JOURNAL OF MEMORY AND LANGUAGE 29, 716–732 (1990)

Illusions of Immediate Memory: Evidence of an Attributional Basis for Feelings of Familiarity and Perceptual Quality

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Experiments were designed to produce illusions of immediate memory and of perception, in order to demonstrate that subjective experience of familiarity and perceptual quality may rely on an unconscious attribution process. Subjects saw a short and rapidly presented list of words, then pronounced and judged a target word. We influenced the fluency of pronouncing the target through independent manipulation of repetition and visual clarity. Judgments of repetition were influenced by clarity (Experiments 1 and 2), but not when subjects knew that clarity was manipulated (Experiment 3). Conversely, judgments of clarity were influenced by repetition (Experiment 4). We interpret these symmetric illusions to mean that fluent performance is unconsciously attributed to whatever source is apparent and that feelings of familiarity and perceptual quality result when fluency is attributed respectively to past experience or current circumstances.

A feeling of familiarity is the essence of remembering (e.g., James, 1892; Pillsbury, 1923; Titchener, 1928). In an encounter with a familiar face, for example, one may have uncertainty as to the source of the familiarity (I know you from somewhere; I know someone who looks like you; you have a common type of face), but little question that past experience is responsible for the feeling. The experience of familiarity has a simple but powerful quality of "pastness" that seems to indicate that it is a direct reflection of prior experience. It is thus plausible that familiarity is simply a conscious feeling that accompanies retrieval of memory for past experience. In that case, familiarity would be a poor guide to deciding the specific nature of a past experience, but, because it directly reflects an influence of the past on one's current state, would serve as a reliable indicator that some aspects of our past are reappearing in our present.

This account of familiarity implies that having and using a memory trace is a necessary and sufficient condition for the feeling of familiarity to arise. Counter to that idea, the relationship between feelings of familiarity and use of a memory representation is actually a loose one (cf., Jacoby, Kelley, & Dywan, 1989; Kelley & Jacoby,

This research was supported by a grant from the National Sciences and Engineering Research Council of Canada to Bruce Whittlesea. We are grateful to Gordon Hayman for supplying the dynamic noise routines. Experiments 1 and 4 were conducted by Krista Girard as part of an honors thesis. We thank Catherine Peters for gathering the data of the remaining experiments. We are also grateful to Henry Roediger and Tom Carr for useful criticism. Correspondence concerning this article and reprint requests should be sent to Bruce Whittlesea, c/o Dep't. of Psychology, Simon Fraser University, Burnaby, B. C., Canada V5A 1S6.

0749-596X/90 $3.00

in press). The use of memory often does not give rise to a feeling of familiarity, as evidenced by the possibility of unintentional plagiarism (cf., Brown & Murphy, 1989; Jacoby, Kelley, & Dywan, 1989), and by dissociations between the effects of prior experience on performance of indirect versus direct tests of memory (see Richardson-Klavehn & Bjork, 1988, for a review). Also, the subjective experience of remembering can arise in the absence of a corresponding memory representation. Examples of that case include confabulation and illusions of memory such as deja vu (e.g., Baddeley & Wilson, 1986; Jacoby & Whitehouse, 1989). Illusions of memory are important in that their existence shows that the feeling of familiarity does not directly reflect the use of memory.

In the experiments to be reported, we attempted to produce systematic illusions of familiarity, by manipulating the characteristics of items presented for a test of recognition. Our experiments were motivated by the notion that subjective experience relies on an unconscious attributive or inferential process of the sort described by Helmholtz (1910/1962). Among Helmholtz's reasons for proposing an unconscious inference process was his claim that memory for prior experience contributes to subjective experience of a present stimulus, although people are generally unaware of the effects of the past on perception of the present. Similarly, James (1892) argued that the feeling of familiarity necessarily relies on an inference about the relation between the past and the present. Finding illusions of memory produced by misattributing present experience to the past would demonstrate the inferential basis of familiarity and could be used to specify the cues upon which the inference relies. The strategy is the same as that of using perceptual illusions to reveal the environmental cues that give rise to subjective experience corresponding to particular physical dimensions, such as the role of pictorial cues in producing the experience of depth.

This strategy has been used to show that past experience can be misattributed to the present and can thereby influence current subjective experience in perceptual and cognitive tasks (e.g., Jacoby & Kelley, 1987; Jacoby, Kelley, & Dywan, 1989). Misattribution of the effects of prior experience can: lengthen the judged duration of presented items (Witherspoon & Allan, 1985); reduce the apparent loudness of a background noise (Jacoby, Allan, Collins, & Larwill, 1988); lead to judgments of brightness or darkness, independent of stimulus intensity (Mandler, Nakamura, & Van Zandt, 1987); influence affective judgments (e.g., Zajonc, 1980); lead to errors in the prediction of the performance of others (Jacoby & Kelley, 1987); and can make nonfamous names seem famous (Jacoby, Woloshyn, & Kelley, 1989). Many of these cognitive and perceptual illusions can be explained as resulting from an influence of prior experience on the *fluency* of perception and thinking (cf., Jacoby, Kelley, & Dywan, 1989). Words read once are more easily read later; an idea considered earlier comes to mind more readily later. These effects of past experience on the fluency of perceptual and conceptual operations can be experienced as a change in the quality of current perceptual or cognitive processing and, consequently, misattributed to a source in the present, such as the quality of stimulus input, or one's current state.

