

Automatic Retrieval of New Associations under Shallow Encoding Conditions

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In two experiments during the study phase participants read unrelated context-target word pairs presented below a line drawing of the context word. During test the strong cue group was presented with context words, line drawings, and stems of target words. The line drawings were not presented in the weak cue group. Stems were paired with the same context words as at study (intact), paired with different context words (recombined), or corresponded to unstudied words (control). In Experiment 1 participants were instructed to complete stems with the first word that came to mind (indirect). The priming effect for new associations was twice as large in the strong cue group. In Experiment 2 the process dissociation procedure was applied and participants completed stems with studied words (inclusion) or with unstudied words (exclusion). Results indicated that consciously controlled and automatic retrieval processes mediated the associative effect in both groups. © 1996 Academic Press, Inc.

Indirect/implicit measures of memory have been extensively used in the study of automatic retrieval of familiar verbal and nonverbal items, resulting in numerous demonstrations of repetition priming effects for such material (for reviews see Moscovitch, Vriezen, & Goshen-Gottstein, 1993; Richardson-Klavehn & Bjork, 1988; Roediger & McDermott, 1993; Schacter, 1987; Shimamura, 1986). In these investigations, study items are single words, highly associated word pairs, or familiar objects. During a later phase of the experiment, which participants are told is unrelated to the study phase, participants are asked to respond to cues corresponding to either studied or unstudied items. Priming is observed as an increased tendency to respond to, or with, studied, compared to unstudied, items.

Although most demonstrations of repetition priming have involved familiar material, there have been some reports of repetition priming for newly acquired or novel information, such as nonwords, unfamiliar objects, and unrelated paired associates, also referred to as new associations (for review see Bowers & Schacter, 1993). In this context an important paradigm was developed by Graf and Schacter, namely,

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the associative, cued, stem completion task (e.g., Graf & Schacter, 1985, 1987, 1989; Schacter & Graf, 1986a, 1986b, 1989). In this task participants studied unrelated context-target word pairs (e.g., TABLE-REASON, WINDOW-SHIRT). All target word stems (e.g., REA___) had several possible completions (e.g., REASON, REACH, REACT, etc.). At test, participants saw a context word beside a target word stem. The pairs were presented either in an intact condition, where target stems were presented with the same context word as at study (e.g., TABLE-REA___, WINDOW-SHI___), or in a recombined condition, where target stems were paired with different context words (e.g., WINDOW-REA___, TABLE-SHI___). On all test trials the indirect instruction condition required participants to complete the stems with the first word that came to mind. Repetition priming for unrelated word pairs (henceforth the associative repetition effect) was obtained when more stems were completed with studied words as a function of preserving, rather than changing, their paired, unrelated context words from encoding to retrieval (i.e., intact > recombined).

Employing the cued stem completion task Graf and Schacter (1985, 1987, 1989; Schacter & Graf, 1986a, 1986b, 1989) successfully demonstrated associative repetition effects. However, there appear to be three important differences between the priming effects obtained with familiar single items and the associative repetition effect. First, Bowers and Schacter (1990; Schacter, Bowers, & Booker, 1989) found that normal participants who reported being unaware that words from the study phase were repeated displayed the same amount of single-word repetition priming as did participants who reported being aware that words were being repeated. In contrast, "aware," but not "unaware," participants demonstrated the associative repetition effect. A similar absence of an associative repetition effect in "unaware" participants was recently reported by McKone and Slee (in press) (but see, however, Howard, Fry, and Brune, 1991).

A second important difference between single-word repetition priming and associative repetition effects is that the former, but not the latter, have been reliably demonstrated in densely amnesic patients (Cermak, Blackford, O'Connor, & Bleich, 1988a; Cermak, Bleich, & Blackford, 1988b; Mayes & Gooding, 1989; Schacter & Graf, 1986b; Shimamura & Squire, 1989). As concluded by Bowers and Schacter (1993) in a recent review, "although data indicating some degree of priming for newly acquired associations have been obtained in certain kinds of patients with memory disorders, there is little or no evidence for intact priming effects of this kind in severely amnesic patients" (p. 320). In addition, these authors highlighted the importance of studying priming for novel information in amnesic patients as a crucial test for deciding between cognitive and neuropsychological theories which "predict that priming should be limited to materials with preexisting memory representations, and those that predict that priming should extend to novel materials without preexisting memory representations" (p. 320). Given that the hallmark of amnesia is a failure to consciously recollect newly acquired information (Moscovitch, 1982), the question then becomes whether evidence could be obtained that a single exposure to a new association can be automatically retrieved by amnesic patients.

