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Implicit Remembering : The Fluency of Reprocessing

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Abstract. Implicit remembering is remembering without intention. Priming is the benefit that occurs on a memory test due to a prior related study episode, without requiring awareness of the study-test relation. Using several different implicit tasks, we first provide evidence that priming in implicit remembering relies on both conceptual and perceptual processing. We then argue that priming is produced by greater fluency of processing for previously encoded as opposed to new stimuli. We present evidence that this fluency is not the result of improved perception, but rather derives from automatic recruitment of memory for similar processing episodes.

Remembering is the interplay between encoding and retrieval, as clearly set out in the concept of "transfer appropriate processing" (Morris, Bransford, & Franks, 1977). Therefore, a critical factor for effective remembering is a good match between encoding and retrieval. Like Kolers and Roediger (1984), we take a view of remembering that emphasizes the processes, rather than the products of those processes. We see encoding as invoking a set of processes to handle an initial episode, and retrieval as invoking another set of processes to handle the same episode when it is repeated. The greater the overlap of the processes on the two occasions, the more likely remembering will be successful. Remembering, then, is the re-enactment of processes. Indeed, under this view, the distinction between encoding and retrieval is not particularly useful : These are just two processing occasions.

Implicit vs. Explicit Remembering

Remembering can occur with or without awareness. When asked to remember what we did on the weekend, we try to recall the events and are quite aware of consulting memory. Such conscious recollection is what people usually think of when they talk about remembering. But this is certainly only a small part of remembering. Much of our day-to-day remembering is done without awareness or intention. To use a familiar word processor with all of its many features necessarily involves remembering, but we need not be (and usually are not) conscious of remembering. Similarly, going over notes prior to giving a lecture must involve remembering, but we generally do not feel as if we are remembering.

Graf and Schacter (1985) called conscious recollection "explicit remembering" and unconscious recollection "implicit remembering," in recognition that these two ways of remembering operate quite differently. In contrast to the past century of research aimed primarily at understanding explicit remembering, much of the recent research has examined instead implicit remembering. Usually, implicit remembering is made evident through the enhanced processing of information that has been previously encountered, a benefit now widely called "priming." This article is intended to serve as an overview of our recent collaborative research on priming in implicit remembering, conducted in our laboratories in Canada.

Processing and Fluency

Roediger and his colleagues (Roediger, 1990 ; Roediger & McDermott, 1993) have developed a processing account of implicit remembering that derives from the concept of transfer appropriate processing. They maintain that certain implicit remembering tasks, such as those that involve identification of degraded words, depend primarily on data-level processing with priming due to the repetition of perceptual processes applied to the specific form of the stimulus. In contrast, explicit remembering is ordinarily much more dependent on conceptually driven processing having to do with reprocessing the meaning of the stimulus. Although the implicit/explicit and data-driven/conceptually driven dichotomies are not perfectly overlapping, this is the typical relation between them, as apparent especially on tests such as word fragment completion, where a subject must attempt to "solve" a fragmented word (e.g., umbrella for the fragment _m_re_la).

The concept of "fluency" has also been put forward as an explanatory framework in the domain of implicit remembering (cf. Jacoby & Brooks, 1984). When we use memory, particularly when we are not aware of using it, we benefit from repeated processing by virtue of the enhanced fluency of that processing. Thus, having read the word "umbrella" earlier in this article can enhance your reading of it again in this sentence. Such priming can be measured by enhanced speed or accuracy of processing a stimulus upon experiencing it a second time.

In contrast to Roediger's view that implicit priming on degraded word identification tasks hinges mainly on perceptual processing, we have argued that both perceptual and conceptual processing underlies such priming (see Masson & MacLeod, 1992). Our view is that when a stimulus is first encountered, people try to derive a quick interpretation of the stimulus that takes in its conceptual as well as its perceptual aspects, resulting in what we call an "initial interpretive encoding." The processes that created this encoding are the ones most likely to be used again the next time the same stimulus appears, supporting priming on implicit tests. If there is incentive or time to continue processing the stimulus during encoding, we may also carry out a "subsequent elaborative encoding," an encoding especially relevant to later explicit recollection.

Reading vs. Generating in Masked Word Identification

We base our explanation on the results of a series of experiments reported in Masson and MacLeod (1992). Subjects did one of two encoding tasks : They either read a word (e.g., horse) or generated it from a clue (e.g., the animal a cowboy rides-h). Reading emphasizes perceptual processing ; generating emphasizes conceptual processing. It is well established that explicit remembering is much better following generation than reading (Slamecka & Graf, 1978). However, implicit remembering has been shown to produce the opposite pattern, with more priming for words read than for words generated (see Roediger & McDermott, 1993, for a review). This is consistent with Roediger's processing view outlined earlier : Perceptual processing helps implicit remembering whereas conceptual processing helps explicit remembering.

