, there was some indication of a reminder effect, in that the subjects remembered more list items, on average, after the word-association task than before it. However, some lack of comparability was introduced by a shift from recall testing before the word associations to recognition testing afterward.

Method

Subjects

The 40 participants in this experiment were drawn from a pool of Stanford University students who had previously received an administration of the Harvard Group Scale of Hypnotic Susceptibility, Form A (HGSHS:A) followed by the Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C). On the basis of their SHSS:C scores the subjects were classified as low (0–4), medium (5–7), high (8–10), and very high (11–12) in hypnotizability, with 10 subjects in each group. In the experiment itself, all subjects were treated as if hypnotizable. The subjects were told during the telephone recruitment that they would learn

a list of familiar words while hypnotized, and they were reminded of this at the outset of the experimental session; no mention was made of the amnesia suggestion. The subjects were paid $3.00 for their participation in the single experimental session, which lasted 75–90 min.

Stimulus Materials

Two lists were prepared, each consisting of 15 stimulus terms used in the Palermo and Jenkins (1964) study of word-association norms, and the corresponding response word given most frequently to each stimulus. The lists were constructed in such a way that each stimulus–response pair in one list was matched with a pair in the other list possessing an approximately equal stimulus–response probability. The two lists and their associated stimulus–response probabilities are presented in Table 1. The average stimulus–response probabilities were virtually identical (List 1: $M = .52$, $SD = .12$; List 2: $M = .51$, $SD = .12$; $t(14) = .08$). The response terms only were then gathered into two lists, one of which was memorized during the learning phase of the experiment (the critical list) while the other served as a control for learning (neutral list). During the word-association phase of the experiment the stimulus terms were employed as cues in an attempt to elicit the critical and neutral list items as targets.

Procedure

At the beginning of the experimental session each subject was hypnotized using the standard induction procedure from SHSS:C. Half the subjects in each hypnotizability group then learned List 1 by the method of free recall, while the other half learned List 2. The list of critical words was read to the subject in a different random order on each trial at the rate of one word every 3 sec, followed by an oral test of free recall. On each trial free recall

TABLE 1

Comparison of Stimulus–Response Properties of Matched Lists (Experiment 1)

List 1			List 2		
Stimulus	Response	*p*	Stimulus	Response	*p*
Boy	Girl	.70	Lamp	Light	.71
Table	Chair	.70	Dogs	Cats	.68
Blossom	Flowers	.63	Man	Woman	.63
Long	Short	.63	Slow	Fast	.63
Black	White	.59	Butter	Bread	.58
Eagle	Bird	.58	Sell	Buy	.56
Bitter	Sweet	.54	Younger	Older	.53
Always	Never	.51	Hammer	Nail	.50
Tobacco	Smoke	.48	Dream	Sleep	.49
Needle	Thread	.46	Fruit	Apple	.45
Eating	Food	.42	Green	Grass	.41
Easier	Harder	.42	Salt	Pepper	.41
Doors	Windows	.36	Spider	Web	.38
Ocean	Water	.36	Sickness	Health	.37
Anger	Mad	.35	Bath	Clean	.35

Note. Words in the "response" columns were memorized by subjects in the learning phase of the experiment; during the word-association phase, the words in the "stimulus" columns were presented in an attempt to elicit the responses listed above, designated as targets.

continued until the subject indicated that he or she had reached an impasse; study–test cycles continued until the subject reached a criterion of two perfect repetitions in succession. The experimenter then administered the following amnesia suggestion.

> Now remain deeply relaxed and pay close attention to what I am going to tell you next. In a moment, I shall count backwards from 20 to 1 . . . and at 1, not sooner, you will open your eyes and no longer be hypnotized. . . .
> When you awaken . . . you probably will have the impression that you have slept because you will have difficulty in remembering the things you did while you were hypnotized. In particular you will not be able to remember that you learned any words while you were hypnotized. After waking you will have no memory that I told you these words, or what the words were. You will not be able to remember them until I say to you, "Now you can remember everything." Then you will be able to remember everything, including the fact that you learned some words and what they were. But you will not be able to remember these things until I say to you, "Now you can remember everything." . . .

After awakening from hypnosis the subject was asked to recall what happened while he or she was hypnotized. In most cases the subject recalled memorizing a list of words; if he or she failed to mention the learning experience, the experimenter specifically reminded the subject of it. In either case the subject was then asked to recall orally any words which he or she remembered learning during the experiment. This represented the initial test of posthypnotic amnesia (Test 1). Next the experimenter administered the word-association test (WAT). As noted earlier, half of the stimuli used in this test had a high probability of eliciting the items of List 1, while the other half had correspondingly high probabilities of eliciting the items of List 2. The stimulus words were read aloud to each subject in a standard random order, with the exception that the first word read was from the neutral list and the second word was from the critical list. In order to maximize the likelihood that the critical and neutral stimuli would elicit their intended targets, the subjects were asked to give three continued associations to each stimulus, following the procedure employed by Bilodeau and Howell (Note 2). The subject was then asked to recall the list orally for a second time (Test 2). Then the experimenter administered the prearranged reversibility cue, followed by yet a third oral recall test (Test 3). After a second administration of the WAT[1], the subjects were interviewed concerning their experiences during the session, debriefed, and dismissed.

Results

The subject selection procedure insured that the four experimental groups would differ substantially in hypnotizability as measured by

[1] The second word-association test of Experiment 1 and the corresponding second category-instances test of Experiment 2 were included to help evaluate whatever effects of the amnesia suggestion might have been encountered on the first administration—for example, the disappearance of the critical items from the subject's vocabulary. Since these effects did not eventuate, the results are not discussed in this paper.

