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An Illusion of Memory: False Recognition Influenced by Unconscious Perception

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The results of two experiments showed that an illusion of memory can be produced by unconscious perception. In a first phase of those experiments, a long list of words was presented for study. For the test of recognition memory given in the second phase of each experiment, presentation of a "context" word preceded that of most recognition test words. Ss were to judge whether or not the test words had been presented during the earlier study phase of the experiment. Effects of a context word on this recognition memory decision were opposite when Ss were aware vs. unaware of its presentation. For example, as compared to a condition in which no context word was presented, the probability of false recognition was increased when Ss were unaware but decreased when Ss were aware of the presentation of a context word that matched the recognition test word. Results are discussed in terms of unconscious influences on an attribution process.

Titchener (1928) described false recognition or paramnesia as an illusion of memory that is produced by "a disjunction of processes that are normally held together in a conscious present" (p. 425). He illustrated his argument with the example of a person who hastily glances across a street in preparation for crossing and is then momentarily distracted by the contents of a store window. On crossing the street, the person experiences false recognition as the feeling of having previously crossed that same street, a feeling of déjà vu. By Titchener's account, "the preliminary glance, which naturally connects with the crossing in a single, total experience, is disjoined from the crossing, . . . , and comes to consciousness separately as the memory of a previous passage" (p. 425). This is described as the severing of "two phases of a single consciousness; the one is referred to the past; and the other, under the regular laws of memory, arouses the feeling of familiarity" (p. 425).

Our experiments were aimed at producing a memory illusion of the sort described by Titchener. We arranged a situation in such a way that a "hasty glance" at a word immediately before its presentation for a recognition memory test might produce the illusion that the test word was one of the words presented in an earlier list. First, we presented a long list of words that people were instructed to remember for a later test. Words from that list were then mixed with new words and presented in a test of recognition memory. Subjects were to judge whether each test word had been presented in the list studied earlier. During that test of list recognition, the presentation of a word for recognition was preceded by a word that was flashed for a brief duration and visually masked to prevent its being seen. The flashed word provided a hasty glance that we expected would produce false recognition of a test word. When the context word was the same word as presented for the test of recognition memory, we expected the probability of false recognition to be higher than it would be had the context word and recognition test word not been the same or if no context word had been presented. We refer to the flashed word as the *context word*, although, in more popular terminology, that word would be called a *prime*. We chose not to use the word *prime* because we later argue that the effects on recognition memory of preceding a test word with a context word are not produced by priming.

We presented the context word subliminally to prevent its entering consciousness as a separate event connected to presentation of the test word. As in the example from Titchener (1928), memory for the glance at the context word was expected to be disjoined from consciousness of its presentation as a test word, which would result in a feeling of familiarity when the test word was presented. A first problem that we faced was that of being certain that any effects that we observed were truly produced by subliminal or unconscious perception of the context word rather than simply the familiarity that would stem from seeing the same word twice.

Claims of the existence of unconscious perception are controversial (see Holender's 1986 review and associated peer commentaries). Much of that controversy has surrounded the sufficiency of procedures used to ensure that the duration, conditions of masking, and so on are such as to make the presentation of an item subliminal. We circumvented those issues by arranging the situation so that awareness of a presented item would produce a pattern of results opposite to that produced by presentation of the item without awareness. Given a finding of opposite effects, one can be certain that

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effects observed in a supposedly unaware condition were not actually due to subjects' being aware of the presentation of an item without the experimenter's detecting that awareness.

There is good reason to think that awareness and lack of awareness of the presentation of a context word would produce opposite effects on the probability of a false recognition. If subjects were aware of the presentation of a context word that was the same as the test word, they might be less willing to call the test word "old" than they would be had no context word or an unrelated context word been presented. This is because any familiarity of the test word could be partly attributed to the word's having just been read as a context word; that is, if subjects were aware that a test word had been preceded by its presentation as a context word, they may discount the familiarity of the test word for recognition because they assume that its familiarity is due to its immediate prior presentation. Doing so would make them less willing to claim that the test word was one of those in the list studied earlier. The predicted decrease in the probability of a false recognition is the opposite of what would be predicted if subjects were not aware of the presentation of context words.

Our reason for attempting to produce an illusion of memory was to learn more about what Titchener (1928) referred to as the "regular laws of memory" that are responsible for arousing the feeling of familiarity. Mandler (1980) described the feeling of familiarity as reflecting the degree of perceptual integration of a tested item. Repetition of a word is said to contribute to the perceptual integration of some abstract representation of the word such as a logogen (Morton, 1969). Although presented under conditions that do not allow its becoming conscious, presentation of a word is said to prime or temporarily activate one or more abstract representations in memory that contain information about the meaning and orthographic characteristics of the word (e.g., Balota, 1983; Evett & Humphreys, 1981; Forster, 1985; Marcel, 1983a). In our situation, priming that is produced by unconscious perception of a context word might be responsible for any feeling of familiarity that is aroused when the same word is presented in a test of recognition memory.

However, rather than talking in terms of priming, we (e.g., Jacoby, 1988; Jacoby & Dallas, 1981; Jacoby, Kelley, & Dywan, 1989) have related the feeling of familiarity to fluency of processing. We have suggested that the feeling of familiarity rests on an attribution or inference about the source of effects on processing. The fluency heuristic that we believe underlies the feeling of familiarity is in some ways similar to the availability heuristic that Tversky and Kahneman (1973) proposed as underlying judgments of probability. By the availability heuristic, the probability of an event will be judged as high if one can easily bring to mind a prior occurrence of that class of events. Similarly, by the fluency heuristic, an item seems familiar if its can be easily brought to mind, fluently processed. This means that factors that facilitate the processing of a test item will produce a feeling of familiarity, whereas factors that disrupt the processing of a test item will produce a feeling of strangeness or lack of familiarity, in comparison to a baseline condition.