Most previous research examining implicit remembering following the read vs. generate manipulation used the word fragment completion test (see Roediger & McDermott, 1993}. We began with a different task : masked word identification (often called perceptual identification). Here, subjects see a word presented very briefly (for about 30 ms) and followed by a pattern mask at the same location. Their task is to try to identify each masked test word, saying it aloud. The task is difficult and the dependent measure is accuracy. Priming is indicated by more probable identification of words encoded during the study phase than of new words not previously studied.

We found (Masson & MacLeod, 1992) virtually always the same pattern over 11 experiments : Priming in masked word identification was robust for both read and generated words and, most important, it was equivalent for the two types of studied words. This was true despite a huge advantage on an explicit recognition test for generated words. As illustrations, we present the data for two of the generation rules in TABLE 1, Experiment 4 using famous names (e.g., F_______ Sinatra ; generate "Frank") and Experiment 7 using definitional sentences (a watch is worn on the w_______ ; generate "wrist"). Clearly, read and generated words produced equal priming. We argued from this very robust and reliable pattern that both conceptual and perceptual encoding must have been carried out during the study phase and must have made significant contributions during word identification in the test phase, in contrast to Roediger's processing account.

TABLE 1 Mean Proportions of Correct Responses in Masked Word Identification and of 'Yes' Responses in Recognition
(from Masson & MacLeod, 1992)

Encoding Condition Test	Generate	Read	New
Exp. 4 : Famous Names			
Masked Word	.72	.72	.60
Recognition	.70	.45	.10
Exp. 7 : Definitional Sentences			
Masked Word	.72	.72	.52
Recognition	.72	.50	.14

Comparing Masked Word Identification with Word Fragment Completion

The contrast between the Roediger findings with word fragment completion and our findings with masked word identification is troubling. The temptation is to ask which pattern is the "real" one : more priming for read than for generated words, as in word fragment completion, or equivalent priming for read and generated words, as in masked word identification. This contrast was made even more troubling when Weldon (1991) reported greater priming for read than for generated words in masked word identification, in direct opposition to our results. We decided to tackle the problem by comparing the two tasks under highly similar situations using identical materials, in this case the definitional clues used by Weldon (1991), much like those used in Experiment 7 of Masson and MacLeod (1992).

TABLE 2 Mean Proportions of Correct Responses in Masked Word Identification and in Word Fragment Completion
(from MacLeod & Masson, 1996a)

Encoding Condition Test	Generate	Read	New
Exp.2 : Masked Word Identification	.54	.59	.29
Exp.3 : Word Fragment Completion	.39	.53	.23

To resolve this conflict, we have now conducted a series of experiments (MacLeod & Masson, 1996a) using the read vs. generate manipulation with both types of tests. The "bottom line" is that only under a particular combination of conditions - at least three different encoding tasks conducted in blocks - does the greater priming for the read condition reported by Weldon appear in masked word identification. Otherwise, the patterns are stable : There is equivalent priming for read and generated words in masked word identification but greater priming for read than for generated words in word fragment completion. The results from one of our new experiments comparing the two tests are shown in TABLE 2. It may well be that performance in word fragment completion relies primarily on perceptual encoding, whereas masked word identification taps into both conceptual and perceptual encoding.

Speeded Oral Word Reading as an Implicit Measure

When task differences of this sort appear, one approach is to compare them directly, as just described (MacLeod & Masson, 1996a). But such discrepant findings also call for generalization. We decided to shift to a radically different implicit measure, oral word reading. This is the task often called "naming," in which subjects must read a word aloud as quickly as possible, the dependent measure being response time. Priming is apparent when previously studied words are faster to read aloud than are unstudied words. MacLeod (1996) has provided evidence that word reading is a sensitive index of priming. Furthermore, word reading has at least two valuable properties as an implicit measure of memory : (1) it does not use degraded test stimuli, eliminating the slow, problem solving approach required by many implicit tasks, and (2) using response latency as the dependent measure encourages subjects to respond quickly, consistent with the highly automatic nature of word reading. Both of these advantages act to minimize the potential for contamination from conscious recollection.

