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Subjective and Categorical Organization of Recall During Posthypnotic Amnesia

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Two experiments were performed to determine the fate of organization of recall during posthypnotic amnesia. In both studies, amnesia suggestions were administered to subjects of low, medium, and high hypnotic susceptibility who had learned a word list by the method of free recall while they were hypnotized. In Experiment 1, the words were unrelated to each other, and subjective organization was measured by raw and adjusted pair frequency (PF). In Experiment 2, the words were drawn from various taxonomic categories, and category clustering was measured by repetition ratio (RR), modified repetition ratio (MRR), and adjusted ratio of clustering (ARC). Compared to baseline levels, subjective organization and category clustering did not decrease reliably during the time the amnesia suggestion was in effect. Moreover, these aspects of strategic organization were not significantly correlated with the number of items recalled during amnesia. Both findings contrast with previous results concerning temporal organization of a word list memorized by the method of serial learning. The experiments suggest that the disruption of retrieval processes in posthypnotic amnesia may be limited to certain organizational schemes.

In posthypnotic amnesia, hypnotized subjects fail to recall the events and experiences that occurred while they were hypnotized (Hilgard, 1965; Kihlstrom, 1985a, 1985b). The amnesia is a phenomenon of suggestion, a fact that differentiates it from the unsuggested state-dependent retrieval often produced by psychoactive drugs. Moreover, the amnesia can be reversed and memory restored following administration of a cue established at the time the original suggestion was given. During the time that the amnesia suggestion is in effect, the extent of recall deficit is correlated with individual differences in measured hypnotizability.

Reversibility marks posthypnotic amnesia as a failure of memory retrieval. In attempting to understand this phenomenon, some investigators have used organization theory, an approach within cognitive psychology that focuses on the relations among items stored in memory (Bower, 1972; G. Mandler, 1979; J. Mandler, 1979; Tulving, 1962). Organization theory exists in various forms, but all agree that recall succeeds when the retrieval process follows the organization of the to-be-remembered material. From the point of view of organization theory, then, the retrieval disruption in posthypnotic amnesia may reflect, at least in part, a disruption of the organized process of memory retrieval. A number of investigators have tested this hypothesis in individuals showing partial posthypnotic amnesia—hypnotizable subjects who, despite a suggestion for complete amnesia, recall sufficient material during amnesia to permit analysis of its organization.

The earliest research along these lines examined temporal organization. For example, on the standardized scales of hypnotic susceptibility, subjects are hypnotized and then receive a series of test suggestions, including one for posthypnotic amnesia. Evans and Kihlstrom (1973) observed that hypnotizable subjects, presumably experiencing at least partial amnesia, showed less tendency than insusceptible subjects to recall test items in the order in which they had occurred. This difference was again obtained in subsequent samples analyzed by Kihlstrom and Evans (1979), who also showed that temporal disorganization was not observed when the amnesia suggestion was omitted from the procedure.

Geiselman et al. (1983) also observed the effect, as well as a similar phenomenon in directed forgetting in the normal waking state (for a comparison of posthypnotic amnesia and directed forgetting, see Kihlstrom, 1983). However, two other investigations largely failed to replicate the temporal effect and criticized the methodology by which the original findings were obtained (Radtke & Spanos, 1981; St. Jean & Coe, 1981; see also Radtke, Spanos, Della Malva, & Stam, 1986). In an experiment that addressed all of these criticisms, Kihlstrom and Wilson (1984) showed that temporal organization in a word list memorized by the method of serial learning is disrupted during posthypnotic amnesia, and that the extent of the disruption is highly correlated with the extent of partial amnesia.

Other studies have examined the fate of other forms of organization during posthypnotic amnesia. For example, when sub-

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jects learn a list of words, they tend to recall items belonging to the same conceptual category together—a phenomenon known as *category clustering* (Bousfield, 1953). In clustering experiments, the subjects pick up on an organizational structure that was determined by the experimenter when composing the list. However, even when the items are explicitly unrelated to each other, subjects tend to recall the items in consistent clusters and strings—a phenomenon known as *subjective organization* (Tulving, 1962).

Although an early investigation found that category clustering was not disrupted during posthypnotic amnesia (Coe, Taul, Basden, & Basden, 1973), more recent investigations have consistently obtained a disruption of category clustering following hypnotic suggestions for amnesia (Radtke-Bodorik, Planas, & Spanos, 1980; Radtke-Bodorik, Spanos, & Haddad, 1979; Spanos & Bodorik, 1977; Spanos & D'Eon, 1980). Moreover, the clustering was related to extent of amnesia: The subjects who recalled only some of the items showed more disorganization than those who recalled the entire list. Interestingly, this disorganization effect is not found consistently in unhypnotized subjects who are administered task-motivation suggestions (Spanos & Bodorik, 1977; Radtke-Bodorik et al., 1979, 1980; Spanos, Stam, D'Eon, Pawlak, & Radtke-Bodorik, 1980) or in insusceptible subjects instructed to simulate hypnosis (Spanos, Radtke-Bodorik, & Stam, 1980; see also Spanos, Radtke, Bertrand, Addie, & Drummond, 1982).