For the attribution process, the presence of alternatives to familiarity as a plausible source of effects is important. In our situation, this consideration brings us back to the manipulation of awareness versus lack of awareness of the presentation of the context word. We expected this manipulation to produce opposite effects on the probability of false recognition by influencing the attribution process. In the following contrast of our attribution view with a priming view, we are concerned only with the case in which people are unaware of the presentation of context words, the case of unconscious perception.

By our attribution view, unconscious perception of a context word can facilitate subsequent processing of that word when it is presented for recognition and thereby give rise to a feeling of familiarity. The unconsciously perceived context word and the recognition test word are integrated perceptually. This results in a head start in the processing of the test word that allows the test word to be more fluently processed. The attribution of this fluent processing of the test word to the past underlies its feeling of familiarity. In this case, the prediction made from an attribution view does not differ from the prediction that would be made if effects on familiarity were seen as reflecting priming. However, consider a case in which the context word and the test word are unrelated, a case in which the two words do not match. The processing of the text word will still be in the context of or integrated with the unconsciously perceived word. However, in this case, any integration with the processing of the unconsciously perceived word will "mislead" the processing of the test word. The effect should be to disrupt or slow the processing of the test word; that is, presentation of a context word that does not match a test word should produce cost in the processing of the test word, in comparison with a condition in which no context word is presented. The effect of this disruption in processing fluency would be to make the test word seem less familiar than it would be had the word's presentation not been preceded by an unconsciously perceived context word.

By a priming account, in contrast, presentation of a context word that does not match a test word should have the same effect as not presenting a context word; that is, it should produce no cost. Priming the memory representation of the context word should have no effect on the representation of the test word if the two words are unrelated. Priming accounts have explained cost as resulting from consciously controlled processing that can occur in addition to the automatic spreading activation produced by presentation of a word (Neely, 1976; Posner & Snyder, 1975). Such consciously controlled processing is clearly impossible in the case of unconscious perception, and so one should observe no cost or any other effects of presenting a context word that does not match a test word.

To summarize, subjects first studied a long list of words, and then the the words from that list ("old" words) were mixed with "new" words and presented in a test of recognition memory. Subjects judged whether a tested word had been one of the words studied in the list presented earlier. Recognition test items were preceded by a context word that matched the test word, a context word that did not match the test word, or, as a baseline condition, no context word. A manipulation of presentation duration along with one of instructions was meant to make subjects in one condition aware and subjects

in another condition unaware of the presentation of context words. In the unaware condition, a match between the context word and the test word was expected to increase and a nonmatch was expected to decrease the probability of a false recognition, in comparison with the baseline condition. In the aware condition, in contrast, a match between the context word and the test word was expected to produce a probability of false recognition that was lower than that produced by a nonmatch; that is, the pattern of results expected in the aware condition was opposite to that expected in the unaware condition. Our two experiments differed in the details of the manipulations used to make subjects aware versus unaware of the presentation of context words.

To this point, the prediction of effects has centered on the probability of false recognition. However, the recognition test list did include words that had been presented in the list studied earlier (old words), as well as words that had not been presented in that list (new words). The manipulation of awareness and of context words for the recognition test of old words was the same as that described for new words. Although the effect of these manipulations on the probability of correctly calling a test word "old" should generally parallel effects on false recognitions, effects on old test words are likely to be smaller than those on new test words. The context word should affect the probability of calling a test item "old" to the extent that it influences fluency of processing. In previous research (e.g., Jacoby & Dallas, 1981) on the impact of one versus two presentations of a word on later fluency of processing as indexed by probability of perceptual identification, investigators found the effect to be largest for the difference between no presentation and one presentation, which is analogous to the impact of the context word on new words. The difference between one and two presentations was found to be much smaller, which we expect to be analogous to the fluency difference between old words in the no-context condition, in comparison with the context condition. Consequently, effects on recognition of new test words were analyzed separately from those on old test words.

Experiment 1

Method

Subjects. The subjects were volunteers from an introductory psychology course and from a 2nd-year cognitive psychology course at McMaster University who served in the experiment for course credit. Sixteen subjects were randomly assigned to each of two experimental conditions produced by a manipulation of awareness of context words. Equal numbers of students from each of the courses were assigned to each of the conditions. Subjects were tested individually.

Materials and design. A pool of 240 medium-frequency (10–49 per million) five-letter nouns were selected from the Thorndike–Lorge word book (Thorndike & Lorge, 1944). Those words were divided into two sets of 120 words each; words from one set served as old words, and words from the other set served as new words in the test of recognition memory. Both the set of old test words and the set of new test words were broken into four smaller sets of 30 words each to represent the different test conditions created by a manipulation of context words. In order to create the test conditions, words were presented as (a) a context word and a test word (match); (b) a test word that was a different word than the context word whose presentation it followed (nonmatch); (c) a test word whose presentation was not preceded by that of a context word (baseline); and (d) a context word that was not the same as the test word whose presentation it preceded. This scheme resulted in the construction of a 90-word study list and a 180-word list (90 old words and 90 new words) presented in a test of recognition memory.