Jacoby and Dallas (1981) suggested that perceptual fluency can also serve as a basis for the feeling of familiarity in recognition memory decisions. Words read during study were identified more readily at the time of test than were "new" words, and this difference in fluency of perception might underlie the feeling of familiarity used as a basis for recognition memory decisions. There is correlational evidence to support the claim of a relationship between perceptual fluency and the feeling of familiarity. Feustal, Shiffrin, and Salasoo (1983) manipulated the fluency of identifying words by varying the rate of clarification of a superimposed noise mask and showed that the amount of clarification that subjects required before identifying a word is correlated with the probability of calling the world "old" on a test of recognition memory. However, rather than reflecting a causal relation between the two, a correlation between perceptual fluency and recognition memory judgments might arise because of item differences or because of an influence of performing one task prior to performing the other (Shimamura, 1986; Watkins & Gibson, 1988).

One way of gaining evidence of a causal relationship between perceptual fluency and familiarity is to show that variations in the correlation between recognition judgments and ease of identification, across tasks and materials, are predictable from differences in the relative importance of familiarity as a basis for recognition judgments (Jacoby & Brooks, 1984). The suggestion is that recognition judgments are sometimes made on a basis other than familiarity (e.g., Mandler, 1980) and that variables that invoke that other basis of recognition reduce the correlation between perceptual fluency and recognition memory performance. Jacoby and Witherspoon (1982) demonstrated that recognition of words can be independent of their perceptual identification, whereas that of nonwords in the same circumstances is not. They argued that the words could be recognized on the basis of retrieval of study context, whereas recognition of nonwords depended more heavily on familiarity. Similarly, Johnston, Dark, and Jacoby (1985) found a higher correlation between identification latency and recognition for nonwords than for words. Kelley, Jacoby, and Hollingshead (1989) produced a variable relationship between perceptual identification and modality judgments by manipulating the bases available to subjects for making modality judgments. Their results show that perceptual fluency serves as one basis for judging that modality was held constant between study and test. The variability across situations in the correlation of perceptual fluency and recognition memory performance cannot easily be explained in terms of item differences.

There is also noncorrelational evidence of a relationship between perceptual fluency and recognition judgments. Jacoby and Whitehouse (1989) found that showing a word too briefly for conscious perception immediately prior to its presentation for a recognition judgment increased the probability that subjects claim to have seen the word in a list of words presented much earlier, regardless of whether the word was truly old or new. When a word was shown long enough to allow its conscious perception immediately before its presentation as a recognition test item, the opposite effect was found. Jacoby and Whitehouse interpreted their results as evidence that, in the first case, unconscious perception resulted in an increase in perceptual fluency that was mistakenly experienced as coming from presentation of the word in the target list. In the second case, increased fluency was correctly attributed to the word's exposure immediately prior to its presentation for test.

The strongest form of evidence to support the claim that the feeling of familiarity rests on an inference process would be to manipulate fluency by a means other than prior presentation of an item and to show effects in recognition judgments. That is, if the attribution notions are correct, it should be possible to produce an illusion of familiarity by manipulating the physical characteristics of an item in a way that influences perceptual fluency without affecting prior experience of the item. Watkins and Gibson (1988) tested this possibility by manipulating the perceptual identifiability of auditorily presented words and the exposure duration of visually presented words. However, they found no relation between those manipulations of perceptual identification and the likelihood of a judgment of "old" in a recognition memory test. They argued that previous evidence of a relationship between perceptual fluency and familiarity was spurious, arising from factors such as item differences.

However, it is possible that Watkins and Gibson (1988) failed to produce an illusion of memory because the particular conditions they used provided subjects with a readily accessible alternative to familiarity as a basis for recognition judgments, such as recall of study context. As discussed earlier, the existence of multiple bases for recognition memory decisions places an important constraint on the relationship between perceptual fluency and recognition judgments. The possibility of producing memory illusions by manipulating the physical characteristics of a tested item is likely restricted to circumstances in which subjects rely heavily on familiarity as a basis for judgments. A second potential problem is that the manipulations of perceptual characteristics used by Watkins and Gibson may not have produced effects that successfully mimicked the perceptual cues that typically serve as a basis for the inference of familiarity. For example, their manipulation of duration of test stimuli may not directly influence the *fluency* of perceptual processing, but rather its probability of success.

Experiment 1: An Illusion of Word Repetition

Our first experiment was designed to produce an illusion of memory by manipulating perceptual fluency, independent of prior presentation. First, we thought it important to design the situation such that people would be forced to rely heavily on familiarity as a basis for recognition judgments. To do that, we presented a list of seven words at a rapid rate and then presented an eighth word as a recognition test item. The recognition test word was repeated from the list (old) on half the trials, and subjects were informed of this. The rapid presentation of words in a list was meant to rule out the possibility that subjects might engage in mnemonic activities of the sort that are necessary to allow recognition memory on a basis other than that of familiarity. To manipulate the fluency of processing the eighth word, we partially occluded its presentation with a mask of dynamic visual noise, varying between light noise (20% occlusion) and heavy noise (40% occlusion). That manipulation was orthogonal to whether the test word was new or old. We selected the 20% and 40% occlusion rates as being about as large a difference as would not be obvious to subjects and interviewed subjects carefully in a debriefing session to determine whether they were aware of the manipulation. To produce an illusion of memory, it was thought to be important that subjects be unaware that visual clarity was varied (cf., Jacoby & Whitehouse, 1989).