One difficulty in interpreting the lack of evidence for priming of new associations in densely amnesic patients is related to the third difference between this effect and the priming effects obtained for single familiar items. A prerequisite for obtaining

the associative repetition effect appears to be that the semantic relationship between word pairs is encoded during study (Graf & Schacter, 1985). Encoding words' surface features (e.g., vowel comparison), or even separately encoding, but not relating, semantic features of context and target words (e.g., pleasantness rating), did not produce the effect (Graf & Schacter, 1985; Schacter & Graf, 1986a). In contrast, repetition priming for single words is relatively insensitive to the level of processing manipulation (Craik & Lockhart, 1972; Craik & Tulving, 1975). Specifically, nonsemantic encoding produced effects only slightly smaller than those produced under deep encoding (Challis & Brodbeck, 1992). The fact that the associative repetition effect demonstrated by Graf and Schacter (henceforth, the elaborative associative effect) seems to depend on semantic, relational encoding, may help explain the failure to demonstrate this effect in densely amnesic patients. Bowers and Schacter (1993) advance the hypothesis that "novel perceptual representations can be acquired normally by amnesic patients. However, the acquisition of novel semantic associations may depend to a large extent on hippocampal and other limbic structures that are typically impaired in amnesic patients" (p. 320).

Thus, Bowers and Schacter (1993) make a distinction between two different types of associative repetition effects; ones that do, and ones that do not, depend on semantic level processing. In fact, there is one report of an associative repetition effect under shallow encoding conditions. Micco and Masson (1991) demonstrated an associative repetition effect when participants encoded word pairs by copying them side by side. This effect was recently replicated by Reingold and Goshen-Gottstein (1996, Experiment 3). As pointed out by Micco and Masson (1991), copying does not require participants to semantically process words beyond initial identification. However, copying may encourage integral processing of the word pair (see Whittlesea & Brooks, 1988) resulting in a unitized, perceptually specific representation which can then be automatically reinstated in response to the test cue. One difficulty with the associative repetition effect under copy instructions is its relatively small magnitude (4% in Micco and Masson, 1991; 5% in Reingold & Goshen-Gottstein, 1996, Experiment 3).

Accordingly, one important goal for the present research was to attempt to demonstrate a larger associative repetition effect under shallow encoding instructions. This was achieved in Experiment 1. Following Reingold and Goshen-Gottstein (1996), in Experiment 2 the process dissociation procedure (Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993) was applied in order to separate the contributions of the automatic and the consciously controlled processes to the associative priming effect obtained in Experiment 1. The results provided strong evidence for automatic retrieval of associative information.

EXPERIMENT 1

The shallow encoding condition used by Reingold and Goshen-Gottstein (1996, Experiment 1) was a reading instruction. Participants were simply asked to read the word pairs out loud. Under this condition an associative repetition effect was not obtained. Similarly, Graf and Schacter (1985) used a vowel comparison task for the shallow encoding condition and did not obtain an associative repetition effect. One

aspect common to both of these shallow encoding conditions is that the context provided for target words was not only impoverished and indistinct in terms of semantic analysis, but also in terms of perceptual analysis. In the present experiment a richer and more distinct perceptual context for target words was provided while maintaining the reading instruction used in Reingold and Goshen-Gottstein (1996, Experiment 1). This was achieved by presenting a line drawing depicting the context word above the context word. Participants were simply instructed to look at the picture and then read the two words out loud (e.g., a line drawing of a horse was presented above the word HORSE, and to the left of the target word COMET). At test, we manipulated the extent to which retrieval cues overlapped with encoding context, i.e., cue strength. The strong cue group were presented with the line drawing, the context word, and the stem of the target word as a retrieval cue. The weak cue group were presented with the context word and the target word stem. The cue strength manipulation was motivated by a large body of research and theorizing indicating that priming is dependent upon the extent of overlap between encoding and retrieval cues and operations (see Roediger & McDermott, 1993; Roediger, Weldon, & Challis, 1989).

Method

Participants. Thirty-six undergraduate students at the University of Toronto participated in return for course credit. Eighteen participants were randomly assigned to each of the two cue strength groups. Participants were tested individually. All had normal or corrected-to-normal vision.