With regard to subjective organization, the first relevant experiment was performed by Spanos, Radtke-Bodorik, and Shabinsky (1980), using a list of eight unrelated words. Although their data seemed to show a loss of subjective organization during amnesia, the detailed findings differed from the clustering results in a number of respects. For example, hypnotized and task-motivated subjects showed equivalent levels of disorganization during amnesia, and the disorganization effect was observed in both partially amnesic and nonamnesic subjects. Moreover, there was no return of organization after the amnesia suggestion was canceled. In a later study, Tkachyk and her colleagues (Tkachyk, Spanos, & Bertrand, 1985) hypothesized that these results reflected a floor effect: Because the subjects showed extremely low baseline levels of organization at the end of the acquisition phase, there was little opportunity for organization levels to decrease during amnesia. In a new experiment, Tkachyk et al. carried out further acquisition trials; this resulted in higher baseline levels of subjective organization before amnesia, a loss of organization during amnesia, and a return to baseline levels after the amnesia suggestion was canceled. Interestingly, an equivalent loss of subjective organization was shown by unhypnotized subjects who were required to perform a distracting task during the amnesia test.

The experiments of Spanos, Radtke, Tkachyk, and their colleagues appear to show that category clustering and subjective organization, as well as temporal organization, are disrupted by hypnotic suggestions for amnesia. However, most of their studies used very short lists—eight or nine items long—as stimulus materials (the study by Radtke-Bodorik et al., 1980, is the only exception). Although organization is usually considered to be important to retrieval from secondary or long-term memory, lists of such length fall within or near the capacity of primary or short-term memory. Moreover, the studies of subjective organization failed to find an association between the degree of subjective organization displayed during amnesia and the hypnotizability of the subject. This is in contrast to the findings of the temporal organization studies by Kihlstrom and his colleagues (Evans & Kihlstrom, 1973; Kihlstrom & Evans, 1979; Kihlstrom & Wilson, 1984). Accordingly, it seemed desirable to continue to examine the generality of the disorganization effect. The present experiments explored the fate of category clustering and subjective organization during posthypnotic amnesia, using lists that make more demands on subjects' strategies for long-term memory retrieval.

Experiment 1

This study was intended as a replication and extension of the previous studies of subjective organization.

Method

Subjects

The 44 participants in this study were drawn from a pool of University of Wisconsin undergraduates who previously had 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), and high (8–10) in hypnotizability, with 10 subjects in each of the low and medium groups and 22 subjects in the high group. Subjects of very high hypnotizability (scoring 11–12 on the 12-point SHSS:C) were not included in the experiment because they typically show too dense an amnesia to permit calculation of organization scores (Kihlstrom, 1980). In the experiment itself, all subjects were treated as if they were hypnotizable. In return for their participation in the experiment, the subjects received $4 or points toward the extra-credit option of their introductory psychology course, for a single experimental session lasting approximately 60 min.

Stimulus Materials

A 20-item word list was prepared, consisting of the third most frequently given instances of the first 20 categories of Battig and Montague (1969).

Procedure

Subjects were recruited for an experiment on hypnosis and learning. At the beginning of the experimental session, each subject was hypnotized using the standard induction procedure of SHSS:C. The subjects then learned the word list by the method of free recall. The word list was read to the subjects in a different random order on each trial at the rate of one word every 3 s; oral recall followed 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. 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. . . ." (Kihlstrom, 1980, p. 232)

After termination of hypnosis, the subjects were asked to recall any words that they remembered learning during the experiment. The experimenter then administered the prearranged reversibility cue to cancel the amnesia suggestion, and a final recall test. On each test, recall continued until the subjects indicated that they had reached an impasse. Finally, the subjects were interviewed about their experiences during the session, debriefed, and dismissed.

Choosing an Index of Subjective Organization

A generalized index of the subjective organization of recall is the pair frequency (PF) measure of bidirectional intertrial repetitions—a statistic based on the number of words appearing in the same adjacent output positions on two successive recall trials. The formula includes a correction for chance, and Sternberg and Tulving (1977) have shown that PF is superior on both psychometric and theoretical grounds to all other available indices of subjective organization. However, the value of PF is dependent on the number of items recalled by the subject, with higher values of PF made possible by higher levels of recall (Kihlstrom & Wilson, 1984). This situation raises the possibility that any diminution of PF observed during amnesia might be an artifact of ceiling effects produced by the diminished number of items recalled by the subject.

The problem may be corrected by calculating the ratio of the obtained PF to the maximum possible PF, given the number of items recalled (Kihlstrom & Wilson, 1984; Pellegrino & Huber, 1982; Pellegrino & Ingram, 1979). Because this correction is controversial (Sternberg & Tulving, 1977), it seemed appropriate to analyze the data using both raw and adjusted PF scores. In the case of the adjusted scores, a value of 1.00 indicates that the subjective organization of the recalled items has been preserved, even though the overall number of items recalled may have been reduced. The adjusted PF score used here is identical to the ARC' measure proposed by Pellegrino and his colleagues. Although Spanos, Radtke-Bodorik, and Shabinsky (1980) analyzed only raw PF scores, Tkachyk et al. (1985) obtained their effects regardless of whether PF or ARC' was used as the measure of subjective organization.