Thus our manipulation of occlusion influenced perceptual identifiability through the *clarity* of the target, whereas Watkins and Gibson (1988) had manipulated the *duration* of the test word. Intuitively, prior experience might be expected to increase the apparent clarity of an item more than its apparent duration. In a similar vein, to say that an argument is "clear" is very different than to say that it is "long." We predicted that both old and new words would be more likely to be called "old" when presented in light rather than heavy visual noise.

Method

Subjects. Fifty-eight undergraduate students participated for course credit.

Design and procedure. The experiment was performed on a Zenith monitor driven by an Apple IIe computer. The stimuli consisted of 975 of the highest-frequency four-letter words from the Thorndike and Lorge (1944) count and were presented in upper case in all conditions. All words displays were 4 cm wide and .5 cm high.

On every trial, a series of seven words was presented in rapid succession, and immediately followed by an eighth word, presented as a recognition test item. Subjects were instructed first to pronounce the eighth word and then to judge whether it was old or new, responding "old" only if they were certain that the test word was a member of the earlier-presented list. On a key-press by the subject, a fixation stimulus ("+ + + +") was displayed for 320 ms in the center of the monitor, after which the screen blanked briefly (160 ms). The series of seven words was then presented, each word for 60 ms, and each was in the same location as the last. Following the seventh word, the screen remained blank for 100 ms, and then the recognition test word was presented, again in the center of the screen. The test word was centered within a dynamic noise mask covering a rectangular area of the screen 7.5 cm wide and 1 cm high. This dynamic mask was created by a machine language routine[1] that presented a random array of dots within the rectangle, changing with each refresh cycle of the screen. Phenomenologically, this mask is quite different from a static noise mask: one has the impression of being able to see the test word through a swarming cloud of dots. It also offers more signal information than a static mask, in that noise dots are only ephemerally connected to the dots making up the test word. The density of this mask (the absolute percentage of dots turned on at any time) could be controlled and could thus be used to manipulate the perceptual clarity of the test word.

The test word remained on the screen until pronounced. Pronunciation latency was measured using a voice key. Immediately after the pronunciation, the screen cleared, and then the question "Did you see that word in the list?" appeared. Subjects responded by striking a "Yes" or "No" key. The total time from the beginning of the trial until the recognition decision was about 2½ s.

On half the trials, the test word was old, meaning that the correct response on those trials was "yes." Repeated words were taken with equal frequency from the second to the sixth position of the list, but never from the first or last position. Subject to those conditions, the list position from which a word was repeated was randomized across trials. Repetitions were unique to particular trials: words were never repeated between trials.

Crossed with the repetition factor, the dynamic mask covering the eighth word was light on half the trials (20% of rectangle occluded by dots) and heavy on the remainder (40% occlusion). Subjects were informed that the probability of old and new items was equal, but were not informed that the density of the dynamic mask would change. Each of the four combinations of old/new test word and light/heavy noise were presented on 30 trials, randomly intermixed. The order of trials and the assignment of words to conditions were randomized for each subject.

Prior to the experimental trials, subjects received 10 practice trials, involving words not used in the succeeding 120 trials. During these trials, dynamic noise on the test word was held constant at 20%, although the repetition status of the test word was manipulated. Following the experimental trials, subjects were interviewed to investigate their perceptions of how they had performed the task of identifying repetitions and, more critically, to determine whether they were aware of the manipulation of the level of dynamic noise on the test word. A series of questions of graded bluntness was asked, consisting of "How did you decide whether an item was repeated?," "Was it more difficult to report some words than others? (If so: On what proportion of trials was it difficult? What caused it? Did it influence your decision?," "Did it seem as if the amount of dots on the test word was changing from trial to trial?," and, finally "We were actually changing the amount of dots on the test word from trial to trial. Do you think that affected your performance?"

[1] This routine, created by Gordon Hayman, will be made available to any interested investigator.

Median latencies for pronouncing test words and probabilities of responding "yes" when asked if the test word was repeated were computed for each condition within subjects and analyzed by means of analysis of variance.

Results and Discussion

We first summarize subjects' reponses to questions asked in the postexperimental interview. Next, we report an analysis of the effects of prior experience and of visual clarity on pronunciation performance. Finally, we examine recognition performance, looking for evidence that varying the visual clarity of recognition test items produced an illusion of immediate memory.

Reports of phenomenology. For a claim to have produced an illusion of memory to be impressive, it is necessary that subjects report generally having had the subjective experience of remembering the earlier presentation of words they called "old" on the test of recognition memory. Awareness of variation in the visual clarity of test items was also of interest, because we suspected an illusion of memory would be produced only if subjects were unaware of the manipulation of visual clarity. Of 58 subjects, eight indicated that they had noticed the manipulation of intensity of dynamic noise on the target stimulus. Preliminary examination of the data clearly indicated that those subjects performed their judgments of repetition differently than did other subjects. We therefore excluded those subjects from the major analysis (and the remainder of this discussion), but made their differences the subject of study for Experiment 3. Of the remaining subjects, several indicated that they were aware of changes in the apparent clarity of the target stimulus, but attributed it to internal sources, including fatigue, blurry vision, lack of attention, and activities of the night before, rather than to true physical differences in clarity. Estimates of the proportion of trials on which the stimulus was particularly blurry ranged from "a few" up to 20% (as opposed to the actual 50% of trials on which 40% occlusion was used). Given the variety of responses to the masking manipulation (noticed and correctly attributed, noticed but internally attributed, and not noticed), we concluded that the 20% difference in mask density is discriminable, but not obvious.

