JOURNAL OF MEMORY AND LANGUAGE **35,** 32–52 (1996)
ARTICLE NO. 0002

Dissociating Automatic and Consciously Controlled Effects of Study/Test Compatibility

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Two experiments examined the effects of reinstated context on consciously controlled and automatic influences of memory. Results showed that reinstating associative context had separate effects of enhancing both controlled and automatic influences. In contrast, dividing attention during study reduced later recollection, a consciously controlled use of memory, but left automatic influences unchanged (Experiment 1). Changing modality between study and test eliminated data-driven, automatic influences of memory but left conceptually driven influences invariant (Experiment 2). The importance of separating consciously controlled and automatic effects of study/test compatibility is discussed.

A condition that sometimes accompanies parole of those who have been incarcerated is that they are to avoid the context which surrounded their crime; consorting with known criminals or returning to their earlier ''haunts'' constitutes a violation of parole. An alcoholic, when sober, is unable to find a hidden bottle of liquor but when intoxicated, returns to it without problem. A person originally from Scotland enters a pseudo-Scottish pub in a North American city in which he has lived for a large number of years. Upon entering the pub, his Scottish accent becomes so ''thick'' that he can scarcely be understood. A very dense amnesic reads pairs of associatively related words. When later given one member of each pair and asked to produce an associate, he produces the earlier-read associates with a frequency that is high above what would be expected without prior study. However, the amnesic is unable to recollect that prior study (Shimamura & Squire, 1984).

Arguably, the above examples illustrate automatic influences of reinstating context. The effects appear automatic in that they seem to occur without intent, without awareness, and with minimal cost in processing capacity (cf., Hasher & Zacks, 1979; Posner & Snyder, 1975; Schneider & Shiffrin, 1977). Indeed, as in the case of an influence of context on criminal behavior, much processing capacity may be required to avoid effects of reinstated context. Awareness of effects of context is sometimes gained but, if so, may follow, rather than being a prerequisite for, the automatic response to its reinstatement.

Almost certainly, automatic influences of reinstating context do occur, but it seems unlikely that all manipulations of study/test compatibility have their effect in that way. The ''encoding-specificity principle'' holds that the effectiveness of a recall cue depends on the relation between the cue and the study encoding of the item that is to be recalled. For example, presentation of an associate of a studied word as a cue for its recall is much more effective if the associate and the to-be-remembered word were studied together (e.g., Tulving & Thomson, 1973). Such context effects might reflect automatic influences, but it is common to describe the use of retrieval cues in more cognitive, intentional terms as in the metaphor of searching memory (Raaijmakers & Shiffrin, 1981). Reinstating context might enhance memory performance because of automatic influences, because recollection (intentional use of memory) relies on the compatibility of a retrieval cue and the study encoding of the target word, or because of both automatic and controlled influences. The

This research was supported by a grant to Larry L. Jacoby from the Natural Sciences and Engineering Research Council (NSERC). The author thanks Ann Hollingshead and Sharyn Kreuger for their assistance in data collection and analyses. Correspondence should be addressed to Larry L. Jacoby, Department of Psychology, McMaster University, Hamilton, Ontario, Canada L8S 4K1.

0749-596X/96 $18.00

goal of the experiments reported here was to separate automatic and consciously controlled effects of reinstating context.

The currently most popular approach to separating automatic and consciously controlled influences of memory is to seek dissociations between performance on indirect and direct tests. However, I begin by arguing that such task dissociations, while certainly consistent with two different forms of memory, do not provide unequivocal evidence for a distinction between automatic and consciously controlled effects of reinstating context. Next, I introduce an opposition (or ''exclusion'') test condition, a condition that does provide conclusive evidence for automatic influences of reinstating context, despite the simultaneous, and opposing, operation of consciously controlled effects of context reinstatement. Opposition experiments allow one to demonstrate the need for a distinction between automatic and consciously controlled effects of context reinstatement, but they do not allow one to measure the magnitude of the two types of effect. To do this, the experiments reported here used the process-dissociation procedure (e.g., Jacoby, 1991; Jacoby, Toth, & Yonelinas, 1993), which was designed to yield quantitative estimates of the degree to which performance of a single task is intentionally controlled vs automatically influenced. In the General Discussion, I consider recent criticisms of that procedure, and describe circumstances that limit its application. Despite such limitations, the reported experiments demonstrate the utility of the process-dissociation procedure by showing that it provides a means of separating automatic and consciously controlled effects of reinstating context. I argue that doing so is important for both theoretical and for applied purposes (also see Jacoby, Jennings, & Hay, in press).

Problems for Identifying Tasks with Processes

For an indirect test of memory, subjects are not asked to report on memory for an event as they would be for a direct test, such as a test of recognition or recall; rather, they engage in some task that can indirectly reflect memory for the occurrence of that event. Word-stem and fragment-completion tasks are among the most popular indirect tests of memory (e.g., Graf & Mandler, 1984; Tulving, Schacter, & Stark, 1982; Warrington & Weiskrantz, 1974). For a stem-completion task, subjects might read the word *scalp* and then be presented with the stem *sca* with instructions to complete that stem using the first word that comes to mind. Although amnesics are unable to remember the earlier presentation of a word, they show memory for that prior presentation by using the word as a completion more often than they would had the word not been earlier presented (for a review, see Moscovitch, Vriezen, & Gottstein, 1993). Similar dissociations are found in people with normally functioning memory (for a review, see Roediger & McDermott, 1993).

Performance on indirect tests is influenced by study/test compatibility. In perceptual tasks such as word-stem completion and visual perceptual identification, similarity between the study and test version of a word is important for showing repetition effects; earlier reading a word does more to enhance its later perceptual identification or use as a completion for a stem than does earlier hearing the word (e.g., Jacoby & Dallas, 1981). Effects of study/test compatibility are also found when associative context is manipulated. The ''associative repetition effect'' refers to the enhancement of memory for target words on indirect tests as a function of preserving, rather than changing, their paired, context words from encoding to retrieval. Using a lexical-decision task as an indirect test of memory, an associative repetition effect has been found for both related and unrelated paired words (McKoon & Ratcliff, 1979). An associative repetition effect for unrelated paired words has also been revealed by the use of stem-completion performance as an indirect test (Graf & Schacter, 1985, 1989; Schacter & Graf, 1986, 1989), and an effect for related word pairs is demonstrated by the earlier-mentioned finding of associative priming shown by amnesics (Shimamura & Squire, 1984).

The importance of study/test compatibility is highlighted by processing accounts of dissociations between indirect and direct tests (Blaxton, 1989, 1992; Jacoby, 1983; Roediger, 1990). By such accounts, dissociations between direct and indirect tests reflect test-appropriate processing (study/test compatibility of processing) just as do dissociations between different direct tests such as recognition and recall. In particular, Roediger and his colleagues (e.g., Roediger, Weldon, & Challis, 1989) predict that manipulations of surface characteristics (e.g., variations of modality) will have an effect in performance of perceptual tasks, such as stem completion, but have no effect in performance of conceptual tests, such as generating associates. In contrast, manipulations of processing strategies (e.g., levels of processing) are predicted to have an effect in performance of conceptual tests but no effect in performance of perceptual tests. Dissociations between direct and indirect tests are said to arise because the manipulation of direct vs indirect test is confounded with type of processing required by the test, data- vs conceptually driven processing.