Results

The subject selection procedure ensured that the three experimental groups would differ substantially in hypnotizability as measured by SHSS:C. In addition, the experimental procedure guaranteed that all subjects would show a high level of mastery of the word list before amnesia was suggested. Of the 44 subjects who participated in the experiment, 2 subjects (both of high hypnotizability) were excluded because they failed to reach the criterion of learning within 15 trials.

Although posthypnotic amnesia has been obtained with memorized word lists in several studies (e.g., Hilgard & Hommel, 1961; Kihlstrom, 1980; Spanos & Bodorik, 1977), most of these studies have employed subjects spanning the full range of hypnotizability. In the present study, by contrast, the most highly hypnotizable subjects—that is, those most likely to respond positively to the amnesia suggestion—were deliberately excluded from the sample. Although amnesia has been obtained under such circumstances (Kihlstrom & Wilson, 1984), the restricted range of hypnotizability considered in this study made it desirable to confirm the effectiveness of the suggestion in the present sample, as a manipulation check.

Accordingly, a 3 × 3 mixed-design analysis of variance (ANOVA) with one between-groups variable (level of hypnotizability) and one within-subjects variable (repeated tests) was applied to the number of items recalled on each trial. The interaction was significant, $F(4, 78) = 3.49$, $p < .05$. The three groups showed equivalent levels of recall on Trial 1, the final learning trial ($M = 19.45$ items), and Trial 3 after the amnesia suggestion was canceled ($M = 18.69$). On Trial 2, during suggested amnesia, subjects of high hypnotizability recalled significantly fewer items ($M = 13.36$, $SD = 6.73$) than the subjects of low ($M = 18.30$, $SD = 2.36$) or medium ($M = 17.70$, $SD = 2.75$) hypnotizability. Thus, the suggestion for amnesia was successful in that it produced a recall deficit as a function of hypnotizability. A total of 2 subjects (both of high hypnotizability) recalled too few items (less than 4) to permit meaningful analysis of subjective organization. Accordingly, they were eliminated from further consideration and all remaining analyses were performed on a final sample of 40 subjects: 10 low-, 10 medium-, and 20 high-hypnotizability subjects.

Initial Learning

There were no group differences in the number of trials required to reach criterion during the acquisition phase (overall $M = 8.80$, $SD = 2.83$), $F < 1$. The degree of subjective organization shown at the conclusion of the acquisition phase was determined by calculating raw PF from the penultimate and final learning trials. The three groups were equivalent on this measure as well (overall $M = 5.42$, $SD = 2.23$), $F < 1$. Thus, the three groups were also comparable in terms of degree of initial learning. The maximum PF possible in a list of 20 items is 17.1; thus, the overall mean translates into an adjusted PF of 0.32.

Hypnotizability, Recall, and Subjective Organization

Because disorganization is hypothesized to be an aspect of posthypnotic amnesia, hypnotizable subjects should show greater disorganization than those who are insusceptible to hypnosis. Table 1 presents the average number of items recalled and the average values of raw and adjusted PF for the hypnotizability groups on each of the three tests of recall: Test 1, the final trial of the acquisition phase; Test 2, during suggested posthypnotic amnesia; and Test 3, after the amnesia suggestion was canceled by the prearranged reversibility cue. For Test 1, PF was calculated considering the penultimate and final trials of the acquisition phase; for Tests 2 and 3, the subjective organization established on the final acquisition trial served as the standard.

Recall. A 3 × 3 mixed-design ANOVA with one between-subjects factor (hypnotizability) and one within-subjects factor (repeated recall tests) applied to the recall scores yielded significant main effects of both hypnotizability, $F(2, 37) = 3.83$, $p < .05$, and trials, $F(2, 74) = 10.43$, $p < .001$. With the removal of the two densely amnesic subjects from the high hypnotizability group, however, the interaction no longer reached acceptable

Table 1
Subjective Organization of Recall for Subjects Classified by Hypnotizability

	Hypnotizability of subject								
	Low			Medium			High		
Variable	T1	T2	T3	T1	T2	T3	T1	T2	T3
Number of items recalled									
M	19.60	18.30	19.80	19.40	17.70	18.50	19.45	14.60	18.30
SD	0.52	2.36	0.42	0.51	2.75	1.08	0.99	5.68	1.53
Raw PF									
M	5.92	5.99	5.42	4.72	4.24	4.96	5.52	3.69	5.34
SD	4.15	3.44	4.20	3.56	3.56	3.08	2.62	2.30	2.81
Adjusted PF									
M	0.37	0.38	0.32	0.30	0.28	0.32	0.35	0.32	0.35
SD	0.26	0.19	0.25	0.23	0.21	0.19	0.16	0.16	0.17

Note. T1 = Trial 1; T2 = Trial 2; T3 = Trial 3; PF = pair frequency; adjusted values are equivalent to ARC'.

levels of statistical significance, $F(4, 74) = 2.49$, $p < .10$—although the trend was in the predicted direction. A planned contrast was performed, predicting that subjects in the high hypnotizability group would show a recall decrement on Trial 2 compared to levels of recall shown on Trials 1 and 3. The trend proved nonsignificant, $F(2, 37) = 2.36$, although again it was in the predicted direction.