We constructed eight list formats by rotating sets of words through conditions (Old vs. New × 4 Manipulations of Context Words) so that, across list formats, each word represented each of the combinations of experimental conditions. Each list format was used equally often. The order of words for presentation in study lists and in test lists was random, except that not more than three words representing the same combination of conditions could be presented in a row and that each third of each list must have an equal number of words representing each of the combinations of conditions. These restrictions were meant to ensure that words representing the different conditions were spread evenly through the list.

An additional 13 medium-frequency five-letter nouns were used as practice words in the test of recognition memory. Of those words, 5 were presented in the study phase (3 at the beginning of the study list and 2 at the end of the study list) and served as old words in the practice test of recognition memory. Thus the list presented for study contained 95 words. Of the remaining additional words, 5 served as new words, and the other 3 additional words were used as context words that did not match the recognition test words that they preceded. Altogether, 190 words, including those in the ten practice trials, were presented in a test of their recognition.

For the aware condition, the ten practice trials included 2 words representing four of the six combinations of conditions (Old vs. New × Match vs. Nonmatch vs. Baseline) and 1 word representing each of the two remaining combinations of conditions. For the unaware condition, the ten practice trials all represented the baseline condition. This was done to further disguise the later presentation of context words in the unaware condition.

A final test of recognition memory for words presented as context words comprised 80 words, 40 of which had been presented as context words. Of those 40 old words, 10 words had been presented as context words in each of four combinations of conditions (Old vs. New × Match vs. Nonmatch) on the earlier test of recognition. The remaining 40 words were new words that were not previously presented in the experiment. The new words were also medium-frequency five-letter nouns. The test of recognition for context words was presented on a sheet of paper.

Procedure. All stimuli were presented by means of an Apple IIe computer interfaced with a Zenith monochrome green monitor. The words were presented in lowercase letters in the center of the screen. The character size of the stimuli was approximately 5.7 × 6.6 mm. The subject was seated at a distance of approximately 70–75 cm from the screen. The response keys used by subjects for recognition memory decisions were telegraph keys mounted on a response board that was connected to the computer. The computer recorded both the subject's response and response time.

In a first phase of the experiment, words were presented at a 1-s rate for study. Before the presentation of the list, subjects were instructed to read the words silently so as to remember them for a later test of memory. In a second phase of the experiment, a test of recognition memory was given. Subjects were instructed to judge, for each test word, whether that word had been in the list of words that was earlier studied. Each recognition test word was preceded by the presentation of a context word or by a series of letters (*xoxoxox*). The sequence of events for each recognition test trial was as follows: presentation of a "premask" (&&&&&&&&) for 500 ms; presentation of a context word or, as a baseline condition, the series of letters; presentation of a "postmask" (&&&&&&&&) for 500 ms; a delay of 300 ms, during which the screen was blank; and presentation of the recognition memory test word. All events occurred in the same

location on the screen. The presentation duration of context words was the same as that of the *xoxoxox* series and was varied between conditions to manipulate awareness of their presentation. In the aware condition, each context word was presented for 200 ms, whereas in the unaware condition, each context word was presented for 50 ms. Along with each test word, the prompt "old or new?" was presented several lines below the test word. Subjects made recognition memory decisions by pressing a key on the right to call a word "old" and a key on the left to call a word "new." Pressing a key resulted in clearing the recognition test word and the accompanying prompt from the screen. The next recognition test trial was then initiated automatically after an interval that varied randomly between 1,865 and 2,865 ms.

To manipulate awareness of the presentation of context words, we varied instructions for the recognition memory test phase of the experiment, as well as the presentation duration of context words. In the aware condition, subjects were instructed to perform two tasks. We explained that just before the presentation of each word in the test of recognition memory, a word would be presented for a relatively brief duration. Subjects were instructed to silently read the briefly presented words and to try to remember those words for a later test. As a second task, subjects were to judge whether the recognition test words (words presented for a relatively long duration along with a prompt) had been among the list of words that they studied earlier. Subjects were told to make their recognition memory decisions as quickly as possible. Subjects in the aware condition were also told that sometimes the context word (the word presented for a relatively short duration) would match the recognition test word, that sometimes the two would not match, and that sometimes a series of *x*s and *o*s would be presented instead of a context word.

For the unaware condition, subjects were not informed that context words would be presented. Rather, they were told that a series of ampersands would be briefly presented on the screen before each word presented for a test of recognition memory. They were instructed to use the presentation of the series of ampersands as a warning signal and to focus on that warning signal so as to be prepared to respond as quickly as possible when the test word appeared on the screen. The variable interval between test trials (ranging from 1,865 to 2,865 ms) was meant to make the warning signal explanation seem more credible. Aside from these differences, instructions for the test of recognition memory were the same for the aware and the unaware conditions. For both conditions, it was stressed that recognition decisions were to be based on whether a test word had been among those words studied in the first phase of the experiment.

In the final phase of the experiment, a test of recognition memory for the context words was given. Before that test, subjects in the unaware condition were told that words had been flashed within the warning signal in the earlier phase of the experiment and that those words sometimes matched and sometimes did not match the recognition test word that they preceded. Subjects in the aware condition were reminded of the presentation of context words. For both conditions, subjects were given the test of recognition memory on a sheet of paper and told to circle words that had earlier been presented as context words. The reaction of subjects in the unaware condition to these instructions was usually sufficient to allow the experimenter to determine whether the subject had earlier been aware of the presentation of any of the context words. However, after the final test of recognition memory, subjects in the unaware condition were asked whether they had noticed that words were flashed within the warning signal. The significance level for all tests was set at $p < .05$.