The test-appropriate-processing view accounts for many dissociations between direct and indirect tests by noting that most popular indirect tests are perceptual tasks whereas direct tests of memory are typically conceptual tasks. However, Roediger acknowledges that the view does not explain well pure differences in intentional vs incidental (automatic) retrieval (Jacoby, 1984). These are said to occur in amnesic patients, who preserve only the ability to engage in incidental retrieval, and in normal subjects when only test instructions (indirect vs direct) are manipulated. What is needed is a means of distinguishing between dissociations produced by differences between incidental vs intentional retrieval and those produced by study/test compatibility. To draw that distinction, it is necessary to separate effects of study/test compatibility on incidental and intentional retrieval.

It is common to claim that effects of study/test compatibility differ for indirect and direct tests of memory, but such claims are based on confounded comparisons. For example, manipulations of modality are said to be important for indirect but not for direct tests (e.g., MacLeod & Bassili, 1989), just as would be expected if indirect tests relied on prior data-driven processing whereas direct tests relied on prior conceptually driven processing. However, the comparisons that serve as a basis for claims that modality is important only for indirect tests confound the cues provided for retrieval with the manipulation of indirect vs direct test. As an example of such confounding, Jacoby and Dallas (1981) found that a manipulation of modality had a large effect in perceptual-identification performance, an indirect test, but no effect in recognition–memory performance, a direct test. When the confounding with cues provided by the test is removed, rather than producing dissociations, manipulations of study/test compatibility produce parallel effects on direct and indirect tests. Craik, Moscovitch, and McDowd (1994) compared the direct test of stem-cued recall with the indirect test of stem completion, and found effects of manipulating modality that were near equal in size for the two types of test. Same-size effects for direct and indirect tests have also been obtained when study/test compatibility was varied by presenting pictures vs words (Weldon, Roediger, & Challis, 1989). Further, the associative repetition effect is approximately the same size for indirect and direct tests of memory (McKoon & Ratcliff, 1979).

Because of the finding of parallel effects, one cannot determine whether study/test compatibility affects incidental retrieval, affects intentional retrieval, or affects both incidental and intentional retrieval, unless one is willing to assume that indirect tests measure *only* incidental retrieval whereas direct tests measure *only* intentional retrieval. However, conscious processes may contaminate performance on indirect tests (e.g., Jacoby, 1991; Reingold & Merikle, 1990; Toth, Reingold, & Jacoby, 1994) and, less obviously, unconscious processes might contaminate performance on direct tests (Jacoby et al., 1993). Craik et al. (1994) used a lack of an effect of level of processing to argue that the effects of study/test compatibility on stem-completion performance, produced by manipulating modality, were not because of contamination by intentional use of memory. However, even if a lack of a levels effect does insure that an indirect test is process pure, which there is reason to doubt (Reingold &

Toth, in press), it still remains to be shown that the direct test was uncontaminated by incidental retrieval before one can conclude that the manipulation of modality produced separate and equal size effects on performance of indirect and direct tests.

THE ADVANTAGE OF OPPOSITION

Because of the possibility of contamination, it is impossible to measure automatic and controlled influences of reinstating context by means of the indirect/direct test distinction. The problem posed by the possibility of contamination is particularly severe when manipulations are expected to produce parallel effects on automatic and controlled influences, as is the case for reinstating context. For producing associates, as an example, earlier reading of an associate together with the word later presented as a cue might facilitate performance by means of automatic influences, but intentional use of memory would produce the same result. When incidental and intentional retrieval would produce the same result, it is necessary to adopt the dubious assumption that indirect and direct tests are process pure in their measurement of automatic and controlled processes to even demonstrate the existence of separate effects of reinstatement of context.

However, by placing automatic influences and intentional use of memory in opposition, one can gain unambiguous evidence that reinstating associative context has separate effects on automatic and controlled processes. To understand the advantages of placing effects in opposition, consider the interplay between automatic influences of memory and recollection illustrated by the everyday example of ‘‘telling the same story twice’’ (Koriat, Ben-Zur, & Sheffer, 1988). We meet a friend and the context that he provides suggests a piece of news or gossip that we know will interest him. But did we already tell him the story on a previous occasion? The context of the meeting serves both as an occasion for automatic re-telling of the news or gossip, and as a cue to recollect the previous telling. On some occasions the reinstatement of context produced by the meeting prompts intentional retrieval and because of the recollection of the previous telling, the story is mercifully withheld. However, as people age, there may be an increasing tendency for the automatic effects of context reinstatement on incidental retrieval to dominate the conscious, cue-providing effects, and so, as is well known, favorite stories are told and re-told by the elderly (Jacoby et al., in press).

Suppose we were able to show that context reinstatement increased the probability of retelling of a story for elderly subjects but had an opposite effect for young subjects. That pattern of results would provide evidence that two processes are involved in determining whether a story is re-told, and that reinstatement of context influences both processes. The finding of opposite effects could be interpreted as showing that for elderly subjects, effects of context reinstatement on incidental retrieval dominated whereas for younger subjects, the effects of context reinstatement on intentional retrieval dominated. In line with an account of this sort, there is evidence to show that age-related differences in memory take the form of a deficit in recollection combined with relatively intact automatic influences of memory (e.g., Jacoby et al., in press).

We have not tried to show opposite effects of context reinstatement on storytelling for young and elderly subjects. However, the pattern of results described for storytelling has been found in an experiment that manipulated the reinstatement of associative context (Jacoby, 1994, Experiment 2). In the study phase of that experiment, associatively related words were presented in pairs (e.g., *talk-chat; eat-drink*) or were re-paired and presented as pairs of unrelated words (e.g., *turtle-cider; apple-shell*). Subjects judged whether words in each pair were related or unrelated. In one condition, subjects devoted full attention to making those judgments whereas in a second condition, they engaged in a listening task while simultaneously judging whether words were related. Effects of dividing attention during study mimic those of aging by reducing recollection but leaving automatic influences of memory unchanged (Jacoby et al., in press b).

For an exclusion test, the first member of each studied pair was presented as a cue along with the initial letter of the associatively related target word (e.g., *eat-d*). Subjects were instructed to produce a word that was associatively related to the cue and began with the presented letter but had not been presented earlier (acceptable responses would be dine or devour as an example). Akin to avoidance of retelling a story, recollection that a word was presented earlier allowed subjects to avoid giving that word as a response for the exclusion test. Automatic influences, in contrast, would have the opposite effect by acting to increase the probability of responding with an old word. Only when words were earlier presented in related pairs did the cues provided at test reinstate the associative context of studied words. Consequently, words presented in related pairs were expected to produce both better recollection and larger automatic influences of memory—separate associative repetition effects for intentional and incidental retrieval.

Results from the exclusion test (Table 1) showed that after full attention to judging whether words were related, probability of responding with an old word was lower when context was, rather than was not, reinstated (.24 vs .30), just as would be expected if reinstating context enhanced recollection. In contrast, after attention was divided during study, recollection was expected to be very poor and, so, effects of reinstating context on automatic influences of memory should dominate. As expected, results after divided attention were opposite to those after full attention, showing that reinstatement of associative context produced an *increase* in the probability of mistakenly using an old word as a completion (.36 vs .29).