Subjective organization. A similar 3 × 3 mixed-design ANOVA applied to the raw PF scores revealed no significant main effects of hypnotizability, $F < 1$, or trials, $F(2, 74) = 1.35$, nor was there a significant Hypnotizability × Trials interaction, $F(4, 72) = 1.29$—although again the trends were in the predicted direction. The planned contrast was not significant, $F(2, 37) = 2.15$.

When the 3 × 3 ANOVA was applied to the adjusted PF scores, there were again no significant effects, all Fs < 1. In addition, the planned comparison was not significant, $F < 1$.[1]

Subjective Organization and Amnesia

Although the disorganization hypothesis, as stated by Evans & Kihlstrom (1973; see also Kihlstrom & Wilson, 1984) applies in principle to all hypnotizable subjects who fail to show complete amnesia, Spanos and his colleagues have noted that the extent of disorganization observed during amnesia should be a function of the extent of amnesia (e.g., Spanos & Bodorik, 1977; see also Kihlstrom & Evans, 1979). Following the procedure used by Kihlstrom & Wilson (1984), a recall deficit index of amnesia response was calculated for each subject as the difference in items recalled between Trial 1 (before amnesia) and Trial 2 (during amnesia); similarly, a reversibility index of amnesia was calculated as the difference between Trial 3 (after amnesia) and Trial 2 (during amnesia). For both indices, higher scores indicate greater amnesia. The two amnesia indices were highly correlatd, $r = .96$, $p < .001$. Table 2 shows that there were no correlations between either index of amnesia and raw or adjusted PF on Trials 1 or 3, before the amnesia suggestion was given or after it was canceled, all ps > .05. During amnesia, on Trial 2, there were significant correlations between both indices of amnesia and raw PF, both ps < .01; however, the corresponding correlations with adjusted PF were negligible, both ps > .05.

Disorganization and Initial Levels of Organization

Tkachyk et al. (1985), reflecting on the anomalous findings of Spanos, Radtke-Bodorik, and Shabinsky (1980), argued that disorganization can be observed during amnesia only when subjects show a level of organization high enough to reflect a decrease. In their experiment, the predicted disorganization effect was obtained in subjects who had built up relatively high levels of organization during learning, by virtue of being given overlearning trials, as opposed to subjects for whom the learning phase was terminated as soon as they met a standard criterion of list mastery. Therefore, it could be that the failure to find a disruption of subjective organization in this study reflects a similar floor effect. However, the levels of subjective organization displayed by the subjects on the final trial of the acquisition phase in the present experiment (mean adjusted PF = 0.32) are quite comparable to those displayed in the Tkachyk et al. (1985)

[1] Additional relevant data were provided incidentally by an earlier experiment (Kihlstrom, 1980). Subjects were stratified into groups of low, medium, high, and very high hypnotizability. After mastering a list of 15 unrelated words while hypnotized, they were given suggestions for amnesia, awakened, and asked to recall the items. Two recall tests and an intervening word-association test were administered during amnesia, and a final recall test was conducted after the amnesia suggestion was canceled. A total of 13 subjects had to be eliminated from the present analysis because they recalled too few items (less than 4) to permit meaningful analysis of the organization of recall. These eliminated subjects included all 10 in the very high hypnotizability group; the remaining 3 were of high hypnotizability. Compared to the levels achieved during the acquisition phase, those hypnotizable subjects who recalled some critical items during the amnesia test showed no deficit in subjective organization, as measured by either raw or adjusted PF scores. For example, both planned contrasts were nonsignificant, $F < 1$. Although the sample of hypnotizable subjects is small, the null findings are consistent with those reported here and, in fact, were the motivation for Experiment 1.

Table 2
Correlation Between Subjective Organization and Recall During Amnesia

Subjective organization	Recall deficit[a]	Reversibility[b]
Raw PF		
Trial 1	.08	.07
Trial 2	−.48*	−.47*
Trial 3	.13	.15
Adjusted PF		
Trial 1	.08	.07
Trial 2	.05	.06
Trial 3	.17	.17

Note. $N = 40$. PF = pair frequency.
[a] Recall on Trial 1 − recall on Trial 2. [b] Recall on Trial 3 − recall on Trial 2.
* $p < .01$.

experiment by the subjects in the overlearning group (mean ARC′ = 0.37), and by those subjects in the standard criterion group whose baseline organization scores were above the median (mean ARC′ = 0.29). Thus, differences in baseline levels of subjective organization are not likely to account for differences in the results of the two studies.

Nevertheless, the subjects were classified according to median splits applied to their raw (median = 5.10) and adjusted PF (median = 0.31) scores for Trial 1, the final trial of the acquisition stage. The level of organization at acquisition then became a blocking variable for analysis of organization scores. Table 3 presents the results. Reanalysis of the data by a $2 \times 3 \times 3$ mixed-design ANOVA with two between-subjects factors (above or below the median PF and hypnotizability) and one within-subjects factor (trials) to the raw PF scores revealed a marginal interaction of initial organization with trials, $F(2, 68) = 3.05$, $p < .10$; but the three-way interaction involving initial organization, hypnotizability, and trials did not reach significance, $F(4, 68) = 1.30$. A planned contrast predicted that subjects of high hypnotizability with high levels of initial organization would show a greater decrement in subjective organization than would other subjects. This contrast was not significant, $F(2, 34) = 1.22$.