Regarding the basis of deciding a word was repeated, subjects reported relying either on recall of the word or a combination of its letters from the earlier list, and/or a feeling of familiarity. Even when informed that they had made false alarms, all subjects insisted that they had not guessed, but rather had responded "yes" only when certain a word was presented earlier. All subjects who reported having experienced variation in stimulus clarity (and attributed it to internal causes) indicated that they thought perceived clarity to be irrelevant to the decision of repetition and had not used it in making their decision. On the basis of these interviews, we concluded that (a) these subjects were unaware that clarity of the test word was systematically varied and (b) they believed that they were relying exclusively on memorial factors (familiarity with or without recall) to make recognition decisions.

Effects on pronunciation latency. Subjects pronounced the test word faster when the mask was light rather than heavy (676 vs. 744 ms), $F(1,49) = 52.18$, $MSe = 4469.24$, $p < .001$, indicating that the manipulation of the mask was sufficient to affect perceptual ease. Additionally, repeated words were pronounced faster than nonrepeated words (701 vs. 720 ms), $F(1,49) = 6.22$, $MSe = 2914.53$, $p = .015$, indicating that the brief presentation of a word in the preceding list facilitated later perception. The interaction between effects of prior presentation and visual clarity did not approach significance, $F < 1$. The eight subjects excluded from the analysis demonstrated a similar pattern, pronouncing the test word faster when the mask was light rather than heavy (631 vs. 690 ms) and when the word was repeated rather than nonrepeated (643 vs. 678 ms).

Effects on recognition judgments. Subjects were much more likely to claim that a word was repeated from the earlier list if it truly was than if it was not repeated (p = .57 vs. .17), $F(1,49) = 427.58$, $MSe = .02$, $p < .001$ (see Table 1). More important, subjects were also more likely to claim that a test word was repeated if it had just been presented in light rather than heavy visual noise (p = .39 vs. .35), $F(1,49) = 8.15$, $MSe = .01$, $p = .006$. The interaction of prior presentation and visual clarity did not approach significance, $F < 1$. Because the manipulation of clarity influenced the ease of perception, we conclude that fluency of perception was the source of the bias for the recognition judgments. Subjects were influenced by the ease of identifying the test word when making recognition decisions, although they were not aware of being influenced. The ease of perception produced by visual clarity was not discriminable from an effect of prior experience and consequently gave rise to a false feeling of familiarity that was used as a basis for recognition judgments. Although small in magnitude, the influence of visual clarity on recognition memory judgments was highly reliable.

The recognition decisions of the eight subjects excluded from the analysis (on grounds that they claimed to be aware of the masking manipulation) were also sensitive to repetition, being more likely to claim that a word was repeated if it was than if it was not (p = .68 vs. .20). However, unlike other subjects, their recognition decisions were not influenced by the masking manipulation (p = .45 in both light and heavy noise conditions). The significance of this difference in performance is explored in Experiment 3.

TABLE 1
PROBABILITY OF CLAIMING TARGET TO BE "REPEATED" IN EXPERIMENT 1

Repetition status	Density of mask 20% p	20% SE	40% p	40% SE
Repeated	.59	.02	.54	.02
Not repeated	.19	.02	.15	.02

Why were we able to produce an illusion of memory although Watkins and Gibson (1988) were unable to do so? Our procedures differ from theirs in a number of ways. First, their study phase presented words for 2 s each, with a 1-s blank interval between words, whereas in our study phase, words were shown for 60 ms with no blank intervals. In consequence, their subjects may have been able to code the study words more effectively, making their subjects less reliant on familiarity as a basis for judgments than were our subjects. Second, their manipulation of fluency consisted of presenting the test word for differing amounts of time, whereas ours consisted of occluding the test word to differing degrees. It is possible that their procedure does not affect the fluency of processing as such, but instead determines whether the processing can run to completion. In contrast, our manipulation of clarity may have influenced the rate of processing in a way that had direct influence on fluency. Third, in the experiments done by Watkins and Gibson, the supposed manipulation of perceptual fluency was separate from the presentation of words for the recognition test. A word was flashed for a varied duration so as to test perceptual identification and was then immediately presented again for a test of recognition memory. In our experiment, subjects saw the test word only until they had pronounced it, whereupon the screen cleared, and they then judged whether the test word was old or new without representation of the word. That is, in contrast to our procedure, the locus of their manipulation of perception was not the presentation of the recognition test item. To produce an illusion of memory, it may be necessary that the perceptual manipulation be applied to the same presentation of the item that is to be judged for recognition.

Experiment 2: An Illusion of Case Repetition

Kelley, Jacoby, and Hollingshead (1989) provided evidence that differences in perceptual fluency serve as a basis for modality judgments as well as a basis for recognition judgments. In Experiment 2, we examined the possibility that differences in perceptual fluency also contribute to judgments of whether a repeated word is presented in the same typecase as it was when presented earlier. The goal of this experiment was to produce an illusion of case repetition parallel to the illusion of word repetition found in Experiment 1. Some words in the study list were presented in upper case and some in lower case letters. The test word was always a repetition of one of the earlier words, but was presented in the same or opposite case as compared to its first presentation. Otherwise, the details of list presentation and the manipulation of visual clarity were the same as in Experiment 1. We expected the manipulation of visual clarity to influence subjects' willingness to judge that a test word was in the same case as it was when presented earlier.