TABLE 1
PROBABILITIES OF RESPONDING WITH AN OLD WORD AND ESTIMATES OF RECOLLECTION (R) AND AUTOMATIC INFLUENCES (A)

Pair type	Probabilities test		Estimates	
Attention	Inclusion	Exclusion	R	A
Related				
Full	.60	.24	.36	.37
Divided	.48	.36	.12	.40
Unrelated				
Full	.37	.30	.07	.32
Divided	.37	.29	.08	.31

Note: Baserate = .29.

The above pattern of results provides unambiguous evidence for the necessity of a distinction between intentional and incidental retrieval, and shows that each of the two types of retrieval is influenced by the reinstatement of associative context. However, results gained by placing intentional and incidental retrieval in opposition do not allow one to gain a quantitative estimate of their separate contributions to performance, which is the goal of the process-dissociation procedure.

THE PROCESS-DISSOCIATION PROCEDURE

The process-dissociation procedure builds on findings of dissociations between performance on indirect (implicit) and direct (explicit) tests of memory, but extends the analysis to situations for which it is acknowledged that both consciously controlled and automatic influences contribute to performance. Such an analytic technique seems especially important given that, in most real-world tasks, both controlled and automatic processes are operating. Conscious control is measured by combining results from a condition for which automatic and consciously controlled processes act in opposition (e.g., an exclusion test), with results from a condition for which the two types of processes act in concert. The measure is the very commonsensical one of the difference between performance when one is *trying to* as compared with *trying not to* engage in some act. The difference between performance in those two cases reveals the degree of cognitive control. I illustrate the process-dissociation procedure by further describing the experiment done by Jacoby (1994).

In that experiment, an ‘‘inclusion’’ test condition was used to arrange a situation for which automatic and controlled processes act in concert. For the inclusion test, subjects were instructed to use the presented cue word and first letter to recall an earlier-presented word that was associatively related to the cue word and began with the provided first letter. If subjects were unable to recall a suitable old word, they were told to respond with the first word that came to mind that fit the remaining restrictions. Inclusion and exclusion test items were intermixed, with the color of test items (green or red) signaling their type.

Results from inclusion test items showed that reinstating associative context enhanced performance in both the full- and the divided-attention conditions, but the effect was larger after full attention had been devoted to study (Table 1). These results are consistent with the suggestion that reinstatement of context influences both automatic and controlled processes—incidental and intentional retrieval.

Results from the inclusion and exclusion tests were combined to estimate the separate contributions of automatic and controlled processes. For an inclusion test, subjects could respond with an old word either because they recollected the word as presented in Phase 1, with a probability R, or because, even though recollection failed (1-R), the old word came automatically to mind (A): R + A(1-R). For an exclusion test, in contrast, an old word would be given as a response only if recollection failed and the word came automatically to mind: A(1-R). Thus, the difference between the inclusion and exclusion tests in the probability of responding with an old word provides a measure of the probability of recollection. Given that estimate, the probability of an old word automatically coming to mind as a completion can be computed. One way of doing this is to divide the probability of responding with an old word for an exclusion test by (1-R): Exclusion/(1-R) = A(1-R)/(1-R) = A.

This estimation procedure is based on several assumptions. Most important is the assumption that recollection and automatic influences independently contribute to performance. That assumption along with others underlying the estimation procedure will be considered in the General Discussion, and have been extensively discussed elsewhere (Jacoby, Begg, & Toth, in press a; Jacoby et al., 1993; Jacoby, Toth, Yonelinas, & Debner, 1994; Jacoby, Yonelinas, & Jennings, in press c; Toth, Reingold, & Jacoby, 1995 Yonelinas, Regehr, & Jacoby, in press).

Estimates of recollection and automatic influences showed that reinstatement of associative context affected both intentional and incidental retrieval (Table 1). Recollection that a word was presented in Phase 1 allowed subjects to correctly include or exclude that word as a completion, whichever they were instructed to do. Automatic influences, in contrast, are assumed to increase the probability that an old word is produced as a completion, regardless of whether doing so results in a correct response (inclusion test) or an error (exclusion test). The cues provided at test reinstated associative context for words presented in associatively related pairs during Phase 1. Because of effects of reinstating context, words presented in related pairs produced both better recollection and larger automatic influences of memory than did words presented in unrelated pairs. Divided, as compared to full, attention to judging whether words were related in Phase 1 reduced later recollection but left automatic influences of memory largely unchanged, replicating the results of earlier experiments (e.g., Jacoby et al., 1993).

The Experiments

The question of greatest interest for Experiment 1 reported here was whether there are any automatic influences of memory when associative context is not reinstated. Jacoby (1994) found that estimated automatic influences for words presented in unrelated pairs during Phase 1 did not differ significantly from the baseline probability of producing those words as a completion. That result is surprising because data-driven processing would be expected to serve as a source of automatic influences (Jacoby, 1983; Jacoby et al., 1993). A potentially important detail is that Jacoby (1994) provided only the first letter of a target word at test (*knee b________*). Perhaps a first letter does not provide sufficient constraints for automatic influences originating from prior data-driven processing to be observed. In Experiment 1, responding was further constrained by providing word fragments, rather than only initial letters, and results were expected to reveal automatic influences even when associative context was not reinstated.

Reinstating associative context allows both prior conceptually driven and prior data-driven processing to serve as sources of automatic influences whereas only prior data-driven processing is likely to produce automatic influences when associative context is not reinstated. Experiment 2 sought further evidence of the difference in sources of automatic influences by varying the modality (heard vs read) in which pairs were presented in Phase 1. Earlier reading a word was expected to produce automatic influences even when associative context was not reinstated, but earlier hearing a word was not expected to do so. That is, effects of prior data-driven processing were expected to be modality specific. In contrast, the change in modality might not reduce automatic influences that originated from prior conceptually driven processing.

Experiment 1

Method

Subjects. Eighty-six students in an introductory psychology class at McMaster University volunteered to participate in the experiment for course credit. Forty-two subjects were randomly assigned to the full-attention and divided-attention conditions produced by a manipulation during Phase 1. Results from 2 additional subjects assigned to the full-attention condition were discarded for purposes of analyses because they produced no old words for the exclusion test (discussed later).

Materials. A pool of 104 associatively related pairs of words was selected from several sources (Bousfield, Cohen, Whitmarsh, & Kincaid, 1961; Nelson, McEvoy, & Schreiber, unpublished manuscript; Postman & Keppel, 1970). Words from these norms were chosen from a range of association frequencies with the majority being from the medium range. The highest frequency associate of a word was never chosen, and chosen words were 4 or 5 letters in length. An additional criterion was that there must be at least one other associate that would complete the same word fragment as constructed for a selected associate (e.g., rent ---se; house, lease). When choosing associates and constructing word fragments, care was taken to minimize associations between words from different pairs, and to insure that fragments were unique to a selected word. That is, fragments could not be completed with a word from a pair other than that for which they were constructed. Unrelated pairs were formed by re-pairing words from related pairs. The materials used to construct lists are presented in the Appendix.