A similar ANOVA applied to the adjusted PF scores again yielded a significant interaction of initial organization with trials, $F(2, 68) = 3.87$, $p < .01$; however, the three-way interaction was not significant, $F(4, 68) = 1.07$. The planned contrast was not significant, $F < 1$.

Experiment 2

In light of the findings of Experiment 1, in which no evidence of a disruption of subjective organization was obtained, a further experiment was conducted to reexamine the fate of category clustering.

Method

Subjects

The 59 subjects in this experiment were drawn from the same student pool as in Experiment 1, although none had participated in the prior experiment. As before, the subjects were classified as low (0–4, $N = 10$), medium (5–7, $N = 10$), and high (8–10, $N = 20$) in hypnotizability on the basis of their SHSS:C scores. The subjects received $4, or extra-credit points, in return for their participation.

Stimulus Materials

The two 16-item word lists employed by Kihlstrom (1980, Experiment 2) were used in this experiment. All of the words were high-frequency exemplars of common taxonomic categories, with four items in each of four categories (Battig & Montague, 1969). One half of the subjects learned one list, and one half learned the other; because there were no list effects, data from the two lists were combined in the analyses.

Procedure

The procedure for Experiment 2 directly paralleled that of Experiment 1. Study–test cycles continued until the subject reached a criterion of two perfect repetitions. Following the acquisition phase, subjects received the amnesia suggestion, termination of hypnosis, initial recall tests, reversibility cue, and final recall test. After a postexperimental inquiry, subjects were debriefed and dismissed.

Choosing an Index of Category Clustering

As in the case of subjective organization, there has been some debate concerning the comparative merits of various measures of category clustering (Murphy, 1979; Murphy & Puff, 1982). The original repetition ratio (RR) measure of Bousfield (1953) was promoted by Frender and Doubilet (1974) on the ground that it is not influenced by the number of items recalled; however, it does not take into account the level of clustering that might be observed by chance. The modified repetition ratio (MRR) expresses the ratio of obtained repetitions to the maximum number of repetitions possible, given the number of items recalled. Neither of these measures, however, incorporates a correction for chance. The adjusted ratio of clustering (ARC) of Roenker, Thompson, and Brown (1971) incorporates such a correction and also expresses clustering as a ratio of obtained to maximum possible repetition. It is generally considered to be the index of choice, although it does suffer from one disadvantage: It is undefined when all of the items are recalled from just a single category, or when each item is recalled from a different category. The MRR is undefined under the latter condition as well. However, RR is undefined only when recall is zero. Accordingly, all three indices of clustering were used in this experiment.

Results

Again, the selection procedure ensured that the subject groups would differ substantially in hypnotizability as measured by SHSS:C. A single highly hypnotizable subject failed to reach the criterion of learning within 15 trials and was excluded from the study.

As in Experiment 1, a 3×2 mixed-design ANOVA with one between-groups variable (level of hypnotizability) and one within-subjects variable (repeated tests) was applied to the number of items recalled on each trial. Again, the interaction was significant, $F(4, 110) = 7.78$, $p < .001$. The three groups showed equivalent levels of recall on Trials 1 and 3 (both Ms = 16.00). On Trial 2, during suggested amnesia, subjects of high hypnotizability recalled significantly fewer items ($M = 6.81$, $SD = 6.67$) than those of low ($M = 14.50$, $SD = 2.55$) or medium ($M = 11.73$, $SD = 5.82$) hypnotizability. Thus, the amne-

Table 3
Subjective Organization of Recall for Subjects Classified by Hypnotizability and Baseline Level of Organization

	Hypnotizability of subject								
	Low			Medium			High		
Subjective organization	T1	T2	T3	T1	T2	T3	T1	T2	T3
Raw PF									
Below median									
M	2.28	4.08	1.65	2.42	2.07	3.28	4.00	3.60	5.06
SD	2.38	3.72	2.08	2.02	2.11	2.64	0.91	1.88	2.31
Above median									
M	8.34	7.27	7.94	8.18	7.50	7.48	7.80	3.83	5.76
SD	3.16	2.85	3.19	2.16	2.65	1.69	2.72	2.97	3.57
Adjusted PF									
Below median									
M	0.14	0.26	0.10	0.15	0.16	0.22	0.26	0.33	0.34
SD	0.15	0.21	0.13	0.13	0.17	0.18	0.06	0.14	0.14
Above median									
M	0.52	0.46	0.47	0.51	0.47	0.47	0.46	0.31	0.37
SD	0.20	0.14	0.19	0.16	0.12	0.10	0.17	0.20	0.21

Note. T1 = Trial 1; T2 = Trial 2; T3 = Trial 3; PF = pair frequency.

sia suggestion appeared to have its predicted effect on highly hypnotizable subjects. A total of 18 subjects (1 of medium, 17 of high hypnotizability) recalled too few items (less than 4) to permit meaningful analysis of subjective organization. Accordingly, they were eliminated from further consideration and all remaining analyses were performed on a final sample of 40 subjects: 10 low-, 10 medium-, and 20 high-hypnotizability subjects.