Method

Subjects. Twenty-six undergraduates participated for course credit.

Procedure. As in Experiment 1, on every trial the subject saw a list of seven briefly-presented words followed by a test word. The temporal parameters of the trials were the same as in Experiment 1. However, in this study the test word was always a repetition of one of the earlier words, and subjects were required to judge whether the test word was in the same or different typecase as it was when presented earlier. Test words were selected at random from the earlier list, excluding the first and last words of the list, which were never presented as the test word. The six nonrepeated list words were, at random, presented either in uniform upper case or uniform lower case. List presentation of the test word was equally often in upper and in lower case, and was factorially combined with test presentation (same vs. different case). In addition, crossed with the previous two factors, the test word was masked with 20% dynamic noise, and with 40% dynamic noise on the remainder. Subjects were informed about the proportion of upper and lower case presentation of the earlier and later presentations of the test word and the fact that the test word was always a repetition, but not that the density of the mask would vary. As in Experiment 1, subjects were required to pronounce the test word as rapidly as possible, upon which the screen cleared. They were then required to answer the question "Was that word in the same case as in the list?." Other details of the experiment were the same as in Experiment 1.

Results and Discussion

Reports of phenomenology. Most subjects reported attempting to recall the earlier word in deciding the similarity of case at test. Many also reported using feelings of familiarity as the basis of case judgments. About half thought there may have been some variability of the clarity of words, but all of those subjects attributed differences in clarity to internal factors such as fatigue rather than to experimental manipulation.

Effects on pronunciation latency. Subjects were faster to pronounce the test word when it was masked with 20% noise than with 40% noise (466 vs. 501 ms), $F(1,25) = 23.82$, $MSe = 2610.64$, $p < .001$. This effect shows that the masking manipulation affected subjects' fluency of processing. Pronunciation was slightly faster when the first presentation was in lower case letters rather than upper case (479 vs. 487 ms), $F(1,25) = 5.56$, $MSe = 506.92$, $p = .016$ and when the test presentation was lower case rather than upper case (478 vs. 488

ms), $F(1,25) = 5.54$, $MSe = 1029.12$, $p = .025$. The finding that presentation of a word in lower case speeds its pronunciation is not surprising, because lower case presents more distinctive information (cf. Jacoby & Hayman, 1987). However, the match between case of first and second presentations did not produce a reliable effect, $F < 1$. That is, pronunciation latency was not significantly influenced by whether a test word was presented in the same or different typecase, as compared to its earlier presentation. This means that repetition of typecase did not produce extra perceptual fluency, so that, normatively, subjects should not have interpreted more rapid identification of test words as resulting from repetition of case.

Effects on repetition decisions. Subjects were sensitive to the repetition of typecase, being more likely to claim that the case of a word was repeated from the earlier list if it truly was ($p = .52$) than if it was not ($p = .41$), $F(1,25) = 31.11$, $MSe = .02$, $p < .001$ (see Table 2). The main effect of the level of masking on repetition decisions was not reliable, $F(1,25) = 2.20$, $MSe = .0,2$, $p = .147$. At first glance, this seems to indicate that the manipulation of perceptual fluency did not affect decisions about the repetition of case. However, the level of masking reliably interacted with the match of case between first and second presentations in influencing decisions, $F(1,25) = 7.43$, $MSe = .02$, $p = .011$. This indicates that manipulation of the mask influenced the subjects' sensitivity in discriminating repeated from non-repeated case: with 40% occlusion, the subjects could actually see less of the surface structural detail of the letters, leading to reduced discriminability (hit rate = .48, false alarm rate = .42) relative to 20% occlusion (hit rate = .56, false alarm rate = .40). Thus the masking manipulation simultaneously influenced subjects' sensitivity and bias, with the result that the main effect of the level of mask may underrate the biasing influence of the mask.

TABLE 2
PROBABILITY OF CLAIMING TARGET TO BE "REPEATED" AS A FUNCTION OF MASK DENSITY AND MATCH OF CASE BETWEEN FIRST AND SECOND PRESENTATIONS IN EXPERIMENT 2

Case of second presentation	Case of first presentation: Upper		Lower		Marginal hit/false alarm rate
	p	SE	p	SE	
20% mask					
Same	.54	.04	.57	.04	.56
Different	.44	.03	.36	.03	.40
40% mask					
Same	.46	.04	.49	.04	.48
Different	.47	.05	.37	.04	.42

In order to compute independent estimates of the sensitivity and bias effects, we employed Snodgrass and Corwin's (1988) logistic indices, d_L (sensitivity) and C_L (bias)[2]. Using this technique, we found a d_L of .67 for 20% masking, but a d_L of .18 for 40% masking, demonstrating that subjects had greater sensitivity under lighter than heavier masking. However, we also found a C_L of .03 for 20% masking and a C_L of .24 for 40% masking, demonstrating that lighter masking made subjects more willing to respond "repeated" than heavier masking. Computed for each subject,[3], this difference in C_L was reliable, $F(1,23) = 4.36$, $MSe = .25$, $p = .045$. Because the manipulation of masking was orthogonal to actual repetition, this bias must be due to differences in perceptual fluency accompanying manipulation of the masking rather than to any memorial factor. However, given that subjects reported responding that case was repeated only if they believed it was, the manipulation of fluency appears to influence performance by creating a false feeling of familiarity. We concluded that for case, as for word identity, manipulation of perceptual ease can bias willingness to decide

[2] $d_L = \ln\{[H(1 - H)]/[FA(1 - fa)]\}$, and $C_L = 0.5[\ln\{[(1 - FA)(1 - H)]/[h)(FA)]\}]$. Conservative biases produce positive values of C_L, and liberal biases produce negative values.