Design and materials. The experimental design consisted of one between-subjects factor and one within-subjects factor. The between-subjects factor was retrieval cue strength (strong or weak). The within-subjects factor was test trial type (intact, recombined, or control).

The first stage in creating the test list was pairing the 126 context words, which were names commonly given to Snodgrass and Vanderwart (1980) line drawings (e.g., SPIDER), with 126 three-letter stems which could be completed to form at least two five-letter words, one of which was designated the target completion (e.g., SCA _ _ with SCALP as the target completion, and SCALE, SCARE, SCARF as additional completions). No two target words shared the same stem. As well, none of the stems of context words overlapped with target stems. Mean word frequency for the context and target words was 42 ($SD = 53$) and 45 ($SD = 71$), respectively (Kucera & Francis, 1967). These unique pairs of context word and stem served as retrieval cues in 126 test trials which constituted the test list given to participants in the weak cue group. In the test list for the strong cue group, in addition to the context word-stem pairs, the line drawings from Snodgrass and Vanderwart (1980) corresponding to the context words were displayed above the context words. During study both groups were presented with the line drawings above the context words.

Thus, at test all participants received exactly the same 126 pairs of context words and stems. However, by counterbalancing which words were paired with the context words during study, across participants each of the 126 test trials was equally likely to represent an intact, recombined, or control test condition. Counterbalancing was achieved by devising six study lists. The 126 context words were used once in each

list. In each study list only 84 of the target words corresponding to test stems were presented. Forty-two of these 84 target words were paired with the same context word which was paired with their stems during test, constituting the intact test trials. The rest of the target words in each list were paired with 42 context words different from those paired with their stems during test. Test trials corresponding to these target words constituted the recombined test trials. The 42 remaining context words in each study list were paired with words which were used only during study and which did not correspond to any of the 126 test stems. At test these 42 context words were paired with stems of the 42 target words which were not seen during study, constituting the control, or baseline, test trials. Note that all context words used as retrieval test cues were seen by participants during study. This was done so that the study status of the context word would not vary across the intact, recombined, and control test trials.

Accordingly, in each of the two groups three participants were randomly assigned to each of the six study lists. Across all participants in each group, each test item was equally likely to represent the intact, recombined, or control condition, and every participant received 42 trials in each test condition. This counterbalancing scheme was identical to the one used by Reingold and Goshen-Gottstein (1996, Experiment 1).

Procedure. At study, all participants were asked to look at the picture and read the two words out loud. All participants were given 10 practice pairs to illustrate the nature of the study task, followed by a randomized order of their study list. The 126 study pairs were then presented on the screen of an IBM compatible computer. Each pair was presented for 5 s and then disappeared. Presentation was self-paced. After the 5-s presentation of a word pair, participants initiated the presentation of the next pair by pressing the spacebar. The next pair appeared 250 ms after the spacebar had been pressed.

After the study list had been presented, participants performed the indirect associative stem completion test. Participants in the strong cue condition were told that a word and a picture would appear to the left of a three-letter stem. Participants in the weak cue condition were told that a word would appear to the left of a three-letter stem. All participants were asked to complete the stem with the first word that came to mind and to say it out loud. They were instructed that all completions should be five-letter words which are not proper nouns. No explanation was given regarding the function of the context word/picture. After a practice session of 10 pairs, the test list was presented in a different random order for each participant. An experimenter typed the participants' answers directly into the computer.

Results and Discussion

Table 1 presents the proportion of stems completed with target words and the standard error of the mean by test trial type and by group. Examination of the data reveals that in both the strong cue group and in the weak cue group, more stems were completed with studied words in the intact than in the recombined condition (strong cue group $t(17) = 3.28, p < .01$; weak cue group $t(17) = 2.95, p < .01$). Thus, an associative repetition effect was obtained in both groups.

To compare the magnitude of the associative effect across groups a two-way

TABLE 1
 Experiment 1: Mean Proportion of Stems Completed with Target Words by Cue Strength and by Test Trial Type

Cue strength	Test trial type		
	Intact	Recombined	Control
Strong cue	0.51 (.03)	0.41 (.02)	0.22 (.01)
Weak cue	0.41 (.02)	0.36 (.02)	0.23 (.02)

Note. Standard errors are shown in parentheses.