Initial Learning

There were no group differences in the number of trials required to reach criterion during the acquisition phase (overall $M = 4.63$, $SD = 1.63$), $F < 1$. The RR, MRR, and ARC measures of category clustering were also calculated for the final acquisition trial: None of these showed any group differences (e.g., ARC, overall $M = 0.94$, $SD = 0.16$), all Fs < 1. All of the subjects showed above-chance degrees of category clustering, as measured by MRR and ARC, and indeed all of the subjects showed very high (if not perfect) clustering scores. Thus, the three groups were comparable in terms of initial learning, and the structure imposed by subjects on their lists strongly followed the categorical relations among the items.

Hypnotizability, Recall, and Category Clustering

Table 4 presents the average number of items recalled and the average values of RR, MRR, and ARC for the hypnotizability groups on each of the three tests of recall: Test 1, the final trial of the acquisition phase; Test 2, during suggested posthypnotic amnesia; Test 3, after the amnesia suggestion was canceled by the prearranged reversibility cue.[2]

Recall. A 3 × 3 mixed-design ANOVA with one between-subjects factor (hypnotizability) and one within-subjects factor (repeated recall tests) applied to the number of items recalled yielded a significant main effect of trials, $F(2, 74) = 14.46$, $p < .001$; however, there was no significant effect of hypnotizability, $F(2, 37) = 1.02$, and no interaction, $F(4, 74) = 1.15$. The planned comparison failed to show a significant decrement in recall on Test 2 among subjects of high hypnotizability, $F(2, 37) = 1.16$, *ns*.

Category clustering. A similar ANOVA was applied to the various clustering scores. There were no significant main effects and no interactions on any measure of clustering. For example, for ARC, the main effect of hypnotizability was nonsignificant, $F(2, 37) = 1.27$, as was the main effect of trials, $F(2, 74) = 1.87$, and the Hypnotizability × Trials interaction, $F < 1$. Nor did any of the planned comparisons show significant effects. For example, for ARC, $F < 1$. Thus, there was no overall decrement in either recall or clustering among hypnotizable subjects during posthypnotic amnesia.

Category Clustering and Amnesia

Each of the indices of clustering was correlated with each of the continuous indices of amnesia response, recall deficit and

[2] The pattern of recall displayed by 3 other subjects did not permit calculation of at least one measure of category clustering during Trial 2. Two subjects each recalled 4 items, all from the same category. For these subjects, adjusted ratio of clustering (ARC) was indeterminate, although repetition ratio (RR) and modified repetition ratio (MRR) were both 1; these subjects were assigned ARC scores of 1.00 for the purpose of the statistical analysis (their recall was perfectly clustered by category). One subject recalled 4 items, each from a different category. For this subject, MRR and ARC were indeterminate, although RR was 0; this subject was assigned MRR and ARC scores of 0.00 for the purpose of the statistical analysis (this subject displayed no clustering of items by category). None of the results reported here would change materially if these subjects were excluded from the analysis.

Table 4
Category Clustering of Recall for Subjects Classified by Hypnotizability

	Hypnotizability of subject								
	Low			Medium			High		
Variable	T1	T2	T3	T1	T2	T3	T1	T2	T3
Number of items recalled									
M	16.00	14.50	15.80	16.00	12.60	15.90	16.00	12.70	15.90
SD	0.00	2.55	0.63	0.00	5.32	0.32	0.00	5.10	0.31
RR									
M	0.78	0.75	0.80	0.77	0.82	0.79	0.75	0.65	0.77
SD	0.04	0.09	0.01	0.06	0.11	0.02	0.12	0.25	0.06
MRR									
M	0.98	0.94	1.00	0.97	0.98	0.99	0.94	0.86	0.97
SD	0.06	0.10	0.00	0.08	0.08	0.03	0.16	0.32	0.08
ARC									
M	0.97	0.91	1.00	0.95	0.96	0.99	0.92	0.85	0.96
SD	0.07	0.16	0.00	0.11	0.12	0.04	0.21	0.38	0.11

Note. T1 = Trial 1; T2 = Trial 2; T3 = Trial 3. RR = repetition ratio; MRR = modified repetition ratio; ARC = adjusted ratio of clustering.

reversibility. The two indices themselves were highly correlated, $r = .99$, $p < .001$. Table 5 shows that all the correlations were low and nonsignificant (all $ps > .05$). In particular, there was no correlation between either index of amnesia and the level of category clustering observed on Trial 2, during amnesia.

Disorganization and Levels of Initial Clustering

Because all of the subjects showed extremely high levels of clustering on the final trial of the acquisition phase, no attempt was made to take account of floor effects on Trial 2 levels of organization.

List Structure and Amnesia

In this experiment, a total of 37 highly hypnotizable subjects had to be recruited in order to produce a final sample of 20 eligible subjects: The remaining 17 subjects recalled too few items during the amnesia test to permit analysis of category clustering. This situation was in contrast to Experiment 1, in which only 22 highly hypnotizable subjects were required to obtain a final sample of 20 subjects with at least partial recall during posthypnotic amnesia. Interestingly, in an earlier experiment on serial learning (Kihlstrom & Wilson, 1984), which employed selection criteria identical to those used here, only 18 subjects were required to fill a sample of 15. In other words, 47.3% of highly hypnotizable subjects (17/37) who memorized the categorized list in Experiment 2 responded with complete amnesia, whereas only 16.7% of subjects who memorized the randomly arranged list (4/24) and another 16.7% of subjects who memorized the serial list in the earlier study (3/18) did so. The difference among the conditions is statistically significant, $\chi^2(2) = 7.97$, $p < .05$.