Results and Discussion

Effects on the false recognition of new words were analyzed separately from those on correct recognition of old words. For both new words and old words, we report an analysis of the probability of calling a word "old" and an analysis of time to make correct recognition memory decisions.

False recognitions. We analyzed the probability of a false recognition (calling a new test word "old") for each of the combination of conditions (see Table 1). The analysis showed a significant effect of the manipulation of context words, $F(2, 60) = 4.46$, and a significant interaction between that manipulation and the manipulation of awareness, $F(2, 60) = 14.79$, $MS_e = 0.007$. For the aware condition, words were marginally less likely to be falsely recognized if their presentation was preceded by a matching (.24) rather than a nonmatching context word (.29), $t(30) = 1.67$, $p < .10$. Presentation of a matching context word presumably resulted in the discounting of the familiarity of the test word because of the possibility that its familiarity arose from its having just been read as a context word. For the unaware condition, new test words that matched a context word were more likely to be falsely recognized (.36), $t(30) = 4.14$, and new test words that did not match a context word were less likely to be falsely recognized (.19), $t(30) = 2.90$, than were test words that were not preceded by a context word (.26); that is, the manipulation of context words produced effects in the unaware condition that were roughly the opposite of those produced in the aware condition. In comparison with the baseline condition of no context word, presentation of a context word in the unaware condition had the effect of either increasing or decreasing the probability of false recognition, depending on whether the context word matched the recognition test word.

In another analysis we examined differences among conditions in the mean time to correctly call a new word "new" (see Table 2). Only the interaction between the manipulation of context words and that of awareness approached significance, $F(2, 60) = 2.55$, $p < .10$, $MS_e = 36{,}938$. According to the data in Table 2, people in the aware condition were faster in correctly calling a test word "new" if the test word matched rather than did not match the context word that preceded its presentation. Although small in magnitude, an opposite effect was produced in the unaware condition.

Correct recognition of old test words. For each combination of conditions, we analyzed the probability of correctly recognizing an old test word (see Table 3). The analysis showed a significant effect of the manipulation of context words, $F(2, 60) = 9.46$, and a significant interaction between that manipulation and the manipulation of awareness, $F(2, 60) = 4.99$, $MS_e = 0.007$. In the unaware condition, the probability of a correct recognition was higher when a test word matched (.69) rather than did not match (.63) the

Table 1
Probability of Calling a New Test Word "Old"

Condition	Match	Nonmatch	Control
Experiment 1			
Aware	.24	.29	.23
Unaware	.36	.19	.26
Experiment 2			
Aware	.21	.36	.33
Unaware	.26	.17	.17

Note. Control = baseline, a condition in which no context word was presented.

Table 2
Mean Time (in ms) to Call a New Word "New"

Condition	Match	Nonmatch	Control
Experiment 1			
Aware	1,143	1,290	1,224
Unaware	1,285	1,245	1,179
Experiment 2			
Aware	1,476	1,599	1,725
Unaware	1,175	1,152	1,214

Note. Control = baseline, a condition in which no context word was presented.

context word that preceded its presentation, $t(30) = 2.03$, whereas the opposite (.62 vs .69) was true in the aware condition, $t(30) = -2.36$. Also, subjects in the aware condition were less likely to correctly recognize a test word that was not preceded by a context word than they were to recognize a test word that was preceded by either a matching or a nonmatching context word (see Table 3). We have no explanation for this latter result.

An analysis of times to correctly recognize a test word as old revealed only a significant effect of the manipulation of context words, $F(2, 60) = 5.95$, $MS_e = 27{,}765$. Subjects were faster in correctly calling a test word "old" when that test word was preceded by a matching context word (977 ms) rather than by either a nonmatching context word (1,083 ms) or no context word (1,115 ms). Data of this sort cannot provide conclusive evidence for the existence of unconscious influences because unconscious and conscious perception of a context word would likely produce effects in the same direction. For the aware condition, reading a context word that matched the test word would likely speed the reading of the test word and, consequently, produce an advantage in decision times over the other context conditions. Any time spent discounting the familiarity of the test word because it matches the context word might be offset by a reduction in the amount of time required to read the test word. For the unaware condition, presentation of a matching word might contribute to the familiarity of a test word and thereby also speed decisions, in comparison with the other context conditions.

Final recognition of context words. In an additional analysis, we examined recognition memory for context words tested in the final phase of the experiment as a check of the awareness manipulation. That analysis included data only for context words that did not match a test word. The analysis showed a significant interaction between awareness and prior presentation, $F(1, 30) = 26.61$, $MS_e = 0.009$. In the aware condition, words that had been previously presented only as context words were more likely to be called "old" (.32) than were new words (.08), whereas in the unaware condition, words that had been previously presented only as context words were no more likely to be called "old" (.06) than were new words (.07). We also examined recognition memory for context words that matched a recognition test word. However, those data are not reported because the test list did not include words that had only been earlier presented as test words. Test items of that sort are necessary to separate out the probability of calling a word "old" because of its prior presentation as a context word from that because of its prior presentation as a test word. In sum, the analyses of recognition for context words provided no evidence of such recognition for subjects in the unaware condition.