SHSS:C. The subjects of very high hypnotizability represent approximately the top 5% of the distribution of SHSS:C scores in an unselected university student sample, while those of high hypnotizability represent another 21%; a further 29% are classified as medium in hypnotizability, while the remaining 45% are classified as low (Hilgard, 1965).

There were small group differences in the number of trials required in the acquisition phase, with the insusceptible subjects reaching criterion somewhat faster than their more hypnotizable counterparts ($F(3,36) = 2.64, p < .05$), but no group differences in the subjective organization of recall displayed on the final criterion trial. The learning-to-criterion procedure insured that all subjects showed perfect recall on the final learning trial.

Initial Amnesia Response

The results of the first recall within amnesia (Test 1), given to all subjects, are presented in Table 2. All of the lows and mediums remembered the learning trials, while one of the high subjects and seven of the very high group had to be reminded of the experience. The lows and mediums showed essentially no recall deficit as a consequence of the amnesia suggestion (recall = 92.7 and 90.0% of the total pool of available items, respectively). By contrast, the highs showed an appreciable deficit (recall = 50.0%), while the subjects of very high hypnotizability were almost totally amnesic (recall = 1.3%). Analysis of variance of recall on Test 1 showed, as expected, that the level of memory shown was significantly associated with hypnotizability ($F(3,36) = 34.00, p < .001$).

Performance on Word-Association Task

The subjects' responses on the WAT were evaluated in several ways. First, the number of critical targets (i.e., those learned but covered by the amnesia suggestion) and the number of neutral targets (i.e., unlearned words) elicited by the word-association stimuli were compared. Because there were three responses given to each stimulus word, the targets were counted in two ways: the number elicited as first associates, and the number appearing anywhere in the subject's series of three continued

TABLE 2

Group Comparisons of Initial Amnesia (Experiment 1)

	Hypnotizability			
Variable	Low	Medium	High	Very high
Recall				
M	13.90	13.50	7.50	.20
SD	2.85	2.84	5.64	.63

TABLE 3

Group Comparisons of Word-Association Test Performance (Experiment 1)

Variable	Hypnotizability							
	Low		Medium		High		Very high	
	Critical	Neutral	Critical	Neutral	Critical	Neutral	Critical	Neutral
Number of targets elicited, first Associates only								
M	8.80	7.00	8.20	6.40	8.00	7.70	9.70	7.80
SD	3.19	2.67	4.34	4.01	3.16	2.71	2.75	3.43
Number of targets elicited, first or continued associates								
M	10.80	8.40	9.70	8.30	10.10	9.20	12.20	10.40
SD	2.49	2.50	4.11	4.11	3.15	3.19	2.78	2.55
Latency to targets[a]								
M	2.75	2.62	3.60	5.65	2.88	2.45	4.00	4.15
SD	1.50	1.50	2.29	6.06	1.28	.84	1.98	2.04
Target-related intrusions								
M	1.80	.10	1.20	.70	2.00	.20	2.00	.10
SD	3.99	.32	1.03	.67	2.71	.42	4.00	.32

[a] Time in seconds.

associations. Second, the response latencies were compared to determine the ease with which the critical and neutral target associates were generated. The third measure was the frequency of occurrence of other associations from the same list (critical or neutral) as intrusions—that is, given as first or continued associations to stimuli which were *not* intended to elicit them. Average scores for each of these measures, by group, are presented in Table 3, and are considered in turn.

Targets elicited as first or continued associates. In all groups critical targets were elicited by the WAT at a higher rate than neutral targets. Considering only the targets elicited as first associates, a repeated-measures analysis of variance revealed a significant main effect for type of target ($F(1,36) = 15.12, p < .001$), but no effect of hypnotizability ($F(3,36) = .36$) and no interaction ($F(3,36) = 1.06$, ns). Similar results were obtained counting all targets elicited, whether as first or continued associates (target type: $F(1,36) = 16.73, p < .001$; hypnotizability: $F(3,36) = 1.14$, ns; interaction: $F(3,36) = .64$). Words which had been learned by subjects earlier in the experiment were more likely to be elicited in the WAT than words that had not been learned. However, the presence of posthypnotic amnesia, even in the most highly hypnotizable subjects, apparently had no impact on this aspect of the word-association performance.

Response latency to targets. Of equal interest was the question of how readily the targets were elicited, if in fact they were given by the subjects in response to appropriate stimuli on the WAT. Response latencies to critical and neutral targets were taken from audiotape records of the experimental sessions. For each subject, two latency scores were calculated by averaging over his or her individual critical and neutral target latencies, respectively. A repeated-measures analysis of variance revealed no effect of either target type ($F(1,36) = 1.35$, ns) or hypnotizability ($F(3,36) = 1.68$, ns); the interaction trend did not reach significance ($F(3,36) = 2.51$, $p < .10$). Despite the fact that critical target items had a significantly higher probability of being elicited by the WAT than neutral items (as shown by the previous analysis), the former were not elicited more quickly than the latter; and the degree of amnesia, again, had no effect on the response latencies.