ANOVA, with test trial type (intact, recombined, or control) as a within-subjects variable and cue strength (strong or weak) as a between-subjects variable was conducted. The main effect of cue strength was marginally significant ($F(1, 34) = 4.01$, $MSE = .014$, $p = .053$). The main effect of test trial type was highly significant ($F(2, 68) = 75.33$, $MSE = 0.007$, $p < .001$). Most important, the interaction between test trial and cue strength was significant ($F(2, 68) = 3.49$, $MSE = 0.007$, $p < .05$). This interaction reflected the fact that the associative repetition effect was twice as large in the strong cue group (10%) compared to the weak cue group (5%). In the intact condition there were significantly more target completions in the strong cue group compared to the weak cue group ($t(34) = 2.65$, $p < .05$). The proportion of target completions did not vary significantly across cue strength groups for either recombined trials ($t(34) = 1.42$, $p = .17$) or control trials ($t < 1$).

The associative effects in the present experiment, and the associative repetition effect under copy instructions which was reported by Micco and Masson (1991) and replicated by Reingold and Goshen-Gottstein (1996, Experiment 3), provide strong convergent evidence that priming for new associations under shallow encoding conditions can be reliably obtained. The small magnitude of the associative repetition effect in the weak cue group was comparable to the magnitude obtained under copy instructions. However, a very robust and fairly large associative effect was obtained in the strong cue group.

EXPERIMENT 2

An important question concerning the associative repetition effects obtained in Experiment 1 is to what extent these effects reflect automatic, unintentional retrieval, and/or consciously controlled, intentional retrieval of associative information. Although some implicit memory researchers assume that performance on indirect tasks exclusively reflects "implicit," unintentional retrieval processes, there is a growing realization that memory measures in general, and indirect measures in particular, should not be assumed to be "process pure." That is, these measures may reflect both consciously controlled, intentional retrieval and automatic, unintentional retrieval (Jacoby, 1991; Jacoby et al., 1993; Merikle & Reingold, 1991; Reingold & Merikle, 1988, 1990; Reingold & Toth, 1996; Schacter et al., 1989; Toth, Reingold, & Jacoby, 1994).

The process dissociation procedure was introduced (Jacoby, 1991; Jacoby et al.,

1993) as a means of quantifying the separate contributions of consciously controlled and automatic influences which codetermine task performance. Reingold and Goshen-Gottstein (1996) applied the process dissociation procedure to the associative stem completion task. At test, the indirect instruction was replaced by two instructional conditions. In the inclusion condition participants were instructed to complete stems with words they had seen in the study phase, and if they could not retrieve such words, to complete stems with the first word that came to mind. In contrast, in the exclusion condition, participants were instructed to avoid completing stems with studied words and instead to complete them with new unstudied words.

In the exclusion condition, consciously controlled and automatic processes are placed in opposition, because consciously controlled influences lead participants to successfully exclude studied words, whereas automatic or unconscious influences lead participants toward a completion with studied words. Thus, in the exclusion condition a studied word is incorrectly produced as a completion only if it comes to mind automatically (A) and participants fail to consciously recollect it ($1 - C$). If (A) and (C) are assumed to be independent, then the probability of completing with a studied word in exclusion equals

$$P(\text{exclusion}) = A(1 - C) \text{ and } A = P(\text{exclusion})/(1 - C).$$

In the inclusion condition a stem would be correctly completed as a studied word if the participant consciously recollected it (C) or if the participant did not recollect the word ($1 - C$) but it came to mind automatically (A):

$$P(\text{inclusion}) = C + A(1 - C) \text{ and } C = P(\text{inclusion}) - P(\text{exclusion}).$$