Table 3
Probability of Calling an Old Test Word "Old"

Condition	Match	Nonmatch	Control
Experiment 1			
Aware	.62	.69	.56
Unaware	.69	.63	.59
Experiment 2			
Aware	.59	.68	.66
Unaware	.61	.63	.64

Note. Control = baseline, a condition in which no context word was presented.

Although the recognition data did not provide any evidence that subjects in the unaware condition were actually aware of the presentation of context words, all of those subjects, when later questioned, did claim to have noticed the presentation of some context words. Subjects generally claimed that they noticed that a word was sometimes flashed in the warning signal but that they disregarded the presentation of those words, attributing their presentation to a glitch in the computer. The presentation of a context word that matched an old test word was probably most likely to be noticed. Identification of those words would be made easier by their prior presentation during study (e.g., Jacoby & Dallas, 1981).

To summarize, the overall pattern of results provides evidence that subjects in the unaware condition were generally unaware of the presentation of context words. This is shown by the fact that manipulation of context words produced opposite effects in the aware and the unaware conditions. When a context word matched the word presented for a recognition test, the probability of false recognition was *higher* in the unaware condition but *lower* in the aware condition than when the context word and the test word did not match. In the unaware condition, unconscious perception of a context word either increased or decreased the probability of falsely recognizing a test word, depending on whether the context word matched the test word. In contrast, making subjects aware of the presentation of context words resulted in their discounting the familiarity of test words when the context word and the test word matched, in comparison with when the two did not match. The effect of the manipulation of context words on correct recognitions generally paralleled those on false recognitions. However, it was only for false recognitions that presenting a nonmatching context word produced a reduction in the probability of calling a word "old," in comparison with the baseline condition, in which no context word was presented. This pattern of results can be taken as showing that it is more difficult to interfere with the processing of an old test word and thereby reduce its familiarity than it is to interfere with the processing of a new test word.

Experiment 2

The manipulation of awareness used in Experiment 2 was more extreme than that used in Experiment 1. In the unaware

condition, context words were presented for a briefer duration in the second than in the first experiment. Also, if a subject in the unaware condition in Experiment 2 claimed to be aware of the presentation of any flashed words or letters when later questioned, data from that subject were not included in the analyses. In the aware condition, context words were presented for a longer duration in Experiment 2 than in Experiment 1. We ensured awareness of the context words by requiring subjects to read the context words aloud.

Method

Subjects. Sixteen subjects from the same pool of volunteers used for Experiment 1 were randomly assigned to each of the two conditions produced by the manipulation of awareness. The data from an additional 8 subjects tested in the unaware condition were not entered into the main analyses. For those main analyses, a subject's data were used only if the subject professed to be unaware that any words had been flashed when he or she was questioned at the end of the experiment. The 8 subjects whose data did not enter into the main analyses reported having seen at least one word or some letters flashed before presentation of the warning signal.

Materials and procedure. The materials and procedures for this experiment were identical to those of Experiment 1 with the exception of changes in the manipulation of awareness and a change in the makeup of the test of recognition memory for context words given in the final phase of the experiment. In order to manipulate awareness, context words were presented for 600 ms in the aware condition, in comparison with the 200 ms presentation used in Experiment 1. In the unaware condition, context words were presented for 16 ms rather than the 50 ms used in Experiment 1. No premask was presented, but the presentation of context words was followed by that of a postmask. In the aware condition, subjects were instructed to read the context words aloud and to make a recognition memory decision when recognition test words were presented. No mention was made of the later test of recognition memory for the context words.

The test of recognition memory for context words was the same as that used in Experiment 1, except that 20 of the 40 new words in that test were replaced with words that had been presented as test words in the earlier phase of the experiment but not presented as context words. Of those 20 words, 10 had been presented earlier as old test words (presented during both the study phase and the test phase) and 10 words had been earlier presented as new test words. Those words that had earlier appeared as test words but not as context words were used as a measure of baseline false recognition to compare with recognition of words that had appeared as context words that matched test words.

Results and Discussion

The analyses of the results of Experiment 2 paralleled those of Experiment 1 (see Tables 1, 2, and 3).

False recognition. The analysis of the probability of a false recognition showed a significant main effect of the manipulation of awareness, $F(1, 30) = 8.08$, and a significant interaction between the manipulation of awareness and that of context words, $F(2, 60) = 22.09$, $MS_e = 0.006$. Subjects in the aware condition were more likely to falsely recognize new words (.30) than were subjects in the unaware condition (.20). More interesting, the manipulation of context produced opposite effects in the aware and the unaware conditions. Subjects in the unaware condition were more likely to falsely recognize a test word that was preceded by a matching (.26) rather than by a nonmatching (.17) or by no (.17) context word. Subjects in the aware condition were less likely to falsely recognize a test word that was preceded by a matching (.21) rather than by a nonmatching (.36) or by no (.33) context word.

The shorter presentation of context words for the unaware condition in Experiment 2 only partly replicated the findings from Experiment 1 (see Table 1). In both experiments, the probability of a false recognition was increased when the context word and recognition test word matched. However, the finding in Experiment 1 of a decrease in the probability of a false recognition when the context and recognition test word did not match was not replicated. The less complete processing of a context word produced by its shorter presentation may have been sufficient to facilitate but not to interfere with the processing of a test word.