Target-related intrusions. During the WAT the subjects occasionally gave more than one item from the previously memorized word list as an associate to a critical stimulus. For example, a subject who had learned List 1 during the acquisition phase responded to *always* with *never*, followed by *smoke*. The list of continued association responses was examined to determine the frequency of this type of intrusion. As a control the frequency of neutral targets intruding as continued associates to neutral stimuli not specifically intended to elicit them was also counted. Although the incidence of target-related intrusions of either type was rather low, a repeated-measures analysis of variance revealed a significant main effect

for target type ($F(1,36) = 9.03$, $p < .01$); there was no main effect of hypnotizability ($F(3,36) = .02$) and no interaction ($F(3,36 = .45$). It seems likely that the intrusions from the critical list stem from the subjects' imposition of subjective organization on the word list during the acquisition phase of the experiment, that is, that the intrusions reflect interitem associations newly formed in episodic memory, rather than preexisting ones in semantic memory. Again, however, this influence of the prior learning experience was not affected by the presence of amnesia in the most highly hypnotizable subjects.

Performance on Subsequent Recall Tests

In addition to performance on the word-association test, this experiment was also concerned with the subjects' memory for the memorized word list, as reflected in the four recall tests (Tests 0, 1, 2, and 3). Test 0 is the final learning trial, and shows that the subjects have achieved some degree of mastery over the list. Test 1 is the first recall after hypnosis, and permits assessment of the degree to which the amnesia suggestion was effective in disrupting retrieval of the critical words. The WAT, occurring between Tests 1 and 2, afforded the amnesic subjects an opportunity to be reminded of those words which they had previously learned; therefore Test 2 provides a test of the "reminder effect" produced by the WAT; the prearranged cue to cancel the amnesia suggestion was administered between Test 2 and Test 3; therefore, Test 3 is a test of the reversibility of the amnesia, and indicates the number of memorized words remaining accessible in memory after amnesia has been lifted, for comparison with the effects observed on Test 1 and Test 2 during amnesia.

Figure 1 presents the average number of items remembered on each of the three tests of posthypnotic recall (recall on Test 0 was perfect, 15 items, for all subjects). A repeated-measures analysis of variance indicated significant main effects of both hypnotizability ($F(3,36) = 39.55, p < .001$) and tests ($F(2,72) = 76.43, p < .001$). Most important, however, was a significant interaction between hypnotizability and tests ($F(6,72) = 26.08, p < .001$).

Recall on Test 1 was very close to ceiling for the low and medium hypnotizability groups, so the changes in recall on Tests 2 and 3 were necessarily small and nonsignificant. The subjects of high hypnotizability (i.e., scale scores of 8–10), most of whom manifested at least a partial amnesia on initial testing, showed a small overall improvement from Test 1 to Test 2 during amnesia ($t(9) = 1.91, p < .10$), and a further improvement from Test 2 to Test 3, after amnesia was lifted ($t(9) = 2.57, p < .05$). In contrast, the subjects in the very high hypnotizability group, all of whom manifested complete or virtually complete amnesia, showed only a very small improvement in recall from Test 1 to Test 2 during amnesia ($t(9) = 1.31$, ns). In other words, all of the very highly hypnotizable

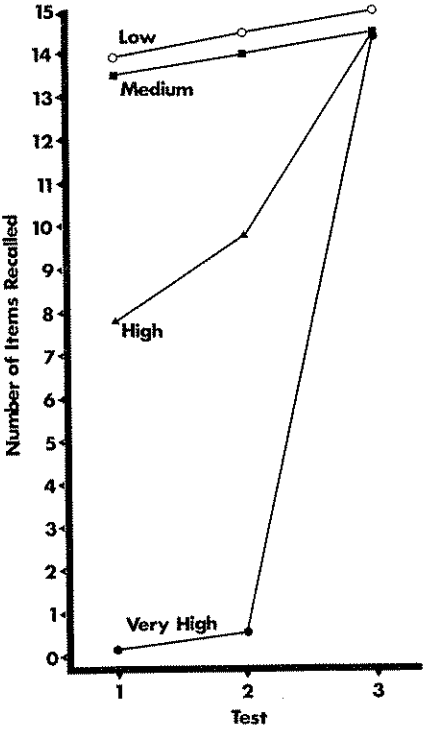

FIG. 1. Number of items recalled on three tests of posthypnotic memory for a word list memorized during hypnosis (Experiment 1). Tests 1 and 2 occurred during suggested amnesia, before and after the word-association test, respectively; Test 3 occurred after administration of the reversibility cue.

subjects showed complete amnesia on Test 1 and maintained it on Test 2. On Test 3, however, after administration of the reversibility cue, there was a dramatic improvement in recall ($t(9) = 32.39$, $p < .001$), with all subjects now showing full memory.

The average probability of recalling an item on Test 2, given that it had been elicited on the WAT, was .98, .93, .68, and .04, respectively, for the subjects of low, medium, high, and very high hypnotizability. Analysis of variance revealed highly significant group differences ($F(3,36) = 41.05$, $p < .001$). The WAT reminded some of the partially amnesic subjects of the words which they had originally failed to recall, but did little or nothing to improve the memories of those who were most completely amnesic. For the latter subjects, relief of the amnesia was achieved only after administration of the reversibility cue.

Summary

Experiment 1 thus confirmed the findings of Williamsen et al. (1965)

that posthypnotic amnesia for a memorized word list does not prevent the amnesic subject from employing the list items in a concurrent word-association task. In contrast to the earlier experiment, however, there was a significant carry-over effect of the prior learning onto the subsequent word-association task: critical items, from the memorized word list, were elicited more readily than neutral items, which had not been learned. Subjects who were amnesic for the learning experience, however, showed no reduction in the carry-over effect. Finally, production of the critical items as word associates, when this occurred, did not remind the amnesic subjects of the items which they had previously learned but could not now remember.