Reingold and Goshen-Gottstein (1996) applied these equations to obtain estimates of conscious control (C) and automatic influence (A) in both an elaborative encoding condition (make a sentence containing the word pair), as well as the copy encoding condition. Their results indicated that the elaborative associative repetition effect reported by Graf and Schacter (1985, 1987, 1989; Schacter & Graf, 1986a, 1989) is largely attributable to consciously controlled processing rather than to automatic, unconscious influences. In contrast, the associative repetition effect under copy instructions first reported by Micco and Masson (1991), and replicated by Reingold and Goshen-Gottstein (1996), appeared to primarily reflect automatic retrieval of associative information. If indeed the elaborative associative effect reflects consciously controlled or intentional retrieval of new associations, then it is not surprising that such an effect has not been demonstrated in densely amnesic patients who are profoundly impaired in terms of their ability to consciously recollect the study episode. It is also not surprising that participants "unaware" of the indirect test manipulation do not typically demonstrate such an effect. Furthermore, the dependence of this associative effect on semantic relational processing during encoding is understandable because these processes are known to enhance consciously controlled, intentional retrieval. Some investigators question the validity of comparing performance on indirect memory tests with estimates derived from the process dissociation procedure (e.g., Graf & Komatsu, 1994). However, the results of Reingold and Goshen-Gottstein (1996) suggest that, at the very least, there appears to be an interesting convergence across paradigms. More specifically, consistent with the proposal

of Bowers and Schacter (1993) the process dissociation procedure appears to differentiate between two types of associative repetition effects: one which seems to rely on semantic analysis of word pairs and another which appears to be dependent on a perceptually specific unitized representation of study pairs. Accordingly, the process dissociation procedure was used to evaluate the contributions of consciously controlled and automatic influences to the associative repetition effects obtained in Experiment 1.

Method

Participants. Sixty-four undergraduate students at the University of Toronto participated in return for course credit. Thirty-six participants were randomly assigned to each of the two cue strength groups. Participants were tested individually. All had normal or corrected-to-normal vision, and none had participated in Experiment 1.

Design and materials. The experimental design consisted of one between-subjects factor and two within-subjects factors. The between-subjects factor was retrieval cue strength (strong or weak). The within-subjects factors were test trial type (intact, recombined, or control) and instruction (inclusion or exclusion).

For both cue strength groups the study phase was identical to that of Experiment 1. The test list from Experiment 1 was modified to create two test lists in order to insure that each item would be equally likely to be in the intact, recombined, or control condition and to appear with inclusion or exclusion instructions. The first test list was created by adding the word OLD above half the items, signaling the participant to complete the stems with studied words (i.e., inclusion), and the word NEW above the remaining half of the items, signaling the participant to complete the stems with new, unstudied words (i.e., exclusion). The second test list was created by exchanging the OLD and NEW instructions for the items used in the first list. Half of the participants received the first test list and the other half received the second test list. Consequently, for each cue strength group, across participants each test item was equally likely to represent one of the six test conditions (test trial type by instruction). Each participant received 21 test trials in each of these six test conditions. This counterbalancing scheme was identical to the one used by Reingold and Goshen-Gottstein (1996, Experiment 2). All other aspects of the design and materials were identical to those of Experiment 1.

Procedure. The procedure for the study phase was identical to that of Experiment 1. After the study list had been presented, participants received inclusion and exclusion instructions. They were told that the instruction for completing the stem would be written above the stem. If the word OLD appeared above the stem, participants were to complete the stem with an old, studied word. If they could not remember the studied word, they were to complete the stem with the first word that came to mind. If the word NEW appeared above the stem, participants were to complete the stem with an unstudied word. For both the inclusion and the exclusion instructions, participants were given the option of not completing the stem, but were told to avoid arbitrary use of this option, and to try to comply with the OLD/NEW instructions. They were to use this option only if they felt they could not comply with the instructions or could not come up with a valid completion for the stem. All other aspects of the procedure were identical to those of Experiment 1.

TABLE 2

Experiment 2, Strong Cue Group: Mean Proportion of Stems Completed with Target Words by Retrieval Instructions and Test Trial Type, and the Estimates of Controlled and Automatic Processes for the Intact and Recombined Conditions

	Pair type		
	Intact	Recombined	Control
Inclusion	0.49 (.03)	0.36 (.02)	0.22 (.02)
Exclusion	0.30 (.02)	0.28 (.02)	0.22 (.02)
Estimates			
Control	0.19 (.03)	0.08 (.02)	
Automatic	0.37 (.02)	0.29 (.01)	

Note. Standard errors are shown in parentheses.