Of the subjects retained in the final samples, 45% of those who memorized the categorized list in Experiment 2 (9/20) recalled all of the items on the test for posthypnotic amnesia, whereas 16% of those given the random list in Experiment 1 (4/20) and only 6.7% of the subjects given the serial list in the earlier experiment (1/15) did so. Again, the difference among the conditions is significant, $\chi^2(2) = 7.13$, $p < .05$.

Table 5
Correlation Between Category Clustering and Recall During Amnesia

Category clustering	Recall deficit[a]	Reversibility[b]
RR		
Trial 1	.14	.17
Trial 2	−.30	−.29
Trial 3	.06	.09
MRR		
Trial 1	.14	.17
Trial 2	−.29	−.29
Trial 3	.07	.09
ARC		
Trial 1	.14	.17
Trial 2	−.29	−.28
Trial 3	.07	.09

Note. $N = 40$. RR = repetition ratio; MRR = modified repetition ratio; ARC = adjusted ratio of clustering.
[a] Recall on Trial 1 − recall on Trial 2. [b] Recall on Trial 3 − recall on Trial 2.

General Discussion

The experiments reported here used conventional verbal-learning procedures to study the fate of organized recall in posthypnotic amnesia. The list items were presented to the subjects in a random order; as is commonly observed in multitrial free-recall learning, the subjects developed a consistent organizational structure on this material as they committed it to memory. At issue in this experiment was the fate of organized recall during posthypnotic amnesia. In Experiment 1, in which the items were explicitly unrelated to each other, subjective organization did not diminish significantly during the time that the amnesia suggestion was in effect. In Experiment 2, in which the

words were instances of various taxonomic categories, there was no effect on category clustering. Moreover, the amount of subjective organization and category clustering was not significantly correlated with the number of items recalled during amnesia. Both findings contrast with previous results concerning temporal organization of a word list memorized by the method of serial learning (Kihlstrom & Wilson, 1984). In addition, the findings of the present study diverge in salient ways from results obtained in other investigations of subjective organization and category clustering (e.g., Spanos & Bodorik, 1977; Tkachyk et al., 1985).

The results of Experiment 1 parallel those of Spanos, Radtke-Bodorik, and Shabinsky (1980) in failing to find an effect of amnesia suggestions on subjective organization. Tkachyk et al. (1985) argued that this failure may have been caused by the low baseline levels of organization developed by the subjects in the earlier experiment. Consistent with their hypothesis, Tkachyk et al. (1985) found a significant decrement following amnesia suggestions for those subjects who had attained relatively high levels of organization by virtue of an overlearning schedule. However, the results of Experiment 1 do not seem to be an artifact of this kind of floor effect. First, the overall levels of subjective organization achieved by our subjects were comparable to those achieved by the subjects of Tkachyk et al.: mean adjusted PF = 0.32 vs. 0.37, respectively. Moreover, our subgroup of subjects with high baseline organization showed higher levels of subjective organization at the conclusion of the acquisition trials than did the subjects in their overlearning condition: mean adjusted PF = 0.44 versus 0.37. In fact, our subgroup with *low* baseline levels of organization showed more organization than did their subjects who were given the standard learning regime: mean adjusted PF = 0.25 versus 0.15, respectively. Thus, the failure of the subjects in the present experiment to show a loss of subjective organization during amnesia was not because they failed to organize the material in the first place.

Similarly, the results of Experiment 2 parallel those of Coe et al. (1973), who failed to find an amnesic effect on category clustering. Radtke-Bodorik et al. (1980) argued that this was attributable to poor levels of initial learning (and thus low baseline clustering); they reported a significant effect of amnesia on clustering when subjects were given more opportunity to master the list. However, their criticism does not apply in the present case, because our subjects (unlike theirs) showed complete mastery of the list during the acquisition phase (mean recall = 100% vs. 82.2%) and even *higher* baseline levels of clustering (mean ARC = 0.94 vs. 0.89). Even if low baseline organization accounted for the results of Experiment 1, some other principle would have to be offered to account for the results of Experiment 2.

The raw PF results of Experiment 1 did show a trend, approaching statistical significance, toward a temporary diminution of subjective organization during amnesia. Thus, it is possible to argue that our design simply lacked power to detect an effect of amnesia on subjective organization. However, note that even this trend disappeared entirely when the more appropriate adjusted PF scores were analyzed. Moreover, the number of subjects (40) in Experiment 1 compares favorably to the number of subjects (39) in the hypnotic condition of Tkachyk et al. (1985). More important, perhaps, Kihlstrom and Wilson (1984), using both raw and adjusted measures of organization in a design that included only 35 subjects, obtained profound effects of amnesia on temporal organization. If there were effects of amnesia on subjective organization and category clustering in our study, they were very weak indeed, much weaker than the effect on temporal organization observed in the earlier study.