[3] C_L could not be calculated for two subjects, owing to their having false alarm probabilities of zero.

that one has experienced a repetition and that the influence of perceptual ease, in the absence of knowledge that it is being manipulated, is attributed to, and indeed feels like, familiarity.

Experiment 3: Eliminating the Illusion

Experiments 1 and 2 demonstrated that a manipulation of visual clarity can give rise to a false feeling of familiarity that is reflected as a bias in recognition memory and case judgments. However, subjects in those experiments were unaware that differences in masking affected the fluency of their performance, or even that the density of the mask actually differed between trials. Consequently, it is unclear whether familiarity is an attribute of fluency, such that feelings of familiarity arise whenever performance is fluent, or an attribution based on fluency, an unconscious inference that fluency reflects an influence of the past on current performance. Experiment 3 was conducted to choose between those two possibilities. Subjects in Experiment 3 performed under identical conditions to those in Experiment 1, except that they were informed of the variation in visual masking of test words. If familiarity is an attribute of fluency, then informing subjects of the variation of clarity should not allow them to escape its influence. So long as a manipulation influences fluency, that manipulation should also influence familiarity, regardless of whether or not the subject is informed of the manipulation. In contrast, if familiarity is an attribution of the source of fluency, then knowing that differences in fluency could be ascribed to manipulation of the mask might prevent subjects from attributing those differences to an influence of the past and thus prevent a sense of familiarity when an item was processed particularly fluently.

Method

Subjects. Fifty-five undergraduate subjects participated for course credit in Experiment 3.

Procedure. The procedure was identical to that in Experiment 1, except that subjects were warned in advance about the manipulation of noise level on the test word.

Results and Discussion

Reports of phenomenology. As in Experiment 1, subjects indicated that they had made decisions about repeated words based on a combination of recalled information about words and letter groups and a feeling of familiarity. Subjects denied making a deliberate attempt to ignore familiarity of the stimulus in favor of relying on recall alone, or to discount the familiarity of the stimulus when it was particularly easy to identify.

Effects on pronunciation latency. Main effects on latency of pronouncing the test word were observed both for word repetition, repeated words being pronounced faster than non-repeated words (580 vs. 593 ms), $F(1,54) = 6.35$, $MSe = 1408.37$ $p = .014$, and for level of dynamic noise on the test word, with 20% noise leading to faster pronunciation than 40% noise (567 vs. 606 ms), $F(1,54) = 46.32$, $MSe = 1884.24$, $p < .001$, the interaction being unreliable, $F < 1$. Thus repetition and level of masking appear to have similar effects on identification latencies in Experiments 1 and 3, despite the difference in instructions.

In order to test this similarity formally, we performed an omnibus analysis of the data from the two experiments, including instructional differences between experiments (Experiment 1 vs. Experiment 3) as a factor. Several differences between the experiments became apparent, first of which was that subjects in Experiment 3 responded more quickly on average than those in Experiment 1 (587 vs. 710 ms), $F(1,103) = 6.25$, $MSe = 256368.39$, $p = .013$. This difference is likely attributable to the fact that different experimenters were responsible for conducting the two experiments, and differed in their insistence on fast responding. Second, the size of both the repetition effect (19 ms in Experiment 1 and 13 ms in Experiment 3) and the masking effect (68 ms in Experiment 1 and 40 ms in Experiment 3) declined between experiments, although only the latter difference was reliable, $F(1,103) = 6.81$, $MSe = 3114.00$, $p = .010$. The smaller size of these effects is probably due in part to the overall decrease in response time between the experiments. Despite their decreased size, however, simple effects computed in the omnibus analysis again demonstrated that the effects of both repetition and masking were reliable in Experiment 3, respectively, $F(1,54) = 5.32$, $MSe = 1683.14$, $p < .02$ and $F(1,54) = 40.51$, $MSe = 2374.69$, $p < .001$. We concluded that although their effects are attenuated in Experiment 3, both repetition and manipulation of the mask reliably influenced the fluency of perceiving the test word, as they had in Experiment 1.

Effects on recognition judgments. Also as in Experiment 1, we observed that repeated words were judged repeated with higher probability than nonrepeated words ($p = .49$ vs. $.17$), $F(1,54) = 154.90$, $MSe = .04$, $p < .001$, indicating a respectable sensitivity to repetition (see Table 3). However, unlike Experiment 1, in which a highly reliable effect of the masking manipulation was observed, there was no evidence in Experiment 3 of any effect of the level of masking on recognition judgments, test words occluded with light noise being judged to be repeated at about the same rate as words occluded with heavy noise ($p = .33$ in both cases), $F < 1$.