EXPERIMENT 2

Experiment 2 attempted to assess the generalizability of the findings of Experiment 1 by substituting a list of conceptually related items for the unrelated words of Experiment 1 and a category-instances procedure for the word-association task. The relation between amnesia for a word list and hypnotic susceptibility had been shown clearly in Experiment 1, so the second experiment employed only subjects from the extremes of the distribution of hypnotizability (low and very high). In all other respects the method of Experiment 2 directly paralleled that of Experiment 1.

Method

Subjects

The 24 participants (12 males, 12 females) in this experiment were drawn from the same student pool as in Experiment 1; none had participated in the prior experiment. On the basis of their SHSS:C scores the subjects were classified as low (0–4) or very high (11–12) in hypnotizability, with 6 males and 6 females per group. Again, all subjects were treated as if hypnotizable. The subjects were paid $3.00 for a single session lasting 60–75 min.

Stimulus Materials

Two word lists were prepared, each consisting of 16 words drawn from the Battig and Montague (1969) normative study of category instances. The eight categories with the highest potency (number of instances generated in a 30-sec interval) were selected and assigned to one list or the other so that the resulting lists were closely matched in terms of the average number of instances given by the subjects in 30 sec (List 1: $M = 9.71$, $SD = 1.14$; List 2: $M = 9.70$, $SD = .82$; $t(6) = .01$), actual category size (List 1: $M = 50.75$, $SD = 29.55$; List 2: $M = 50.75$, $SD = 28.73$; $t(6) = .01$), and subjects' 1–7 ratings of category size (List 1: $M = 5.59$, $SD = .43$; List 2: $M = 5.83$, $SD = 1.01$; $t(6) = 1.01$). The norms provided by Battig and Montague list, in descending order of frequency, all instances generated by 10 or more subjects in their normative group under a given category label. Items in positions 5, 7, 11, and 13 within each category were arbitrarily chosen for inclusion in the word lists. The resulting list items and normative data on the categories from which the words were drawn are presented in Table 4. During the learning phase of the experiment the subjects learned one of the lists (critical) while the other served as a control for learning (neutral). During the category-instances phase of the experiment, the category labels were employed as cues in an attempt to elicit the critical and neutral targets.

TABLE 4

Categories and Items in Matched Lists (Experiment 2)

List 1		List 2	
First name of a woman or girl		First name of a man or boy	
Judy		Tom	
Barbara		Dick	
Nancy		Harry	
Jean		Larry	
Number of Instances	= 92	Number of Instances	= 91
Actual Frequency	= 9.66	Actual Frequency	= 10.76
Rated Frequency	= 6.05	Rated Frequency	= 6.07
Part of the human body		Country	
Foot		Germany	
Finger		Italy	
Mouth		Japan	
Hair		Brazil	
Number of Instances	= 47	Number of Instances	= 49
Actual Frequency	= 11.34	Actual Frequency	= 8.77
Rated Frequency	= 5.53	Rated Frequency	= 5.73
Four-footed animal		Article of clothing	
Lion		Blouse	
Elephant		Coat	
Rat		Tie	
Sheep		Jacket	
Number of Instances	= 42	Number of Instances	= 37
Actual Frequency	= 9.03	Actual Frequency	= 9.54
Rated Frequency	= 5.75	Rated Frequency	= 5.62
Unit of time		Color	
Day		Orange	
Month		Purple	
Eon		Violet	
Era		Turquoise	
Number of Instances	= 22	Number of Instances	= 26
Actual Frequency	= 8.81	Actual Frequency	= 9.73
Rated Frequency	= 5.02	Rated Frequency	= 5.89

Note. Number of Instances = number of category instances given by 10 or more subjects in normative group; Actual Frequency = average number of instances listed in 30 sec; Rated Frequency = average rating of category size on a 1–7 scale.

Procedure

In general the procedure for this experiment paralleled that employed in Experiment 1. The subjects received the SHSS:C induction procedure and while hypnotized learned the list of 16 critical words by the method of free recall to a criterion of two perfect repetitions in succession. As a precaution against nuisance effects ensuing from the sex-role connotations of some of the categories and words targeted by the item-selection procedure, half the males and half the females learned List 1 while the other half learned List 2. Then the subjects received the amnesia suggestion and were aroused from hypnosis. Following an oral free-recall test of amnesia (Test 1), the subjects engaged in a category-instances test (CIT),

attempting to generate 15 instances of each of the critical and neutral categories. The 15 instances were required in order to maximize the probability that the procedure would elicit the intended target words: occasionally a subject failed to give the required 15 instances, but this had no bearing on the results of the experiment. The experimenter then requested oral recall of the word list a second time (Test 2) and then a third time after giving the reversibility cue to cancel the amnesia suggestion (Test 3). After a second run of the CIT the subjects were interviewed about their experiences, debriefed, and dismissed.

Results

The use of categorically related items yielded even faster learning than was obtained in Experiment 1 with unrelated words. Comparison of the groups again revealed a small difference in speed of learning with the insusceptible subjects learning the list somewhat more quickly than the hypnotizables ($t(22) = 1.93, p < .05$, two tailed). The two groups did not differ in terms of category clustering on the criterion trial as measured by Bousfield's (1953) Repetition Ratio (RR; $t(22) = .30$). As before, the learning-to-criterion procedure employed insured that all subjects showed perfect recall on the final learning trial.