From the selected pairs, 3 sets of 32 pairs each were rotated through each of the three experimental conditions: related pairs, unrelated pairs, and new pairs. Each of these sets was further divided into two sets of 16 pairs each, one set to be tested in the inclusion condition and the other set to be tested in the exclusion condition. Each set had an equal distribution of both word frequency and probability of completing fragments when new. To avoid primacy and recency effects, three pairs each were presented at the beginning and at the end of the list used in Phase 1 of the experiment. These buffer items stayed constant across all formats.

The test list contained one word from each associatively related pair of words along with the fragment of the other word from the pair (rent ---se). Test pairs corresponded to the 32 pairs presented as related pairs in Phase 1, 32 pairs whose words were re-paired to be presented as unrelated pairs in Phase 1, and 32 pairs that were not presented in Phase 1. For each pair type (i.e., related, unrelated, and new), half of the test pairs (word and fragment) were presented in red (exclusion test), and half were presented in green (inclusion test). Six practice test pairs were added to the beginning of the test list—four pairs from the primacy and recency buffers (two related and two unrelated pairs) and two new pairs. In all phases of the experiment, order of presentation was random with the restriction that not more than three items representing the same combination of conditions could be presented in a row, and all conditions were presented evenly throughout the list. An additional restriction on presentation of items in unrelated pairs during Phase 1 was that at least 15 items must intervene between presentation of words taken from the same associatively related pair of words. That is, related words that were re-paired were widely separated in the list.

The listening task used in the divided-attention condition was one previously used by Craik (1982). In this task, subjects monitored a tape-recorded list of digits to detect target sequences of three odd numbers in a row (e.g., 9,3,7). The digits were random with the exception that a minimum of one number and a maximum of five numbers occurred between the end of one target sequence and the beginning of the next target sequence. Digits were recorded at a 1.5-s rate.

Procedure. Words were presented and responses were collected on a PC-compatible computer interfaced with a color monitor. Words were presented in the center of the screen in lowercase letters. The character size of the stimuli was approximately 3 × 4 mm, and subjects were seated approximately 70–75 cm from the screen.

In Phase 1, pairs of words were presented at a 2-s rate with an interval of 500 ms, during which the screen was blank, intervening between the presentation of pairs. Words were presented in white letters on a black background. Subjects in the full-attention condition were instructed to read the words aloud and to try to remember them for a later memory test. Subjects in a divided-attention task were given the same instructions but were also required to simultaneously engage in a listening task. They were informed that it was very important not to miss a target sequence in the listening task. Subjects responded by pressing a key whenever they detected a target sequence.

In the test phase of the experiment, words were presented paired with word fragments. These test items appeared in either green or red and the two colors of test item were randomly intermixed. Subjects were told that if the test item appeared in green (inclusion test), they were to use the word and fragment as cues for recall of an associate of the word that was presented in Phase 1. They were informed that the target word may have been earlier presented as a member of an unrelated pair rather than with the context word with which it was tested. If they could not think of an old associate of the context word, they were to complete the fragment with the first associate of the context word that came to mind. Subjects were told to also use red test items (exclusion test) as cues for recall of a word presented earlier but they were to complete those fragments with an associate of the context word that was *not* presented earlier in the experiment. They were told they would have 10 s to complete each fragment, at which time the computer would beep. If a completion was given, the experimenter pressed a key to remove the test item from the screen and then pressed another key to present the next test item, which appeared 500 ms after the keypress. If the time elapsed and the computer beeped, the experimenter pressed a key, and 500 ms after the keypress the next test item was presented. The first six test items were used for practice. After the subjects repeated instructions back to the experimenter, the experimenter ‘‘talked through’’ each of the practice items, reinforcing the previous instructions, but not providing feedback regarding the responses given by the subjects. Then, after giving subjects a final chance to ask questions, the main test began.

Analyses. The equations described earlier were used to gain estimates, for each subject, of recollection and automatic influences, separately for related and unrelated pairs. The equations are mathematically constrained such that a subject scoring perfectly in the exclusion condition (i.e., zero) will have an estimate of zero for the automatic component. The consequence of such floor effects is an underestimation of the automatic contribution to performance (Jacoby et al., 1993). As indicated earlier, subjects scoring perfectly on the exclusion test were replaced.

The significance level for all tests was set at $p < .05$. Tests revealing significant main effects are not reported when variables producing those main effects entered into significant interactions. Only analyses of effects on estimates of R and A will be reported. Analysis of effects of manipulated variables on R (e.g., full vs divided attention) is equivalent to analyzing the interaction of those effects with the manipulation of inclusion vs exclusion test (e.g., the interaction of full vs divided attention with type of test) in an analysis of the probability of completing a fragment with an old word. That is, the means of estimating R turns interactions with type of test into main effects, which, for most purposes, makes analysis of the probability of completing a fragment with an old word redundant with analyses of estimates of R and A.

Results and Discussion

In the divided-attention condition, the probability of detecting a target sequence for the listening task during Phase 1 was .86. In the test phase, completion rates for fragments corresponding to new words in the inclusion and exclusion tests were .30 and .32, respectively, in the full-attention condition, and .34 and .32, respectively, in the divided-attention condition. Analyses revealed that differences among conditions did not approach significance ($F < 1$ for the interaction of inclusion vs exclusion with full vs divided attention). This lack of a difference is important because an assumption underlying the procedure for estimating recollection and automatic influences is that the criterion for responding does not change across conditions. Scores were collapsed across the test and attentional manipulation to yield a baserate value of .32.

Proportion of fragments completed with old words. Table 2 presents the proportion of fragments completed with old words under each experimental condition. Dividing attention decreased the probability of completing a fragment with an old word for the inclusion test and increased that probability for the exclusion test. This pattern of results was more pronounced when associative context was reinstated at test (related pairs) than when context was not reinstated (unrelated pairs). Results for the exclusion test replicate the pattern of results reported by Jacoby (1994). Although differences were small, after full attention to study, the probability of mistakenly giving an old word as a response was higher when context was, rather than was not, reinstated whereas the opposite was true after attention was divided during study. As described earlier, this pattern of results provides unambiguous evidence that reinstating context has separate effects on automatic and consciously controlled processes. Use of the process-dissociation procedure provides a means of measuring those separate effects.

TABLE 2

PROBABILITIES OF RESPONDING WITH AN OLD WORD AND ESTIMATES OF RECOLLECTION (R) AND AUTOMATIC INFLUENCES (A)

Pair type	Probabilities test		Estimates	
Attention	Inclusion	Exclusion	R	A
Related				
Full	.65	.32	.32	.45
Divided	.55	.40	.15	.46
Unrelated				
Full	.43	.34	.09	.37
Divided	.41	.37	.04	.38

Note: Baserate = .32.

Estimates of recollection and of automatic influences. By the process-dissociation procedure, the probability of recollection (R) is estimated as the difference between the probability of completing a fragment with an old word in the inclusion condition as compared to the exclusion condition. As shown in Table 2, the influence on R of divided vs full attention interacted with type of study pair (related vs unrelated), $F(1,82) = 5.57$, $MSe = .026$. The reduction in recollection produced by dividing attention was significant for words studied in related pairs, $F(1,82) = 13.93$, $MSe = .044$, but only approached significance for words studied in unrelated pairs, $F(1,82) = 2.77$, $MSe = .02$. The smaller effect for words from unrelated pairs probably reflects that recollection for those words was near floor even after full attention.