The steps taken to ensure awareness in Experiment 2 were successful in producing a larger effect of the manipulation of context words than was observed in Experiment 1 (see Table 1). Also, the effect of context words on false recognitions in the aware condition of Experiment 2 was the total opposite of that on false recognitions in the unaware condition in Experiment 1. This was true although the overall probability of a false recognition was approximately the same across conditions and experiments. With the exception of the unaware condition in Experiment 2, manipulations had the effect of redistributing the probabilities of false recognitions among conditions rather than influencing their total number. This is because, although not instructed to do so, subjects generally called approximately half of the recognition test words "old." The lower probability of a false recognition in the unaware condition of Experiment 2 might reflect effects of subject selection that we produced by eliminating data of subjects who reported seeing some context words.

An analysis of the mean times to correctly respond "new" to new recognition test words (see Table 2) showed a significant effect of the manipulation of awareness, $F(1, 30) = 4.75$; a significant effect of the manipulation of context words, $F(2, 60) = 5.88$; and a significant interaction between the effects of those two manipulations, $F(2, 60) = 3.22$, $MS_e = 28{,}848$. The manipulation of context words in the unaware condition had little effect on the time to correctly call a test word "new" (see Table 2). For the aware condition, subjects were faster to correctly call a test word "new" when the test word was preceded by a matching, rather than by a nonmatching or by no, context word. When compared across experiments, the pattern of results in Experiment 2 was generally the same as that in Experiment 1.

Correct recognition of old test words. An analysis of the probabilities of correctly recognizing old test words (see Table 3) did not reveal any significant main effects or a significant interaction between awareness and the manipulation of context words. However, a separate comparison for the aware condition did show that subjects in that condition were less likely to call a test word "old" if it did match (.59) rather than did not match (.68) its context word, $t(30) = 1.93$. The major difference in results across experiments was for subjects in the unaware conditions (see Table 3). The briefer presentation of

context words used for the unaware condition in Experiment 2 did not produce the increase in the probability of correct recognition when the test and context word matched that was observed in Experiment 1.

An analysis of the mean times to make a correct recognition memory decision showed a significant effect of the manipulation of context words and a significant interaction between that manipulation and the manipulation of awareness, $Fs(2, 60) = 7.80$ and 5.66, $MS_e = 43{,}635$. For the unaware condition, the time to correctly recognize a test word that was preceded by a matching context word (1,009 ms) was not much less than that to recognize a test word that was preceded by a nonmatching (1,100 ms) or by no (1,069 ms) context word. For the aware condition, it took substantially less time to correctly recognize a test word that matched a context word (1,356 ms) than to correctly recognize a test word that was not preceded by a context word (1,704 ms) or was preceded by a nonmatching context word (1,417 ms).

Final recognition of context words. Recognition memory for context words that matched a test word was analyzed separately from that of context words that did not match a test word during the earlier phase of the experiment. The analysis of the recognition of context words that matched a test word in the earlier phase showed a significant interaction between awareness and prior presentation, $F(1, 30) = 37.65$, $MS_e = 0.022$. In the aware condition, a word was more likely to be recognized as a context word if it had been presented as a context word and as a test word (.53) than if it had been presented only as a test word in the earlier phase of the experiment (.20). Subjects in the unaware condition, in contrast, showed no evidence of recognition memory for context words. A word that had been presented only as a test word was as likely to be called "old" (.23) as was a word that had been presented as a context word as well as a test word (.23) in the unaware condition. The results of the analysis of recognition for words presented only as context words (nonmatch context words) point toward the same conclusion. The interaction between awareness and prior presentation was significant, $F(1, 30) = 36.68$, $MS_e = 0.011$, in that analysis. In the aware condition, words that had been presented as a context word were more likely to be called "old" (.36) than were new words (.05), whereas in the unaware condition, words presented as context words were no more likely to be called "old" (.06) than were new words (.08). In sum, there was no evidence that subjects in the unaware condition were able to recognize words that had been presented as context words.

The subjects in the unaware condition whose data were used for this analysis all denied having noticed the presentation of any context words. Those subjects agreed to complete the test of recognition memory for context words only at the experimenter's insistence. Eight other subjects who were tested in the unaware condition, when later asked, claimed to have seen at least one word flashed during the earlier phase of the experiment. The results for those subjects also showed no evidence of recognition memory for context words. According to data from the earlier phase of the experiment for subjects who were not totally unaware, their performance was generally similar to that of subjects who were totally unaware of the presentation of context words. However, the effects of the manipulation of context words appeared smaller and less consistent across subjects who were not totally unaware. Any true differences in performance between those who professed not to be and those who professed to be totally unaware might exist because of a variety of factors other than a difference in awareness. For example, Marcel (1983a) showed that in his studies of unconscious perception, effects were larger for subjects who took a passive rather than an active attitude toward the test.

The procedure of presenting context words for a shorter duration in Experiment 2 than in Experiment 1 did result in fewer subjects' being aware that any context words were presented. However, the effect of context words on the probability of calling a recognition test word "old" was also diminished. Only an increase in the probability of a false recognition for a test word that matched a context word remained significant when the presentation duration of context words was made shorter. Unlike the results of Experiment 1, there was neither a reduction in the probability of false recognition produced by a nonmatch between context and test words nor an increase in the probability of correct recognition of old words produced by a match between context and test words. Because of their prior presentation, the processing of old test words might be more difficult to influence than is that of new test words. Consequently, the reduction in the processing of context words resulting from their briefer presentation eliminated the effects on correct recognitions of presenting context words. Interference with the processing of a test word might require more processing of a context word than does facilitation of the processing of a test word, and so interference effects are also particularly sensitive to a reduction in processing of context words.