Initial Amnesia Response

All of the insusceptible subjects remembered the learning trials; five of the very highly hypnotizable subjects failed to do so. In terms of item recall, the hypnotizable subjects showed good response to the suggestion for amnesia, while the insusceptible subjects did not ($M = 1.25$, $SD = 3.41$, vs $M = 15.83$, $SD = .39$, respectively; $t(22) = 14.72, p < .001$). In contrast to the findings in their counterparts in Experiment 1, amnesia was not ubiquitous in the very high group: one subject recalled fully 12 of the 16 critical items. Even among subjects of very high hypnotizability complete amnesia is not always obtained in response to the experimenter's suggestion (Hilgard, 1965).

Performance on Category-Instances Task

The subjects' performance on the CIT was evaluated in a manner parallel to that of the WAT of Experiment 1. Table 5 presents analyses (corresponding to those for Experiment 1 in Table 3) of the number of targets elicited by the CIT procedure, response latency to the targets, and the clustering of targets within the lists of category instances produced by the subjects.

Number of targets elicited. As before, critical targets were elicited by the CIT at a higher rate than neutral targets. A repeated-measures analysis of variance revealed a significant effect of list type ($F(1,22) = 20.33, p < .005$); the apparent difference between the hypnotizability groups did not prove to be significant ($F(1,22) = 2.85, p < .10$), and there was no interaction between list type and hypnotizability ($F(1,22) = .32$). Thus, the carry-over effect of the prior learning trials was observed again

TABLE 5
Group Comparisons of Category-Instances Test Performance (Experiment 2)

Variable	Hypnotizability			
	Low		Very high	
	Critical	Neutral	Critical	Neutral
Number of targets elicited				
M	10.83	7.83	9.42	7.08
SD	3.04	1.11	2.31	1.56
Latency to targets[a]				
M	10.99	15.24	16.34	14.63
SD	5.40	5.75	6.77	6.53
Latency to first target within category[a]				
M	7.50	9.05	9.08	11.44
SD	3.44	3.80	3.28	5.69
Clustering of targets[b]				
M	.35	.16	.14	.11
SD	.24	.16	.14	.12

[a] Time in seconds.
[b] Bousfield's (1953) Repetition Ratio (RR).

in this experiment: the items comprising the critical list were more likely to be produced as category instances than their neutral counterparts.

Response latency to targets. As in Experiment 1, response latencies to critical and neutral targets were collected from the audiotape records of the sessions. For each subject two latency scores were calculated by averaging over the individual response times to critical and neutral targets, respectively. Repeated-measures analysis of variance indicated that there was no main effect of either target type ($F(1,22) = 1.04$, ns) or hypnotizability ($F(1,22) = 1.90$, ns); there was, however, a significant interaction between the two factors ($F(1,22) = 7.52$, $p < .05$). Individual comparisons showed that the latencies to critical targets were faster than those to neutral targets for the insusceptible subjects ($t(11) = 3.65$, $p < .005$), but were not significantly different for the hypnotizable subjects ($t(11) = 1.19$, ns); considering only the critical targets, response latencies were significantly faster for the insusceptible subjects than the hypnotizable subjects ($t(22) = 5.74$, $p < .001$).

When the analysis was repeated counting only the first target within each critical and neutral category, the interaction disappeared ($F(1,22) = .21$). There was a significant main effect of target type ($F(1,22) = 5.00$, $p < .05$), but no main effect of hypnotizability ($F(1,22) = 1.83$, ns). Thus, in contrast to the findings of Experiment 1, the first critical target was elicited significantly more quickly than the first neutral target. The presence of amnesia in the hypnotizable subjects did not affect this tendency. How-

ever, the amnesia apparently influenced the response latencies associated with those critical targets which *followed* the first one, inasmuch as these were shorter for the insusceptible than for the hypnotizable subjects.

Clustering of targets. The response latency findings were clarified when the critical and neutral targets elicited by the CIT were examined in terms of clustering of targets within a category, as measured by RR. For each subject, clustering scores were derived for the critical and neutral targets by counting the number of repetitions of target items within a category with no intervening nontarget items. A repeated-measures analysis of variance showed significant main effects for both list type ($F(1,22) = 5.33, p < .05$) and hypnotizability ($F(1,22) = 8.24, p < .01$). The interaction term did not reach statistical significance ($F(1,22) = 2.08$, ns) because of the high degree of clustering of critical targets shown by the single subject in the very high hypnotizability group who responded poorly to the amnesia suggestion. Nevertheless, the individual comparisons were carried out as planned, with this outlier left in the sample. The clustering of critical targets was significantly higher than neutral targets in the low hypnotizability group ($t(11) = 2.26, p < .05$) but not in the very high hypnotizability group ($t(11) = .67$); and clustering of critical targets was significantly higher in the insusceptible than the hypnotizable subjects ($t(22) = 2.62, p < .05$). Thus, the critical targets tended to cluster in the lists of category instances, but only for the subjects in the low hypnotizability group. This observed clustering accounts for the relatively low response latencies to the second and subsequent critical targets in these same subjects: once they reached one of the critical targets, they strongly tended to produce the others immediately afterward.

Performance on Subsequent Recall Tests

As was the case in Experiment 1, the hypnotizable subjects produced many of the critical items on the CIT, despite their amnesia for the list-learning procedure. Thus, again, they had the opportunity to be reminded that these words were the ones that had been learned during the earlier phase of the experiment. Figure 2 shows the average number of items remembered on each of the posthypnotic recall tests: Test 1, the initial test of amnesia; Test 2, also during amnesia but following the CIT; and Test 3, following the reversibility cue. A repeated-measures analysis of variance again showed significant effects of both hypnotizability ($F(1,22) = 167.93, p < .001$) and tests ($F(2,44) = 108.00, p < .001$), and a significant interaction ($F(2,44) = 105.47, p < .001$).