Dividing attention during study was expected to reduce the probability of recollection but leave automatic influences invariant. A process dissociation of that sort would provide support for the assumption that automatic and intentional processes independently contribute to performance by showing that the two types of influence can be independently manipulated. The equations described earlier were used to estimate automatic influences (see Table 2). An analysis of those estimates revealed that dividing attention during study had no effect on later automatic use of memory ($F < 1$), replicating the results of earlier experiments (Debner & Jacoby, 1994; Jacoby, 1994; Jacoby et al., 1993). In contrast, reinstating associative context did affect automatic influences. When context was reinstated (related pairs), old words were more likely to be automatically produced as a completion of a fragment than when context was not reinstated (unrelated pairs), $F(1,82) = 21.98$, $MSe = .012$.

Did reading a word produce significant automatic influences of memory when associative context was not reinstated? Such an effect would be expected if data-driven processing serves as a source of automatic influences. To examine that effect, estimates of automatic influences when context was not reinstated were compared with new-item performance (baserate). Effects of data-driven processing were documented by the finding that estimated automatic influences after study in unrelated pairs was higher than the baseline completion rate (.38 vs .32), $F(1,82) = 20.96$, $MSe = .006$.

Correlations between R and A

Correlations between R and A were computed in two different ways: by aggregating (collapsing) across subjects to compute item correlations between R and A and by aggregating across items to compute the correlation between R and A for subjects. Correlations have been treated as important for assessing the validity of the independence assumption underlying the process-dissociation procedure (Curran & Hintzman, 1995). Violation of the independence assumption can produce a bias in the estimate of automatic influences. However, it is only the correlation at the level of items that is potentially relevant when R and A is estimated for each subject, and even the importance of correlation at that level is arguable (Jacoby et al., in press a). When R and A are estimated separately for each subject, any correlation between R and A at the level of subjects is irrelevant for estimating automatic influences for the same reason that a correlation between height and weight across individuals is irrelevant for measuring the weight of a particular individual. That is, lack of stochastic independence between R and A at the level of subjects cannot bias estimates of A when A is estimated separately for each subject.

There was a significant correlation for subjects between R and A, collapsed across related and unrelated study pairs, r (82) = −.34. The correlation between R and A for items was also significant, r (88) = .24. Although significant, correlations at both the subject and item levels were small and, so, account for little of the variance. There are several possible accounts of the negative correlation between R and A at the subject level. As one possibility, subjects might differ in the extent to which they adopt a passive attitude at the time of test, and adopting a passive attitude might reduce the probability of recollection but enhance automatic influences (cf., Marcel, 1983). The positive correlation at the item level might be interpreted as showing differences among items in memorability that influence both R and A. However, even if R and A are not perfectly independent at the item level, the correlation is so low as to suggest that any influence on estimates of A produced by violation of the independence assumption would be trivially small (Jacoby et al., in press c).

In summary, reinstating associative context increased both recollection and automatic influences of memory. Dividing attention during study reduced the probability of later recollection but left automatic influences almost perfectly invariant. These results replicate those reported by Jacoby (1994). However, in contrast to results reported by Jacoby (1994), words studied in unrelated pairs produced automatic influences of memory as compared to baseline, showing an effect of data-driven processing. The reason for this difference is probably that word fragments were used in the present experiment whereas Jacoby (1994) provided only the first letter of the target word. The greater constraints on completing word fragments increased the likelihood of automatic influences.

EXPERIMENT 2

The results of Experiment 1 provided evidence that reinstating associative context has two independent effects—one effect on automatic influences and a second on intentional, controlled use of memory. Dividing attention during study produced a process dissociation by reducing the probability of recollection but leaving automatic influences invariant. Experiment 2 was designed to further differentiate the two effects of reinstating associative context, and to produce a process dissociation of a form opposite to that found in Experiment 1. The full-attention vs divided-attention manipulation used in Experiment 1 was replaced by a manipulation of study modality in Experiment 2. Changing modality between study and test was expected to have no effect on recollection but was expected to reduce automatic influences, showing a process dissociation opposite to that produced by full vs divided attention. The lack of an effect on recollection was expected because recollection in cued-recall performance is seen as primarily relying on prior conceptually driven processing when associative context is provided at test (cf., Jacoby, 1983).

Results of Experiment 1 can be interpreted as showing that there are two components of automatic influences: a conceptually driven and a data-driven component. The effects of reinstating associative context, measured as the difference between performance on related and unrelated pairs, can be taken as reflecting prior conceptually driven processing whereas the difference between performance on words from unrelated pairs and baseline can be interpreted as showing an effect of prior data-driven processing. Automatic influences based on prior data-driven processing may be fully eliminated by changing modality between study and test. When words are studied and tested in isolation, allowing only prior data-driven processing to influence word-completion performance, changing modality between study and test results in estimated automatic influences that do not differ from baseline (Jacoby et al., 1993; Jacoby et al., in press c; Toth et al., 1994). Consequently, words that were heard in unrelated pairs were expected to produce no automatic influences of memory on fragment-completion performance.

Will changing modality between study and test fully eliminate automatic influences of memory when associative context is reinstated? The answer to that question depends on the extent to which data-driven and conceptually driven processing are integrated. If the two types of processing are tightly integrated, as some (e.g., Jacoby & Brooks, 1984; Jacoby, Levy, & Steinbach, 1992; Kolers, 1975; Levy & Kirsner, 1989) have claimed, automatic influences should be fully eliminated by changing modality even when associative context is reinstated at test. That is, the effect of reinstating associative context should interact with the manipulation of modality such that reinstating context increases automatic influences only when modality is held constant between study and test. Because of their integration, changing modality would eliminate transfer from both data-driven and conceptually driven processing. Alternatively, effects of prior data-driven and conceptually driven processing might be largely independent in their contribution to automatic influences (Craik, 1991). In that case, changing modality would produce the same reduction in automatic influences, reflecting the elimination of data-driven automatic influences, regardless of whether or not associative context was reinstated. However, prior conceptually driven processing would remain as a source of transfer for words heard in related pairs and, so, estimated automatic influences for those words would be above baseline.

Method

Subjects. Sixty students enrolled in an introductory psychology class at McMaster University volunteered to participate in the experiment for course credit. Thirty subjects were randomly assigned to each of two experimental conditions produced by a manipulation of study modality.

Materials and procedure. The materials and details of list construction were the same as in Experiment 1. The procedure was also the same except that during Phase 1, pairs of words were either read or heard and subjects were required to judge whether words in a pair were associatively related. They were told to make their judgments by responding on the appropriately labeled key as quickly as possible before the next pair was presented. Each word pair was presented for 2 s, with a 500-ms delay between pairs. The judgment task was used to insure attention to the presentation of words in Phase 1. Other details of the procedure were the same as for Experiment 1 as were the analyses of results.

Results and Discussion

The probability of a correct judgment in Phase 1 for related and unrelated pairs was .91 and .95, respectively, when pairs were read and .90 and .92, respectively, when pairs were heard. Only the difference in accuracy for related vs unrelated pairs was significant, $F(1,58) = 6.45$, $MSe = .005$. In the test phase, completion rates for fragments corresponding to new words in the inclusion and exclusion tests were .29 and .33, respectively, for the condition in which words were read and .29 and .32, respectively, for the condition in which words were heard in Phase 1. Analyses revealed that the difference between baserates for inclusion and exclusion tests was not significant, and the interaction of modality with type of test did not approach significance ($F < 1$). Scores were collapsed across conditions to yield a baserate value of .30.