General Discussion

We set out to produce an illusion of memory of the sort described by Titchener (1928) and were successful in doing so. In Titchener's example, memory for a glance across a street was experienced as déjà vu when the street was later crossed. We produced a similar illusion of memory by presenting an unconsciously perceived word before presenting that word in a test of recognition memory. Our results provide conclusive evidence for the existence of unconscious perception (cf. Holender, 1986). The effects on recognition memory performance that we attribute to unconscious perception of context words cannot be explained as due to subjects' actually being aware of those context words. We have eliminated that possibility by showing that aware perception produced results that are opposite to those produced by unconscious perception of the context words.

The effects of unconscious perception on recognition memory judgments are consistent with our claim that an attribution process underlies the feeling of familiarity. We (e.g., Jacoby & Dallas, 1981; Jacoby & Kelley, 1987; Jacoby, Kelley, & Dywan, 1989) have argued that the feeling of familiarity arises from the attribution of effects on fluency of processing to past experience. An implication of a fluency interpretation of familiarity is that it should be possible to produce memory

illusions; that is, if fluency is the basis for familiarity, it should be possible to induce the feeling of familiarity and produce false recognition by enhancing the processing of new items on a recognition test. The results of our experiments provide direct support for the claim that fluency is the basis for familiarity by showing that the effects of unconscious perception can create an illusion of memory.

In the remainder of this discussion, we first contrast our attribution view with other accounts of unconscious perception. Next, we consider results produced by the aware conditions in our experiments and relate those results to problems for discounting familiarity. We argue that the discounting of familiarity is important for interpreting one's own performance in a variety of tasks.

Memory Attributions Influenced by Unconscious Perception

The results of our experiments can be interpreted as showing that unconscious perception can influence the processing of a later presented test word and that, as a result of an attribution process, those effects on processing underlie the feeling of familiarity that is aroused. By an account of that sort, effects on false recognition resulted when the processing of test words was integrated with, or processed in the context of, the unconscious processing of the context word. More accurately, it is memory for the unconscious processing of context words that influenced the processing of recognition test words. In our experiments, presentation of a context word was separated from that of a test word by a visual mask for 500 ms and an empty interval that lasted for an additional 300 ms. The delay was such that simple sensory integration seems unlikely. By some means, presenting a test word must result in the unconscious retrieval of memory for the earlier processing of the context word. The test word is then processed in the context of or integrated with the memory for that prior processing. We realize that this use of the word *retrieval* is potentially confusing because of the short time span and because the word *retrieval* traditionally refers to a conscious use of memory. However, by talking about unconscious retrieval, we mean to point up the possibility that the direction of effects is backward from the test word to integration with memory for the context word, rather than being forward from the context word to prediction of the test word, as proposed by priming accounts. We have used retrieval arguments of this sort to explain unconscious influences of memory (e.g., Jacoby, 1983a, 1983b; Jacoby & Brooks, 1984). Similar notions were advanced by Koriat (1981).

Our proposal that unconscious influences are followed by an attribution process is similar to arguments made by others. In a discussion of the attribution of dispositions in person perception, Trope (1986) proposed that unconscious influences on interpretation precede dispositional inference processes. He showed that manipulations can have effects on interpretation of an ambiguous stimulus that are opposite to those that the same manipulations have on later dispositional inference processes. Marcel (1983b) argued that unconscious processes always precede awareness. He saw consciousness as relying on an inference or attribution process by which one attempts to "make sense of as much data as possible at the most functionally useful level" (p. 238). We differ from these other approaches in that we looked for similar effects between unconscious memory and unconscious perception and in our suggestion that subjective experience reflects not only the eventual interpretation of "data" but also the ease with which that interpretation comes to mind. By our view, fluency of processing can give rise to a feeling of familiarity, whereas a disruption of processing can give rise to a feeling of strangeness.

As an alternative to a fluency account, one could argue that effects observed in our experiments were produced by confusion in a comparison process. By an argument of that sort, the effects of presenting context words on recognition decisions were produced by subjects who were mistakenly comparing the test word to memory for the context word rather than to memory for the list of words presented earlier. As contrasted with a condition in which no context words were presented, saying "old" because the test word matched the context word would produce an increase in false recognitions, and saying "new" because the test word did not match the context word would produce a decrease in false recognitions. This, of course, is the pattern of results produced by the unaware condition in our first experiment. However, for a confusion account to work, one must assume that the comparison process goes on without a person's being aware that a context word has been presented and that confusion in the comparison process is produced by that lack of awareness. Those assumptions are necessary because making subjects aware produced effects that were opposite to those observed when subjects were unaware that context words were presented. Further assumptions would be necessary to explain why effects on correct recognitions of presenting context words did not always parallel those on false recognitions. Also, one would have to explain how memory for an unconsciously perceived context word is retrieved or selected for comparison with the test word even when the test word and context word do not match. Refinements along these lines would probably produce an account that would be formally equivalent to our fluency view. We prefer to talk in terms of effects on fluency of processing rather than in terms of comparing memory traces. In part, this is because the processing view accounts for misattributions (e.g., Jacoby & Kelley, 1987) that would be difficult to describe in terms of comparing memory traces.