TABLE 3
PROBABILITY OF CLAIMING TARGET TO BE "REPEATED" IN EXPERIMENT 3

Repetition status	Density of mask 20% p	20% SE	40% p	40% SE
Repeated	.49	.03	.49	.03
Not repeated	.17	.02	.18	.02

A second omnibus analysis, in this case of the recognition data, demonstrated that the difference between experiments had a small and unreliable effect on the overall probability of judging a word to be repeated ($p = .37$ in Experiment 1 and $p = .33$ in Experiment 2), $F(1,103) = 2.13$, $MSe = .06$, $p = .143$. However, the effect of the masking manipulation was found to depend on the instructions given in each experiment, $F(1,103) = 3.62$, $MSe = .01$, $p = .056$, the size of the masking effect declining from 4% in Experiment 1 to 0% in Experiment 3. Simple effects computed in the omnibus analysis again indicated that the difference in Experiment 1 was reliable, $F(1,49) = 7.30$, $MSe = .01$, $p < .01$, whereas the difference in Experiment 3 was not, $F(1,54) < 1$. We concluded that in Experiment 3, unlike Experiment 1, changes in perceptual fluency resulting from manipulation of visual clarity did not influence recognition decisions.

Because the effect of the masking manipulation on pronunciation latency was smaller in this experiment than Experiment 1, as noted in the last section, the lack of effect of the masking manipulation on recognition decisions could be interpreted as due to the weakness of its effect on pronunciation latency rather than due to the change in instructions. However, we note that in Experiment 2, the effect of the masking manipulation on pronunciation latency was even smaller (35 ms), but had a reliable influence on recognition decisions of about 3%. We therefore concluded that the 40 ms effect of masking on pronunciation latency in Experiment 3 was large enough to expect an effect on recognition decisions and that the lack of effect was the result of the changed instructions. Moreover, the eight subjects excluded from the analysis of Experiment 1 on the grounds that they had become aware of our manipulation of visual clarity (and whose knowledge was therefore comparable to that of subjects in Experiment 3) demonstrated a larger effect of masking on pronunciation latency (59 ms), but still showed no effect of masking on repetition judgments (p = .45 for both light and heavy masking). We concluded that the change in instructions between Experiments 1 and 3 had caused a real decrease in the effect of the masking manipulation on recognition decisions.

Awareness of the masking manipulation might have prevented an effect of the manipulation on repetition decisions either because subjects discounted their feelings of familiarity when the mask was light, or because fluency differences simply do not feel like differences in familiarity when the source of the fluency differences is known to be in the present. Subjects in Experiment 3 reported using the familiarity of stimuli as the primary means of making their decisions, and not discounting feelings of familiarity because of apparent changes in stimulus clarity. We concluded that for these subjects, who were aware of a physical source of changes in visual clarity, the fluency of processing the physical display granted by the masking manipulation simply did not contribute to feelings of familiarity.

Moreover, although their awareness of a current source of fluency protected them from feeling that lightly-masked items were familiar, there is some evidence that that knowledge led them to make the opposite error, treating the perceptual fluency granted by repetition as though it were due to the physical manipulation and failing to feel familiarity from an actual effect of the past. Relative to Experiment 1, subjects in Experiment 3 were about 8% less likely to claim that a repeated word was repeated, whereas there was no difference in their likelihood of claiming that a nonrepeated word was repeated. This difference led to a reliable interaction of repetition with experiments in the omnibus analysis, $F(1,103) = 5.93$, $MSe = .03$, $p = .015$. It seems likely that the greater conservatism of subjects in Experiment 3 in dealing with repeated items resulted because the subjects did not (and may have been unable to) discriminate the two sources of fluency. In consequence, they treated fluency from both sources as due to the physical manipulation and failed to experience the fluency granted by repetition as familiarity.

Thus subjects in Experiments 1 and 2 apparently experienced perceptual fluency as familiarity, whereas subjects in Experiment 3 apparently did not. We concluded that familiarity is not an attribute of fluent processing, but the result of attributing the source of fluent processing to an influence of the past in the absence of any other discernible source. In other words, when no source of fluency other than the past is evident, then fluency feels like familiarity; whereas when subjects are aware of a current physical basis for fluency differences, then fluency may feel like perceptual clarity.

Experiment 4: An Illusion of Perceptual Clarity

If subjective feelings accompanying processing are as malleable as the foregoing suggests, then it ought to be possible to cause people to confuse effects of repetition and visual clarity in the opposite direction as well. That is, it ought to be possible to manipulate fluency of processing through the prior occurrence of a word, but to cause subjects to attribute the fluency to characteristics of the perceptual array instead of to an influence of the past, and to feel a sense of "perceptual clarity" instead of a sense of "familiarity." Finding this reverse illusion would suggest that the type of subjective feeling aroused while performing a task depends upon the subjects' appreciation of factors affecting their performance rather than upon the true source of processing differences. If feelings of familiarity and perceptual quality are interchangeable in this fashion, then we would have good grounds for concluding that both of these feelings result from attributions about the source of influence on current performance.