The changes in recall from Test 1 to Test 2 during amnesia, and from Test 2 to Test 3 after amnesia, were both small and nonsignificant for the insusceptible subjects. By contrast, the hypnotizable group showed a nonsignificant improvement on Test 2 ($t(11) = 1.22$, ns) but a large im-

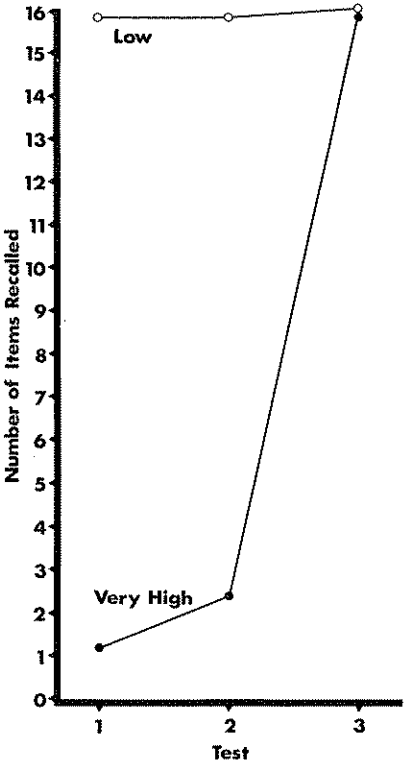

FIG. 2. Number of items recalled on three tests of posthypnotic memory for a word list memorized during hypnosis (Experiment 2). Tests 1 and 2 occurred during suggested amnesia, before and after the category-instances test, respectively; Test 3 occurred after administration of the reversibility cue.

provement on Test 3 ($t(11) = 10.06, p < .001$). In Experiment 1, none of the very highly hypnotizable subjects showed any appreciable recovery of memory on Test 2, after the WAT. In Experiment 2, two subjects showed some improvement on Test 2 (recall = 4 and 12 items, respectively); however, both these subjects showed further recovery of memory on Test 3, after the amnesia was lifted, so the breach in amnesia observed after the CIT phase was only partial. (The subject who had recalled 12 items on Test 1 showed no improvement in memory on Test 2 and complete recovery of memory on Test 3.)

The average probability of recalling an item on Test 2, given that it had been elicited on the CIT, was 1.00 and .18, respectively, for the subjects of low and very high hypnotizability ($t(22) = 8.99, p < .001$). For all the hypnotizable subjects, amnesia was completely relieved only after administration of the reversibility cue.

Summary

Experiment 2 confirmed the results of Experiment 1: posthypnotic amnesia did not prevent the list items from being given as instances of relevant conceptual categories; the carry-over from the previous learning to the CIT was significant; and the reminder effect was minimal. There was, however, one important difference: while for the most part the amnesic and nonamnesic subjects showed similar carry-over effects, the nonamnesic subjects tended to cluster the critical items together in their lists of category instances, while amnesic subjects did not.

DISCUSSION

These two experiments, taken together, indicate that an amnesia for the items of a memorized word list can be induced and lifted by means of hypnotic suggestion. This is not a novel finding (Barber & Calverley, 1966; Coe, Taul, Basden, & Basden, 1973; Graham & Patton, 1968; Spanos & Bodorik, 1977; Williamsen et al., 1965); however, Experiment 1 is the first study to employ a subject sample which has been stratified on the basis of a rigorous classification of hypnotic susceptibility. The principal focus of this research, however, was on the very dense posthypnotic amnesia observed in the most highly hypnotizable subjects, its consequences for the retrieval of related material from "semantic" memory, and the possibility that the amnesia might be breached by reminders provided by the semantic memory tasks.

Amnesia and Retrieval from "Semantic" Memory

It appears that posthypnotic amnesia for a memorized word list does not have any adverse effects on the use of the list items themselves in ordinary vocabulary tasks such as word association and category instances. Prima facie evidence that amnesia was actually in effect in the subjects of very high hypnotizability was provided in both experiments by their extremely low levels of performance on the two recall tests which immediately surrounded the vocabulary tasks. The results of Experiment 1 showed that amnesic subjects, who could not remember (for example) having recently learned the word *thread* on a list, nevertheless gave the word as a free association to *needle* as often and as quickly as nonamnesic subjects. Experiment 2 yielded similar results with a category-instances procedure: subjects who could not remember having learned the word *elephant* gave it as an instance of *four-footed animal* often, and approximately as quickly, as nonamnesic subjects.