In the experiments of Tkachyk et al. (1985) and Radtke-Bodorik et al. (1980), the extent of the disorganization effect was a function of the degree of amnesia exhibited by the subjects. That is, subjects who recalled relatively few items on the amnesia test showed more disorganization than did those who recalled all, or virtually all, of the critical items. In the present experiments, however, there was no correlation between amnesia and disorganization. The predicted negative correlation did appear on Experiment 1 when raw PF scores were analyzed, but this (like the trends observed in the ANOVAs) is probably an artifact of ceilings imposed on raw PF scores by the number of items recalled. When adjusted PF scores were entered into the calculation, the correlation disappeared, even though many subjects showed partial amnesia. Furthermore, no significant correlations were obtained with any of the measures of clustering in Experiment 2. Although the effect of the amnesia suggestion appears sharply reduced when the densely amnesic subjects are removed from the sample, there still remained enough variation in recall during amnesia (4–20 items in Experiment 1, 4–16 items in Experiment 2) that the correlations between amnesia and disorganization were not prevented from occurring by statistical artifacts such as restriction of range. Substantial correlations could have appeared in the data. This adds weight to our assertion that our failure to find significant effects on subjective organization and category clustering during amnesia reflects more than merely low power (Greenwald, 1975).

Nevertheless, we do not wish to conclude that the findings of Radtke, Spanos, Tkachyk, and their colleagues are incorrect. Most of the studies that found significant effects of amnesia on subjective organization and category clustering have used very short word lists, only 8 or 9 items long. The single exception is the study of Radtke-Bodorik et al. (1980), which used a list of 35 words. In that study, however, the disorganization effect was very weak: In the group of partial amnesics, clustering (measured by ARC) dropped from 0.89 on the final learning trial to 0.80 during amnesia, and rose to 0.98 after amnesia was canceled. By contrast, Spanos, Stam, et al. (1980), combining data from three experiments, reported corresponding ARC values (estimated from their Figure 2) of 0.78, 0.56, and 0.80; similarly, Spanos and D'Eon (1980) reported values of 0.80, 0.31, and 0.85, respectively. This difference suggests that strong effects on subjective organization and category clustering may be confined to cases involving very short word lists. Why this should be so is not clear.

On the basis of the currently available evidence, however, it appears that category clustering is at most only weakly disrupted when long word lists are subject to posthypnotic amnesia. In addition, it appears that when words are organized by category clustering, posthypnotic amnesia tends to be an all-or-none affair. Both findings are consistent with current models of category clustering in free recall (Shiffrin, 1970; Raaijmakers

& Shiffrin, 1980; Rundus, 1973). According to these models, the encoded memory structure of a categorized list comprises a three-level hierarchy consisting of a superordinate node representing the list as a whole, nodes at the middle level representing the categories, and subordinate nodes representing the individual list items. Retrieval of a category label is a function of the strength of association between the category and the list node, and retrieval of individual items is a function of the strength of association between the category and its instances. In addition, access to categories may be gained through a subordinate category member. Retrieval from a category is exhausted before another category is sampled. Thus, forgetting is more likely to affect entire categories than individual items within a category. Moreover, recall from a category will follow a some-or-none law, so that it is rare for only a single item to be recalled from a category (Slamecka, 1968; Tulving & Pearlstone, 1966). If a subject recalls several items from the list, as partially amnesic subjects do by definition, it is highly likely that these items will give the subject access to most, if not all, of the categories. And if a subject gains access to a particular category, items organized under that label should also be accessible, and will be clustered together in recall.

Similar considerations may apply to subjective organization. Although no formal models of subjective organization are available, for present purposes it can be considered to be analogous to clustering. That is, some items will be grouped together based on relations imposed by the subject during encoding. Again, access to any item within the subjective cluster is likely to give immediate access to the remaining cluster members, preserving subjective organization for the reduced set of items. If a subject recalls several list items, as partially amnesic subjects do, then at least some of these clusters will be accessed. For both category clustering and subjective organization, then, the number of items recalled is determined by the number of clusters recalled. If the number of items remembered by the subject is large relative to the number of clusters in the list, then the probability of accessing each of the clusters is increased and total recall will be correspondingly large. Although the average number of subjective clusters formed by the subjects in Experiment 1 cannot be determined, the number of category clusters in Experiment 2, four, is equal to the minimum number of items that subjects were required to recall in order to be included in the experiment.

Both subjective organization and category clustering are based on semantic relations between items, either discovered or imposed by the subject in the course of learning. This linguistic organization appears to be preserved during partial posthypnotic amnesia—at least in lists of the length used in these studies. By contrast, serial organization is clearly disrupted in posthypnotic amnesia (Kihlstrom & Wilson, 1984). This difference in the fate of semantic and temporal relations—the one disrupted, the other not—is interesting in light of recent theories of memory that hold that these reflect qualitatively different forms of organization. For example, G. Mandler (1979) has made a distinction between coordinate, subordinate, and proordinate forms of organization. These forms correspond, respectively, to subjective organization, category clustering, and temporal organization. J. Mandler (1979) has made a related distinction between categorical and schematic organization. Schematic structures preserve the temporal relations among events, and do not permit probabilistic or random retrieval mechanisms. Similarly, Anderson (1983) has argued that temporal strings are different forms of representation than are propositional networks, and may involve somewhat different rules of memory processing. If these speculations are correct, it would seem that the process underlying posthypnotic amnesia appears to affect selectively the temporal organization of events in memory.

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