Results and Discussion

Tables 2 and 3 present the proportion of stems completed with target words under each experimental condition in the strong cue group and weak cue group, respectively. To compare the proportion of target completions across conditions, a $2 \times 3 \times 2$ ANOVA was performed with retrieval cue strength (strong or weak) as a between-subjects factor, and test trial type (intact, recombined, or control) and instruction (inclusion or exclusion) as within subjects. Neither the main effect of cue strength nor any of the interactions involving cue strength were significant ($F_s < 1$). Both the main effect of instruction ($F(1, 70) = 40.74$, $MSE = 0.024$, $p < .001$) and the main effect of test trial type ($F(2, 140) = 113.96$, $MSE = 0.010$, $p < .001$) were significant. More important, the instruction by test trial type interaction was significant ($F(2, 140) = 30.62$, $MSE = 0.012$, $p < .001$). This interaction reflects that in inclusion, more intact trials were completed with studied words than recombined trials (strong cue group, $t(35) = 6.78$, $p < .001$; weak cue group, $t(35) = 4.26$, $p < .001$), whereas in exclusion, there was no significant difference between the

TABLE 3

Experiment 2, Weak Cue Group: Mean Proportion of Stems Completed with Target Words by Retrieval Instructions and Test Trial Type, and the Estimates of Controlled and Automatic Processes for the Intact and Recombined Conditions

	Pair type		
	Intact	Recombined	Control
Inclusion	0.51 (.03)	0.39 (.02)	0.22 (.02)
Exclusion	0.30 (.02)	0.29 (.02)	0.23 (.01)
Estimates			
Control	0.21 (.04)	0.10 (.03)	
Automatic	0.37 (.02)	0.32 (.02)	

Note. Standard errors are shown in parentheses.

intact and recombined test trials (strong cue group, $t(35) = 1.11, p = .28$; weak cue group, $t < 1$).

Before computing the estimates of consciously controlled and automatic influences, we ensured that response strategies did not vary across inclusion and exclusion instructions by comparing performance for the inclusion versus exclusion control trials (see Jacoby et al., 1993; Reingold & Toth, 1996). In both cue strength groups there was no significant difference across inclusion and exclusion baselines ($t_s < 1$). Estimates of consciously controlled and automatic influences were calculated for each participant using the equations described earlier and the means are presented in Tables 2 and 3.

To compare automatic estimates across conditions a 2×2 ANOVA with cue strength as a between-subjects factor and intact/recombined as a within-subjects factor was performed. Neither the main effect of cue strength nor the interaction of cue strength with intact/recombined was significant ($F_s < 1$). The main effect of intact/recombined was highly significant ($F(1, 70) = 18.27, MSE = 0.008, p < .001$) indicating a larger automatic estimate in the intact than the recombined condition. The significantly greater automatic estimate in the intact versus recombined conditions was separately observed in the strong cue group ($t(35) = 3.96, p < .001$), as well as the weak cue group ($t(35) = 2.25, p < .05$). Similarly, to compare the consciously controlled estimates across conditions, a 2×2 ANOVA with cue strength as a between-subjects factor and intact/recombined as a within-subjects factor was performed. Neither the main effect of cue strength nor the interaction of cue strength with intact/recombined was significant ($F_s < 1$). The main effect of intact/recombined was highly significant ($F(1, 70) = 18.25, MSE = 0.023, p < .001$) indicating a larger consciously controlled estimate in the intact compared to the recombined condition. The significantly greater consciously controlled estimate in the intact versus recombined conditions was separately observed in the strong cue group ($t(35) = 3.31, p < .01$), as well as the weak cue group ($t(35) = 2.82, p < .01$).

Thus, in the strong cue group, as well as in the weak cue group, both consciously controlled and automatic retrieval of associative information was observed. The finding of automatic retrieval in the present experiment is consistent with the results reported by Reingold and Goshen-Gottstein (1996, Experiment 3) for the copy encoding manipulation. In both cases evidence for automatic retrieval of associative information was obtained under shallow encoding conditions. However, in the copy encoding condition there was no evidence for consciously controlled retrieval of associative information, whereas, consciously controlled retrieval was observed in the present experiment. This difference between the present results and the copy encoding results is not surprising given the difference in the richness and distinctiveness of the context provided during encoding. More specifically, unlike copy encoding, the presentation of the line drawings in the present experiment provided vivid episodic details supporting conscious recollection of associative information.

GENERAL DISCUSSION

Experiment 1 demonstrated that priming of new associations can be reliably obtained under shallow encoding conditions. By applying the process dissociation pro-

cedure, Experiment 2 suggested that these effects reflect both consciously controlled and automatic retrieval of associative information. In addition, greater overlap between encoding and retrieval cues (i.e., strong cue versus weak cue manipulation) increased the magnitude of the associative repetition effect (10% versus 5%) and numerically, if not statistically, increased the extent of automatic retrieval of new associations (8% versus 5%).