Estimates of recollection and automatic influences. An analysis of estimates of recollection (Table 3) showed that recollection was much higher when associative context was reinstated (related pairs) than when it was not reinstated (unrelated pairs), $F(1,58) = 78.42$, $MSe = .032$. Neither the main effect of modality nor the interaction of modality with type of pair approached significance (Fs < 1) in the analysis of estimated recollection.

An analysis of estimated automatic influences (Table 3) replicated the results of Experiment 1 by showing that reinstating associative context increased automatic influences, $F(1,58) = 32.24$, $MSe = .013$. The advantage for words presented in related pairs provides evidence of automatic influences originating from prior conceptually driven processing. Estimated automatic influences were also larger when words were read rather than heard during Phase 1, $F(1,58) = 4.59$, $MSe = .028$, showing that data-driven automatic influences were reduced by changing modality between study and test. The interaction of type of pair and modality did not approach significance ($F < 1$). That lack of interaction shows the separability of effects of prior conceptually driven and prior data-driven processing (Craik, 1991). Even the small numerical differences that were found are in a direction opposite to what would be predicted by a view that holds that data-driven and conceptually driven processing are tightly integrated (e.g., Jacoby & Brooks, 1984). The advantage produced by reinstated associative context (related vs unrelated pairs) was slightly larger when words were heard rather than read during study whereas an integration view would predict the opposite.

TABLE 3
PROBABILITIES OF RESPONDING WITH AN OLD WORD AND ESTIMATES OF RECOLLECTION (R) AND AUTOMATIC INFLUENCES (A)

Pair type	Probabilities test		Estimates	
Modality	Inclusion	Exclusion	R	A
Related				
Read	.69	.32	.37	.48
Heard	.64	.29	.35	.43
Unrelated				
Read	.42	.36	.06	.38
Heard	.37	.28	.09	.30

Note: Baserate = .30.

A comparison of estimated automatic influences for words read in unrelated pairs with baserate replicated the results of Experiment 1 by revealing data-driven, automatic influences on completion performance, $F(1,29) = 10.52$, $MSe = .006$. In contrast, estimated automatic influences were identical to baserate (.30) when words were heard in unrelated pairs, which replicates prior findings (e.g., Jacoby et al., in press c) that data-driven automatic influences are fully modality specific. Automatic influences originating from prior conceptually driven processing remained when modality was changed, as evidenced by the advantage of words heard in related pairs over baserate (.43 vs .30), $F(1,29) = 17.64$, $MSe = .014$.

Correlations between R and A were computed for Experiment 2 in the same way as for

Experiment 1. For subjects, the correlation between R and A was significant, $r\ (58) = -.46$. The correlation between R and A was also significant at the level of items, $r\ (94) = .26$. As in Experiment 1, the correlation at the level of items is so small that any bias in the estimation of A produced by violation of the independence assumption would likely be trivially small (Jacoby et al., in press a).

In summary, the results of Experiment 2 replicated those of Experiment 1 by showing that reinstating associative context enhanced both recollection and automatic influences of memory. Further, the manipulation of study modality revealed that effects of prior conceptually driven processing were modality free whereas effects of prior data-driven processing were fully modality specific. That pattern of results contradicts claims that data-driven and conceptually driven processes are tightly integrated (e.g., Jacoby & Brooks, 1984; Kolers, 1979) and, instead, shows that the two types of processing can separately contribute to performance (Craik, 1991).

General Discussion

Among the oldest and most replicable findings from investigations of memory is that memory performance reflects study/test compatibility (e.g., McGeoch, 1932; Tulving & Thomson, 1973). On a practical level, the importance of reinstated context is acknowledged by requiring its absence for those on parole for having committed a crime, so as to avoid its negative consequences, and by encouraging its presence in the form of environmental support (e.g., Craik, 1983, 1986) for those who are memory impaired, so as to gain its positive consequences. However, to understand effects of study/test compatibility it is necessary to distinguish between automatic and consciously controlled influences.

Results from amnesics and from indirect tests are suggestive but do not provide unambiguous evidence of automatic influences because of the possibility of contamination of performance by intentional, consciously controlled use of memory (e.g., Toth & Reingold, in press). Also, direct tests of memory may be contaminated by automatic influences of memory (e.g., Jacoby et al., 1993) and, so, findings of parallel effects of study/test compatibility on indirect and direct tests (Craik et al., 1994; McKoon & Ratcliff, 1979) are ambiguous with regard to their origin. As important, use of the direct/indirect test distinction provides no way of separating the contributions of automatic and controlled processes in situations for which both are contributing to performance. Placing automatic and controlled processes in opposition provides a means of demonstrating that reinstating context separately affects automatic and consciously controlled use of memory. The process-dissociation procedure allows one to gain quantitative estimates of those separate effects.

Most important, results gained using the process-dissociation procedure showed that reinstating associative context enhanced both recollection and automatic influences of memory, replicating results reported by Jacoby (1994). Dividing attention during study (Experiment 1) produced a process dissociation by reducing later recollection but leaving automatic influences invariant, as has been found in several other experiments (for a review, see Jacoby et al., in press b). Manipulating study modality (Experiment 2) produced an opposite process dissociation by leaving recollection unchanged but reducing automatic influences of memory. Results of further comparisons showed that conceptually driven, automatic influences were unchanged by the manipulation of study modality whereas data-driven, automatic influences were fully eliminated when modality was changed between study and test.

How tightly integrated are data-driven and conceptually driven processing? Levy (1993) provides a review and discussion of research aimed at answering this question. At the one extreme is the claim that data-driven and conceptually driven processing are so tightly integrated as to cast doubt on the utility of the distinction (Kolers, 1975). At the other extreme is the claim that transfer in re-reading produces fully separate effects of prior data-driven and conceptually driven processing (Craik, 1991). Although I have strongly favored an integration view (e.g., Jacoby & Brooks, 1984; Jacoby et al., 1992), the results reported in this paper (Experiment 2) provide strong support for the view that data-driven and conceptually driven processing serve as fully separate sources of transfer. However, it is likely that the integration of data-driven and conceptually driven processing differs across situations so that neither of the extreme positions will always hold. The process-dissociation procedure provides a way of documenting any such differences. If one can design a situation for which the two types of processing are tightly integrated, changes in modality or other perceptual details should eliminate automatic influences regardless of whether associative context is reinstated.

Data- vs Conceptually Driven Processing and Automatic vs Controlled Processing: Orthogonal Distinctions

The distinction between data-driven and conceptually driven processing has been important for theorizing about task dissociations (Jacoby, 1983; Roediger, 1990), and there is danger of confusion between that distinction and the automatic/controlled distinction. It is easy to mistakenly identify effects of prior conceptually driven processing with conscious control and those of prior data-driven processing with automaticity. However, in the reading literature, which is its origin (e.g., McClelland and Rumelhart, 1981), the data-driven vs conceptually driven distinction has been kept separate from the automatic vs controlled distinction. For example, schemas have been treated as a source of automatic, conceptually driven processing (e.g., Owens, Bower, & Black, 1979), and beginning reading has been said to require consciously controlled, data-driven processing (LaBerge & Samuels, 1974).