On the basis of this evidence it might seem that despite appearances the amnesic subjects actually remembered the critical material perfectly well. In fact, such a doubt has sometimes been raised by investigators who argue that posthypnotic amnesia is largely coterminous with the voluntary withholding of memory reports (Barber, 1969; Coe, 1978). Of course, to

the extent that memories are embedded in both episodic and semantic networks, the finding that memory for a word list is disrupted but vocabulary is unimpaired is not particularly troublesome. It may simply be taken to mean that the amnesia affects episodic but not semantic memory (Kihlstrom, 1977; Kihlstrom & Evans, 1979b).[2]

Of course, it would be useful to have empirical evidence as well as a theoretical rationale to support the proposition that the amnesic subjects did not have access to the memorized word list. Such evidence was not forthcoming in Experiment 1, in which amnesic and nonamnesic subjects behaved in precisely the same manner. Some relevant evidence was provided in Experiment 2, in which hypnotizability—and by extension amnesia—interacted with response latency and the clustering of targets within a list of category instances. The insusceptible subjects showed faster latencies to critical than to neutral targets and more clustering of critical than neutral targets. For the hypnotizable subjects there were no differences between critical and neutral targets in either respect. In Experiment 2 it appears that the insusceptible, nonamnesic subjects were able to capitalize on their awareness of the prior learning experience to produce an appropriate list of category instances. Occasionally, in fact, they would begin their lists with the very items that they had just learned. More typically they would employ some other strategy; once they hit upon a critical target, however, it would frequently be followed by one or more of the other critical targets. For these subjects, then, the critical targets elicited by the CIT tended to be clustered together and were produced in relatively rapid succession. The amnesic subjects did not show this tendency. The differences in strategy utilization indicate that the behavior of amnesic and nonamnesic subjects on the CIT was *not* identical and provide empirical evidence for the proposition that the amnesic subjects did not have conscious access to memories for the learning experience.

Priming Effects in Retrieval from Semantic Memory

In addition to the nonamnesic subjects' ability to capitalize on their learning experience in a strategic way, both experiments gave evidence of

[2] This is not to say that disruptions of semantic memory cannot also be induced by appropriate suggestion. The Stanford Profile Scales of Hypnotic Susceptibility, Forms I and II, contain suggestions for temporary, specific aphasia for the meanings of the words *house* and *scissors*, respectively. It is suggested that the subject will no longer know what the target word means, so that it will seem like a word in a foreign language. The suggestion is passed by approximately 40–50% of subjects in the moderate-to-high range of hypnotizability. Interestingly, some subjects show an agnosia as well as aphasia: a subject might be unable to understand *home* as well as *house*, or to demonstrate the use of scissors as well as to name them (Hilgard, 1965, 1977). Neither hypnotic aphasia nor agnosia has been studied systematically as yet.

a residual effect of the original learning episode on a subsequent task involving retrieval from "semantic" memory. Words that had been learned by subjects were more likely to be elicited by the WAT and CIT than appropriately matched control words that had not been previously learned; and at least in the case of the CIT, the first-appearing target items in learned categories were elicited more quickly than those in unlearned categories. The fact that this residual "priming" effect occurred in both amnesic and nonamnesic subjects suggests that the underlying cognitive processes took place outside of phenomenal awareness.

The priming effect observed here seems similar to one which occurs in patients diagnosed with the amnesic syndrome. The cardinal symptom of the syndrome is an apparently dense anterograde amnesia: new learning takes place slowly and forgetting occurs very rapidly. Nevertheless, while the patient cannot directly remember a prior event, it can still have an impact on ongoing behavior and experience. For example, Claparede (1911) pricked an amnesic patient with a concealed pin while shaking hands; she complained loudly, but grew calmer as she was occupied with other matters. When Claparede offered his hand again at the end of the examination she refused it. The patient did not remember the earlier injury, but explained that it had occurred to her that people sometimes concealed pins in their hands, and she did not want to be hurt. H.M., the famous case of bilateral hippocampal amnesia, was not aware in 1966 that his mother, with whom he had been living, had just been hospitalized; yet he was vaguely uneasy that something was the matter with one of his parents (Milner, Corkin, & Teuber, 1968). The literature on organic and functional amnesias contains many clear instances of a memory indirectly influencing subsequent behavior and experience, even though the person cannot directly remember the event itself (Hilgard, 1977; Kihlstrom & Evans, 1979a; Whitty & Zangwill, 1977).

Similar effects have been obtained in some recent formal experiments with amnesic patients. Warrington and Weiskrantz (1974) showed that amnesic patients were able to manifest at least partial long-term retention of a word list when recall was prompted by fragmentary (but not copy) cues. The effect was strongest when the targets came from a narrow range of possibilities. Rozin and Diamond (unpublished study cited by Rozin, 1976) were able to show that the superiority of cued to free recall held only for words that were familiar to the patients before the onset of their illness (e.g., *candy* and *number*) but not for pseudowords (e.g., *canber* and *numdy*). In their study, the effect of the cues dissipated after about 2 hr. Rozin (1976) attributed this effect to the activation of old memories by new learning experiences; even though the new memories were not encoded in retrievable form, the old encodings remained active for a time, much like vacuum tubes remain warm after a radio has been turned off.

Both the "hot tubes" effect in the amnesic syndrome and the "prim-

ing" effect in posthypnotic amnesia appear to stem from the residual effect of those perceptual–cognitive operations which were performed at the time of stimulus input (Craik & Lockhart, 1972; Jacoby & Craik, 1979; Lockhart, Craik, & Jacoby, 1976). These encoding operations entail the interaction between new stimulus information and preexisting schemata. Similar priming effects have been observed within the domain of semantic memory alone (Loftus, 1973; Meyer & Schvaneveldt, 1973; Rosch, 1975) and in the facilitation of new learning by a prior semantic memory task (Macht & Spear, 1977).