Taken together, the results of Reingold and Goshen-Gottstein (1996), Micco and Masson (1991), and the present experiments call into question the early consensus that elaborative, relational encoding is a prerequisite for demonstrating an associative repetition effect in the stem completion paradigm developed by Graf and Schacter (1985, 1987, 1989; Schacter & Graf, 1986a, 1986b, 1989). Indeed, it now appears that the elaborative associative effect demonstrated by Graf and Schacter is qualitatively different from the associative effects obtained under shallow encoding. The former depends on semantic analysis of relational features, while the latter may depend on the formation of a unitized, perceptually specific representation.

The significance of the present findings may be best understood in light of Bowers and Schacter's (1993) conclusion that, "an important task for future research would be to devise paradigms in which priming of new associations can be demonstrated following study tasks that restrict processing to the perceptual level. If the failure to observe consistently normal priming of new associations in amnesic patients is attributable to the dependence of such priming on semantic-level processing, then it should be possible to observe intact priming of novel perceptual associations" (p. 321). To date, the prediction that densely amnesic patients should demonstrate an associative repetition effect under shallow encoding instructions has not been tested. Given that the present methodology appears to reliably demonstrate such effects with normal participants, it satisfies an important prerequisite for testing this prediction. Obviously, the next logical step would be to investigate whether or not densely amnesic patients demonstrate an associative repetition effect with the present encoding manipulations. The strong cue condition may be the preferred test condition for investigating priming of new associations with amnesic patients. Compared to other experiments employing shallow encoding manipulations, this condition produced the largest and most robust associative repetition effects in normal participants.

The application of the process dissociation procedure to the associative stem completion task in Reingold and Goshen-Gottstein (1996), and in Experiment 2, provides important convergent evidence for the qualitative distinction between the elaborative versus the shallow associative effects. The results of these investigations indicate that the elaborative associative effect is largely attributable to consciously controlled retrieval, whereas the associative effects obtained under shallow encoding reflect, at least in part, automatic retrieval of new associations. However, it should not be assumed that an associative effect under shallow encoding exclusively reflects automatic retrieval. Whereas the associative effect under copy encoding may be almost entirely attributable to automatic retrieval (Reingold & Goshen-Gottstein, 1996, Experiment 3), the present associative effects under shallow encoding likely represent a mix of both consciously controlled and automatic retrieval. This is, of course, a restatement of the problem of assuming process purity. It is under conditions where both consciously controlled and automatic retrieval codetermine task performance

that a solution like the one offered by the process dissociation framework is required. The process dissociation approach argues that such codetermination of task performance is the rule, rather than the exception (see Reingold & Toth, 1996).

Finally, given that Experiment 2 employed the process dissociation procedure, it is important to acknowledge that this procedure has generated a considerable amount of controversy (e.g., Gardiner & Java, 1993; Graf & Komatsu, 1994; Jacoby, Toth, Yonelinas, & Debnar, 1994; Jacoby, Yonelinas, & Jennings, in press; Joordens & Merikle, 1993; Reingold & Toth, 1996; Richardson-Klavehn, Gardiner, & Java, 1994; Roediger & McDermott, 1993; Toth & Reingold, 1996). One specific criticism of the process dissociation procedure is especially relevant in the present context. Graf and Komatsu (1994) argued that comparing estimates derived from the process dissociation paradigm with priming effects obtained with indirect memory measures is invalid. This assertion is in conflict with the rationale of Reingold and Goshen-Gottstein (1996), the present paper, as well as other studies (e.g., Jacoby et al., 1993; Toth et al., 1994) which compared performance across indirect/implicit tests with the estimates derived from the process dissociation procedure. A detailed discussion of Graf and Komatsu's (1994) critique is beyond the scope of the present paper (for discussion see Reingold & Toth, 1996; Toth, Reingold, & Jacoby, 1995). However, it is argued here that empirical comparisons across paradigms are essential for fruitful theoretical and empirical progress to occur. As a case in point, the application of the process dissociation procedure to the study of priming of new associations in the present experiments, and in Reingold and Goshen-Gottstein (1996), provides clear convergent evidence for the qualitative distinction between the elaborative versus the shallow associative repetition effects.

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