Results reported here show that the automatic/controlled distinction is orthogonal to the distinction between data- vs conceptually driven processing. As shown by the effects of reinstated associative context, study/test compatibility in conceptually driven processing can enhance both consciously controlled use of memory and automatic influences. Similarly, Jacoby et al. (in press c) showed that study/test compatibility in data-driven processing, produced by match in modality between study and test, enhances both consciously controlled and automatic influences.

Finding effects of prior data-driven and conceptually driven processing depends on the cues present at the time of test. The finding by Jacoby et al. (in press c) that study/test compatibility in modality influences recollection contrasts with the lack of an effect of modality change found in Experiment 2. An important difference between experiments is that associative context was provided at test in Experiment 2 but not in the experiments reported by Jacoby et al. (in press c). Reinstating associative context and instructing subjects to complete fragments with an associate emphasized prior conceptually driven processing, whose effects were modality free. Reinstating context is also important for finding automatic influences. Had word fragments been tested in isolation, differences in conceptually driven processing would not be expected to produce differences in automatic influences (Toth et al., 1994).

For understanding dissociations shown by amnesics and those produced by manipulating indirect/direct test instructions, the important contrast is likely the contrast between automatic vs controlled processing, rather than that between data-driven and conceptually driven processing (cf., Blaxton, 1992). Findings taken as evidence that amnesics are impaired in their ability to engage in conceptually driven processing might be better interpreted as reflecting a deficit in consciously controlled processing. Successful performance of a conceptually driven task might generally require more cognitive control than does successful performance of a data-driven task. For example, answering questions that rely on general knowledge might typically be less automatic than is completing word stems. To show a deficit that is unique to conceptually driven processing, it is necessary to equate tasks with regard to their reliance on controlled processing. Regardless, our results show that manipulations traditionally identified with cognitive control have a large impact on recollection, intentional retrieval, but leave automatic influences unchanged. As described earlier, such dissociations can be found whether the test relies on data-driven or conceptually driven processing although the details of dissociations differ with those of the test.

Assumptions Underlying the Process-Dissociation Procedure

Elsewhere (e.g., Toth et al., 1995) we have responded to critics of the process-dissociation procedure. Here, I briefly respond to critics and, more important, highlight boundary conditions that must be met for use of the process-dissociation procedure. The strategy for the process-dissociation procedure, as used here, is to start with the assumption that consciously controlled and automatic influences *independently* contribute to performance and then design conditions in ways aimed at meeting that assumption as well as other necessary assumptions (Jacoby et al., 1993). It is important to note that I do not claim that automatic and consciously controlled processes are *always* independent (for a discussion of alternative relationships, see Jacoby et al., in press c). Rather, the experiments were carefully designed to produce such independence, and to avoid pitfalls for application of the process-dissociation procedure.

An important concern is the instructions given at the time of test. Instructions for both inclusion and exclusion tests strongly encouraged subjects to use the associate and word fragment as cues for direct retrieval of a studied word. Changing these direct-retrieval instructions to encourage a generate/recognize strategy would likely result in violation of the independence assumption (Jacoby et al., in press a). A criticism voiced by some is that subjects might fail to understand instructions for an exclusion test—responding with an old item whereas if they understood instructions, they would not do so (e.g., Graf & Komatsu, 1994). As described elsewhere (e.g., Toth et al., 1995), we have developed procedures to check subjects' understanding of instructions, and replicated findings of process dissociations using subjects that we can be certain understood exclusion instructions.

Another important concern is avoiding floor and ceiling effects. If performance in an exclusion condition is perfect so that old items are never given as a response (Exclusion = 0), our equations will necessarily estimate unconscious influences as being zero. Such floor effects can mask invariances that would otherwise be found (Jacoby et al., in press a; Jacoby et al., 1993). Equally important, if performance in an inclusion condition is perfect (Inclusion = 1.0) our equations will necessarily estimate unconscious influences as 1.0, producing a ceiling effect. Test items were selected to have a baserate that was sufficiently high to leave room for recollection to operate on the exclusion test, avoiding floor effects. Baserate was also sufficiently low to avoid ceiling effects on the inclusion test.

To show automatic influences, it is important that responding be sufficiently constrained to make it likely that an old item will automatically come to mind. It is probably because of the lack of constraint on responding that Jacoby (1994) failed to show data-driven, automatic influences, and that problem is solved by providing word fragments rather than only the first letter of a target word. Yet another concern is that responding be sufficiently constrained to make it necessary to use recollection to avoid giving an old item as a response for the exclusion test. Had responding not been constrained by materials and instructions, subjects could have ''excluded by rule.'' As an example, they might try to avoid old words by using the rule that if a word is unrelated to the context word it is unlikely to have been in the earlier-presented list. This avenue was closed by instructing subjects to complete fragments with a word that was a common associate of the context word. It is important to avoid exclusion by rule because its use violates the assumption that the consciously controlled use of memory (recollection) for the exclusion test is the same as that for the inclusion test.

As described by Jacoby et al. (in press c) one source of converging evidence of the success of our procedures comes from results showing that variables traditionally associated with reduced cognitive control affect our estimates of consciously controlled processing but leave automatic influences unchanged. We gain further support for our independence model by building on findings of task dissociations. Findings from indirect tests provide converging evidence for conclusions based on the use of the independence model. For example, manipulations of attention (e.g., Koriat & Feuerstein, 1976), and aging (Light, 1991) have large effects on direct test performance but little or no effect on indirect test performance. Similarly, we find those factors affect recollection but not automatic influences. Further, if an indirect test provided a process-pure measure of automatic influences and if automatic and controlled influences are independent, one would expect the estimate of automatic influences gained by use of the process-dissociation procedure to be equal to performance on the indirect test. Under conditions that are least likely to result in conscious contamination of performance on indirect tests, there is a close match between estimated A and indirect test performance (Jacoby et al., in press c; Toth et al., 1994).

The Importance of Separating Automatic and Controlled Processes

Failures to distinguish between automatic and controlled influences of reinstating context can lead to errors in interpretation which potentially have important practical, as well as theoretical, consequences. Effects of environmental support on the memory performance of the elderly serve as an example.

Craik (1983, 1986) used the idea of environmental support to account for different patterns of age-related declines in a variety of memory tasks. For example, age differences in free recall are usually large, whereas differences in recognition are typically small (Craik & McDowd, 1987) and differences in performance on indirect tests are smaller still (Light & La Voie, 1993). To account for these differences, Craik suggested that memory and other cognitive tasks vary in the extent to which the external context induces or supports the mental operations appropriate for the specific situation. Further, he suggested that older people are more reliant on such environmental support, and will perform relatively well when support is present but poorly when it is absent. The poor performance of the elderly in the absence of environmental support is said to result from their lessened ability to engage in self-initiated activities. The importance of environmental support has been acknowledged by attempts to maximize its availability through the design of special environments for people whose memory is impaired (Park, 1992).