The results of our experiments cannot be explained by the claim that unconscious perception of a word serves to prime some abstract memory representation of that word. Indeed, our results seem to conflict with results reported by Forster (1985) as evidence to support a priming account of unconscious influences. Forster examined masked repetition effects on recognition memory decisions and took a lack of a significant effect on new test words as evidence that effects on old test words were produced by the priming of an episodic representation, a representation that did not exist for new words. There are a number of differences between our experiments and those reported by Forster. One difference that might be important is that we presented a long list of words at a relatively rapid rate for study, whereas Forster's subjects

were given a relatively large amount of time to study a much shorter list of words. This difference likely made our subjects more reliant on judgments of familiarity as a basis for recognition decisions than were Forster's subjects. Although differences were not significant in Forster's experiment, effects on false recognitions in his experiment were in the same direction as the effects of masked repetition that we observed.

Our finding that the probability of a false recognition was reduced when a context word did not match a test word, in comparison with when no context word was presented, is inconsistent with predictions that would be made from a priming view. By our argument, the processing of a test word is disrupted when its presentation is preceded by a nonmatching context word, and this reduction in fluency gives rise to a lack of familiarity, a feeling of strangeness; that is, the effect amounts to finding cost in the processing of the test word that is produced by unconscious perception. However, priming views have held that cost cannot be produced by unconscious perception. Cost is said to arise from controlled conscious processing of a prime (Neely, 1976; Posner & Snyder, 1975). Countering this claim are indications in the literature that cost is produced by unconscious perception. Balota (1983) found a larger effect on lexical decisions when he lengthened the delay between presentation of an unconsciously perceived context word or prime and that of the test word. In comparison with a condition in which no prime was presented, the effect of delay was to produce a nonsignificant slowing of decision times when the prime and target word did not match, an indication of cost.

If the reduction in the probability of false recognition in our experiments is taken as evidence of cost, cost was observed for new words but not for old words, and even for new words, cost was not observed when the context word was presented for a very brief duration (Experiment 2). This is arguably because the processing of old words was facilitated by their prior presentation and, consequently, was less easily disrupted. Also, the duration of presentation of a context word (prime) that is necessary to produce cost might generally be longer than that necessary to produce facilitation. For conscious perception, it has been argued that this is true because cost results from conscious prediction that requires time and attention. Our results potentially show that timing parameters operate in the same way for unconscious perception, meaning that the effects of those parameters do not totally reflect differences in conscious prediction.

Discounting Familiarity: Implications for the Ability to Monitor Memory

We find the results from the aware conditions in our experiments to be as interesting as those from the unaware conditions. In the aware conditions, subjects were less willing to call a test word "old" when the test and context word matched than when the two did not match (Experiments 1 and 2) or no context word was presented (Experiment 1). Subjects apparently discounted the familiarity of the test word as a concession to the possibility that the familiarity of the test word was produced by its presentation as a context word rather than by its presentation during study. The extent of discounting familiarity seems to have depended on the amount of attention given to the context word. Effects that we produced by requiring subjects to read the context words aloud were somewhat larger than those produced when subjects read the context words silently in preparation for a later test of recognition memory.

The discounting of familiarity is important both for methodological and for applied reasons. Discounting familiarity creates potential problems for the interpretation of the results from experiments in which researchers have examined the relation between performance on different types of tests. For example, consider experiments concerning the relation between effects of prior experience on perceptual identification and on recognition memory performance (Johnston, Dark, & Jacoby, 1985; Watkins & Gibson, 1988). In those experiments, a word was presented in a test of perceptual identification and then re-presented in a test of recognition memory. According to the results of our experiments, perceptual identification of a word shortly before its presentation for the test of recognition memory may make the person less willing to call the test word "old." An effect of this sort might obscure the presence of any direct relation between performances on the two types of test. Similar effects may operate in applied settings. When judging the novelty of an idea that one has produced, one is often in the situation of attempting a test of recognition memory for the idea shortly after having produced the idea for another purpose, a situation similar to that created for the aware conditions in our experiments. Having just produced the idea might make it more difficult to recognize that the familiarity of the idea stems from its earlier production by somebody else.

The manipulation of context words generally had parallel effects on recognition decisions for old and new words; that is, in the language of signal-detection theory, effects were generally on β (bias) rather than on d' (discriminability of old and new words). The finding of additive effects is consistent with claims that there are bases for recognition memory performance that are separate from that of judging the familiarity of a test word (e.g., Atkinson & Juola, 1974; Jacoby & Dallas, 1981; Mandler, 1980). However, truly additive effects would be surprising because one could argue that reading a word immediately before the word is presented in a test of recognition would result in maximal familiarity, regardless of whether the test word was old or new. This would invalidate judgments of familiarity as a basis for recognition decisions, and the accuracy of recognition memory performance should suffer. We have started on a larger series of experiments to further examine effects on judgments that are produced by the discounting of familiarity.

In sum, we produced an illusion of memory similar to the one described by Titchener (1928). We have shown that unconscious perception can influence the feeling of familiarity. The effects were such that they cannot be explained in terms of priming but can be explained as resulting from unconscious retrieval in combination with an attribution process. The illusion of memory that we have produced by means of unconscious perception joins earlier demonstrations that unconscious influences of memory can enhance perception (e.g., Jacoby & Dallas, 1981), lower the subjective expe-

rience of background noise (Jacoby, Allan, Collins, & Larwill, 1988), increase the fame of nonfamous names (Jacoby, Woloshyn, & Kelley, 1989), and lower the estimate of the difficulty of anagrams for other (Jacoby & Kelley, 1987). We are not really certain that our experiments and arguments are totally in line with the ideas that Titchener had in mind. But, then, the attribution of ideas to a source is always open to error, even when the source that is in question is one's own past.

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