MacLeod and Masson (1996b) report four new experiments in which Reading vs. Generating words during encoding consistently led to equivalent enhancement (priming) of subsequent oral word reading. The data from one of these experiments, again using

Weldon's (1991) definitional generation cues to maintain consistency, are presented in TABLE 3. Clearly, it is the pattern observed in masked word identification that generalizes, not the pattern in word fragment completion. Furthermore, the greater automaticity of the speeded oral word reading measure minimizes concerns about the possible intrusion of intentional recollection. Subjects responded very quickly, hardly allowing the possibility of slower recollective processes.

TABLE 3 Mean Response Latencies of Correct Responses in Speeded Oral Word Reading
(from MacLeod & Masson, 1996b)

Encoding Condition		
Generate	Read	New
500	495	516

We should mention one other intriguing fact. MacLeod (in press) contrasted two implicit tests in a series of experiments where all words were simply read and studied during encoding, in anticipation of an explicit test. At the time of test, all words were presented in one of four randomly assigned print colors. One implicit test was word reading, a direct measure in that subjects read the words at test just as they had at study, ignoring the print color. TABLE 4 presents the data from one of these experiments, and word reading clearly showed reliable priming. However, when asked to do the more indirect test of naming the color and ignoring the word, subjects showed no effect at all of prior study. We take this result as supporting our theoretical view : The processes used during encoding must be used again during retrieval for priming to emerge. This recapitulation of processing happened only for word reading ; for color naming, prior reading at the time of encoding was not relevant and therefore did not affect the time to name colors. Priming is highly specific, dependent on replaying previous processes.

TABLE 4 Mean Response Latencies of Correct Responses in Speeded Oral Word Reading and in Color Naming
(from MacLeod, in press)

Task	Old	New
Word Reading	579	594
Color Naming	639	643

Sensitivity vs. Fluency

What underlies priming? One obvious possibility is that prior experience with a stimulus makes subsequent sensory/perceptual processing of that stimulus easier. In the case of masked word identification, for example, the masked word might simply be easier to see after it has been studied. But the fluency account presents another possibility that we wish to explore in this final section. Perhaps priming does not increase perceptual sensitivity at all, but instead makes the retrieval of studied items more probable. Can we find evidence for this position, which would be very much in accord with our overall fluency explanation?

In this final series of experiments (Masson & MacLeod, in press), we created a new version of the masked word identification task, comparing performance on it to the usual measure. For clarity, we will call the usual measure the "free report" version, because subjects must produce their own responses and are given no candidate possibilities after the mask. We also used a two-alternative "forced choice" version, where the masked target word was followed by two test words and the subject had to pick the one that matched the target word. The studied status of the two test words was the same on every trial : Either both words had been studied or neither word had been studied. It was always the case that one of the two test words matched the target word. If perception of the target was improved for studied words, then both the forced choice and the free report measures should show priming because the target word would be easier to see in both cases. If, on the other hand, priming results from more fluent retrieval of previously studied target words, then that fluency would be experienced for both test words in the case of studied words. Differential fluency could not then be used to distinguish between the two alternatives, thereby eliminating the advantage for studied words. Thus, the fluency account predicts priming only on the free report version.

TABLE 5 Mean Proportions of Correct Responses in Different versions of the Masked Word Identification Task
(from Masson & MacLeod, in press, Experiment 1)

Task	Old	New
Free Report	.59	.46
Forced Choice	.80	.80

As TABLE 5 clearly shows, priming was evident only on the free report version. We repeated this experiment with a "single probe" test word after the mask. Subjects responded either yes or no to indicate whether the probe word matched the target word. We again found no evidence of priming. We went on in another experiment to increase the time between the masked target word and the single probe to 2 seconds, and required the subjects to attempt to identify the target word prior to responding to the probe. The idea was to encourage subjects to reinstate retrieval prior to the probe, leading them to experience a sense of processing fluency associated with the target word. This experience of fluency was expected to restore priming. Indeed, priming returned under this condition. We take these results as evidence that enhanced performance on implicit measures is indeed a consequence of fluent retrieval, and not of greater perceptual sensitivity.

Conclusion

We have described a series of studies supporting the argumant that enhanced performance when a word is processed for a second time depends on the fluent reapplication of processing operations that were applied during an earlier episode. Thus, the concept of fluency is inherently episodic, with the similarity of two processing episodes — encoding and retrieval — leading to priming. Fluency results because the test situation calls forth the same processes as did the study situation. Moreover, we have presented evidence that both conceptual and perceptual processes are used to construct an initial interpretive encoding at the time of study, and it is the match to that encoding that makes retrieval proceed more efficiently for previously studied items at the time of test. Implicit remembering relies strongly on this fluent reprocessing.

Author Notes

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