Craik's (1983, 1986) suggestions concerning environmental support were restricted to the beneficial effects of context on conscious recollection; he did not take into account the complicating factor of induced habit. Effects of both sorts must be considered for understanding age-related deficits. Otherwise, effects of environmental support might be mistakenly taken as showing increased recollection when the true effect is on the contribution of automatic influences. Separating the two effects of environmental support is important for the design of training programs aimed at rehabilitation of memory performance as well as for the design of special environments for memory-impaired people. Only by taking into account automatic influences can one pursue the target of finding means of enhancing and rehabilitating recollection—the consciously controlled use of memory (Jacoby et al., in press b).

At an even more general level, it is common to emphasize the constraining effects of context with reference to science and social behavior. Scientific discoveries are said to reflect the zeitgeist rather than the contribution of any one individual (e.g., Kuhn, 1970). A life of crime is said to be the near inevitable consequence of being in a context that supports crime. However, ''automatic'' is not synonymous with ''inevitable.'' To some extent, we are prisoners of context, but context also offers opportunity for its own consciously controlled change. We contribute to the creation of our own context as well as living in that context. Indeed, Bowers (1973) argues that laboratory experiments overestimate the importance of situational context for social behavior by not allowing the possibility of people choosing or creating their own context. For memory performance, at least, the process-dissociation procedure allows initial steps toward separating automatic and consciously controlled influences of context.

Appendix

Stimuli Used in Experiments

Cue	Fragment	Target	Baserate	Other	Baserate
afraid	--a-e	scare	.46	brave	.03
ale	b-e-	brew	.03	beer	.87
anchor	s--p	stop	.15	ship	.60
apple	-or-	core	.66	worm	.00
arrow	sha--	shaft	.17	sharp	.27
barn	-ar-	farm	.21	yard	.48
basin	--sh	dish	.10	wash	.73
bed	s-ee-	sheet	.19	sleep	.59
belly	f-o-	flop	.33	food	.29
bit	---ll	drill	.06	small	.30
bread	cru--	crust	.18	crumb	.79
bridge	---er	water	.27	river	.06
business	de--	desk	.06	deal	.67
car	m-t--	motor	.62	metal	.02
carbon	co--	coal	.15	copy	.58
carry	-o-d	hold	.35	load	.28
chair	-e-t	seat	.61	rest	.04
cigar	bu--	burn	.13	butt	.71
comfort	--zy	cozy	.59	lazy	.35
criminal	c--e	case	.18	code	.35
cry	--wl	howl	.63	bawl	.17
cushion	s-f-	soft	.27	sofa	.65
cut	--i-e	knife	.19	slice	.38
die	---ve	grave	.43	leave	.01
disappear	--de	fade	.15	hide	.51
door	kno--	knock	.55	knobs	.34
drama	st---	stage	.44	story	.14
dress	s--rt	skirt	.31	shirt	.28
eagle	b--d	bald	.16	bird	.69
earth	-o--d	round	.11	world	.31
figure	s-a-e	skate	.21	shape	.15
find	-ee-	keep	.12	seek	.51
flower	-a-sy	pansy	.06	daisy	.63
fox	-ai-	lair	.04	tail	.40
golf	gr---	green	.39	grass	.22
gun	h--t	hunt	.43	hurt	.11
hair	bl---	blond	.53	black	.30
hard	-o-k	work	.12	rock	.18
head	s--l-	skull	.11	scalp	.03
heart	l-v-	live	.11	love	.88
hell	fie--	fiery	.28	fiend	.17
idiot	du---	dunce	.17	dummy	.48
jail	cr---	crook	.09	crime	.51
joy	gl--	glad	.36	glee	.29
judge	ju--	jury	.73	just	.04
justice	tr---	truth	.17	trial	.60
kids	--ats	brats	.49	goats	.03
king	re---	regal	.15	reign	.33
knee	b-n-	bone	.22	bend	.49
lake	po--	pond	.71	pool	.16
lamb	wo--	wool	.74	wolf	.19
limp	w--k	weak	.51	walk	.46

CUE	FRAGMENT	TARGET	BASERATE	OTHER	BASERATE
LION	-A-E	CAGE	.15	MANE	.20
LOCK	CL-S-	CLASP	.20	CLOSE	.70
LOUD	-OI-E	NOISE	.86	VOICE	.05
MARK	-R-N-	BRAND	.04	PRINT	.03
MATCH	--ME	GAME	.12	SAME	.23
MEMORY	--ST	TEST	.28	LIST	.06
MERMAID	---LE	SCALE	.00	FABLE	.00
MONEY	B-L-	BILL	.56	BELT	.11
MOON	--GHT	NIGHT	.31	LIGHT	.59
MOUNTAIN	HI--	HILL	.33	HIGH	.28
NAIL	-I-E	BITE	.29	FILE	.19
NEEDLE	P-I--	PRICK	.30	POINT	.27
NUT	CRA--	CRACK	.83	CRAZY	.05
OCEAN	S---Y	SPRAY	.30	SALTY	.06
ORDER	C---S	CHAOS	.11	CLASS	.16
PANIC	--RRY	HURRY	.47	WORRY	.27
PEOPLE	-RO--	CROWD	.19	GROUP	.17
PERIOD	CO---	COLON	.13	COMMA	.21
PIG	P--K	PORK	.52	PINK	.26
POTATO	--I-S	CHIPS	.33	FRIES	.13
RABBIT	H--E	HOLE	.21	HARE	.48
RAVINE	GUL--	GULLY	.63	GULCH	.02
REASON	---VE	SOLVE	.03	PROVE	.01
RENT	---SE	LEASE	.32	HOUSE	.41
ROAD	-U--Y	CURVY	.06	BUMPY	.04
ROBBER	-A-K	BANK	.17	MASK	.01
SCISSORS	--IP	CLIP	.37	SNIP	.55
SEA	SH---	SHELL	.32	SHORE	.60
SEQUEL	-OV--	NOVEL	.59	MOVIE	.04
SLOW	--AI-	SNAIL	.19	TRAIN	.03
SNOW	SL---	SLUSH	.22	SLEET	.17
SPEAK	T-L-	TELL	.30	TALK	.52
SQUARE	-O-T	FOOT	.03	ROOT	.43
STANZA	P-E-	POEM	.28	POET	.03
STREET	LA--	LANE	.26	LAMP	.58
SUGAR	--N-Y	CANDY	.29	HONEY	.31
SWEET	T--T-	TOOTH	.29	TASTE	.36
SWIM	FI--	FISH	.71	FINS	.11
TABLE	-L-T-	CLOTH	.23	PLATE	.19
THIEF	S-EA-	SNEAK	.03	STEAL	.64
TOBACCO	SM---	SMELL	.20	SMOKE	.80
TROUT	BA--	BASS	.39	BAIT	.38
WINDOW	CLE--	CLEAN	.37	CLEAR	.39
WINE	G-A--	GRAPE	.26	GLASS	.61
		PRACTICE ITEMS			
FAST	--I-K	QUICK		BRISK	
SCHOOL	-EA--	TEACH	.67	LEARN	
DOCTOR	HE--	HEAL	.50	HELP	.50
EAT	DI--	DINE	.00	DIET	1.00
EXCUSE	ALI--	ALIBI	.50	ALIAS	.00
ANGEL	H-L-	HALO	.20	HOLY	.00
COLD	FRO--	FRONT	.00	FROST	.50

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(Received July 28, 1994)

(Revision received April 7, 1995)