Reminder Effects in Posthypnotic Amnesia

Regarding the effects on amnesia of the WAT and CIT, it is apparent that although the procedure gave the amnesic subjects ample opportunity to be reminded of those words which they had learned while hypnotized, there was virtually no breach in amnesia among the most highly hypnotizable subjects. In Experiment 1, these subjects remembered an average of 1.3% of the total number of available items on the initial recall test of amnesia; they subsequently produced fully 81.1% of these same items on the word-association task; but on the amnesia test which followed immediately thereafter, recall was still limited to 4.0% of the items; following administration of the reversibility cue, the level of recall increased to 95.3%. The corresponding figures for their counterparts in Experiment 2 were 7.8, 58.8, 15.3, and 98.8%. The amnesic subjects occasionally noted a "special" quality to some of the critical targets produced by the WAT or CIT—that they seemed familiar or unusual in some way—but there was very little direct recognition that some of the items retrieved from semantic memory had previously been learned.

It is possible to argue that the amnesic subjects by and large did not perceive the intervening task as relevant to the amnesia tests and therefore that the reminder–failure claimed here is artifactual. However, all subjects had been informed in an initial telephone contact and again at the beginning of the experiment that they would learn a word list while hypnotized, and during the initial amnesia test they were explicitly reminded that they had memorized a word list and asked to recall the list items. Therefore, all the amnesic subjects were aware that they were experiencing a failure to recall some set of familiar words. This awareness should have formed a context in which they would profit from whatever reminders were provided by the semantic memory tasks. Further research is currently underway in which amnesic subjects receive direct recognition tests.

In many respects the results of this research are similar to those obtained by Tulving and his colleagues in studies of encoding specificity in retrieval (e.g., Tulving & Thomson, 1973; Watkins & Tulving, 1975).

These experiments have shown that words learned in the context of particular verbal cues may not be recognized when subsequently presented in the context of other verbal cues, but later may be successfully recalled when the subjects are prompted with the original cues. Similarly, the present study found that amnesic subjects did not recognize critical targets when they occurred as responses on a semantic memory task, but did recall them after hearing the prearranged reversibility cue. The Tulving procedure employs a single study trial and produces different verbal contexts for encoding and retrieval, thus providing evidence for encoding specificity in retrieval. In the present research, the acquisition trials continued until the subjects had mastered the list thoroughly, the amnesia suggestion was not administered until the list had been learned, and there was no comparable change in verbal context. Therefore the effect seems to involve one of "recoding specificity"—somehow the encoded material is rendered temporarily inaccessible to retrieval.

Finally, the results of this research shed further light on the nature of the cognitive processes underlying posthypnotic amnesia. For example, the ability of the amnesic subject to gain efficient access to semantic representations of the material covered by the amnesia seems inconsistent with a repression hypothesis. Repression is commonly held to render both particular memories and associated mental contents unconscious (Erdelyi & Goldberg, 1979), which is why Jung (1906), in his studies of word associations, found unusually long response latencies to "complex indicators." If repression were involved in posthypnotic amnesia, one would expect to find long response latencies to critical stimuli, if not a failure to produce critical targets.

The locus of retrieval deficit also does not appear to reside solely in the "search" process postulated by some versions of the classical two-stage theory of remembering, as has previously been suggested (Evans & Kihlstrom, 1973; Kihlstrom, 1977; Kihlstrom & Evans, 1979b). According to the two-stage theory, stimuli of the sort employed in the WAT and CIT should serve as extralist cues, facilitating the search process; and the copies of the targets themselves, frequently produced by the subjects during these procedures, should serve as recognition items, obviating search entirely. Yet the presence of the extralist and copy cues generally did not remind the amnesic subjects of the critical items.

A more useful construct for describing posthypnotic amnesia may be dissociation (Hilgard, 1977). The basic results supporting a dissociation view are those just cited: extralist and copy cues do little to enhance memory in densely amnesic subjects. Recent extensions of the "levels of processing" account of memory (Craik & Lockhart, 1972) to retrieval (Jacoby & Craik, 1979; Lockhart et al., 1976) hold that memorial activity involves the interaction of information present in the perceptual field with that contained in memory. Sufficient early overlap between the two kinds

of information supports reconstructive activity which continues until an adequate memory is formed. In the case of episodic memories, remembering involves, in the final analysis, reconstructing the spatiotemporal and experiential context in which the event originally took place. It appears that posthypnotic amnesia involves the temporary dissociation of these contextual features from the memory trace. This dissociation does not affect more generalized information about the episode such as the pronunciation and meaning of the individual words and their associations with other words in the mental lexicon; nor does it dampen the residual activation of the generalized schemata which supported perceptual–cognitive activities occurring during encoding. Further research is necessary to clarify the nature of this dissociation of contextual from generalized features of the memory trace (Reed, 1979) and to determine just how the amnesia suggestion and reversibility cue lead to the disruption and restoration of episodic memory.

In some respects posthypnotic amnesia seems similar to directed forgetting in the normal waking state (Bjork, 1972; Epstein, 1972). In both cases a subject encodes some set of new information and then receives an instruction to forget part or all of it. In procedural terms the parallels are especially strong between amnesia and that variant of directed forgetting involving postinput cuing by item sets (Bjork, 1972). In posthypnotic amnesia, however, the critical items are thoroughly learned before the amnesia suggestion is given. In any event, postinput cuing in the normal waking state produces little or no recall deficit (Epstein & Wilder, 1972), while—as demonstrated in the present experiment—in posthypnotic amnesia the impairment in recall can be very profound indeed. Until a direct comparison of the two phenomena is available, the differences between the two paradigms in terms of procedure and outcome preclude any comparison of the underlying mechanisms involved. For the present, it seems reasonable to suggest that posthypnotic amnesia should join directed forgetting as a technique for studying the self-control of remembering and forgetting.

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