Experiments of this reverse kind have

been run by others. For example, Witherspoon and Allan (1985) demonstrated that subjects rate the duration of words encountered previously in the experiment as longer than that of novel words. Similarly, Jacoby, Allan, Collins, and Larwill (1988) showed that in rating the loudness of background noise while listening to old and new sentences, subjects judge the noise to be louder when the sentence is new. These studies suggest that subjects confuse effects of prior experience on perceptual fluency for effects of current physical parameters of the task. Further, they suggest that old items do not feel familiar when the task focuses attention on a physical dimension that affects processing: instead, repetition causes a sense of differential perceptual quality. Experiment 4 was conducted to determine whether such reverse confusion also occurs within the very brief span of time from earlier to later experience used in the other experiments reported in this article.

Method

Subjects: Twenty-five undergraduate subjects participated for course credit.

Procedure. The procedure was generally the same as that of Experiment 1. One change was that, in addition to presenting the test word in a rectangular mask of dynamic visual noise, one of the words in the preceding list was also masked. On half the trials, the test word was a repetition of one of the words in the preceding list and had been presented at random in any list position excluding the first and last. On these occasions, the new mask was superimposed on the to-be-repeated word during the list presentation. When no word from the list was repeated at test, the mask was superimposed on one of the words in the list at random, but again excluding the first and last position. The mask presented over a word in the list was held constant at 25% occlusion across trials and was presented with equal frequency over words in the second through to the sixth position of the list. Presentation of the series was slowed relative to Experiments 1–3, with each word in the list being presented for 120 ms instead of 60 ms, although other temporal characteristics of the trial remained as before. In consequence, the duration of a trial from onset of first word in the list until the subject had identified the test word and was ready to make the final decision was increased to about 3 s.

A major change was that the subject's final task, after pronouncing the test word, was now to state whether the noise on the test word was less than the noise presented over a word earlier in the series. The two levels of noise actually presented were 20% and 30% occlusion, a smaller difference than in Experiment 1. Each level of noise was presented on half the trials, manipulated independently of repetition of a word from the earlier series. As in all previous experiments, subjects were required to pronounce the test word as rapidly as possible, upon which the screen cleared. They then had to make the relative noise decision from memory of what the display had looked like a moment ago. As in all experiments, the sequence of trials of the different conditions and the assignment of words to conditions were rerandomized between subjects. As usual, subjects were interviewed at the end of the experiment to determine their perceptions of what had happened and what they had done.

Results and Discussion

Reports of phenomenology. Most subjects indicated that they were aware that the test word was occasionally repeated from the earlier series. However, they underestimated the frequency with which repetition occurred, most guesses being in the range of 1 to 10%. In general, subjects reported making their judgments of the relative amount of noise on the test word by comparing an image of the earlier mask with the later one. No subject reported using knowledge of the repetition of a word to modify their later judgment of relative intensity; in fact, even following debriefing on the experimental hypotheses, subjects in general indicated disbelief that their judgments of intensity were or indeed could have been influenced by an irrelevant factor such as word repetition. This attitude stands in contrast to subjects in Experiments 1 and 2, who in general recognized during the debriefing that their judgments of repetition could have been influenced by the manipulated clarity of the test word.

Effects on pronunciation latency. Level of dynamic noise had a main effect on latency of pronouncing the test word, with 20% noise leading to faster pronunciation than 30% noise (722 vs. 742 ms), $F(1,24) = 5.11$, $MSe = 1876.40$, $p = .03$. Word repetition was also observed to have a marginally reliable main effect, with repeated words being pronounced faster than nonrepeated words (726 vs. 739 ms), $F(1,24) = 3.61$, $MSe = 1096.17$, $p = .066$. Although the interaction of these factors was unreliable, $F(1,24) = 1.63$, $MSe = 1131.23$, $p = .212$, the effect of word repetition was larger when the mask was heavy (repeated: 731 ms; nonrepeated: 753 ms) than when the mask was light (repeated: 720 ms; nonrepeated: 724 ms).

Effects on relative noise decisions. Subjects were sensitive to the differences of masking levels, the hit rate (claiming that the light mask was less noisy than the earlier mask, $p = .77$) being much greater than the false alarm rate (claiming the heavy mask was lighter than the earlier mask, $p = .28$), $F(1,24) = 116.90$, $MSe = .05$, $p < .001$ (see Table 4). However, word repetition was also observed to have a reliable main effect on decisions about the density of the masks, repeated test words being more likely to be rated as less noisy ($p = .54$) than nonrepeated test words ($p = .51$), $F(1,24) = 4.55$, $MSe = .01$, $p = .041$. Moreover, although the interaction of mask level and word repetition was not reliable, $F(1,24) = 2.81$, $MSe = .01$, $p = .103$, word repetition influenced decisions primarily at the 30% level of masking (repeated: $p = .31$; nonrepeated: $p = .25$) rather than at the 20% level (repeated: $p = .77$; nonrepeated: $p = .76$), in the same way that it influenced pronunciation latency.

TABLE 4

PROBABILITY OF CLAIMING NOISE ON TEST WORD TO BE LESS THAN ON EARLIER PRESENTATION IN EXPERIMENT 4

Repetition status	Density of mask: 20% p	20% SE	30% p	30% SE
Repeated	.77	.02	.31	.03
Not repeated	.76	.03	.25	.02

To summarize, in this experiment subjects reported relying on feelings of perceptual clarity to judge the relative density of the mask. These feelings of clarity were apparently influenced by differences in fluency of identifying the stimulus. In turn, the fluency of identification was influenced not only by manipulation of the density of the mask, but also by repetition of the test word. In this case, then, prior exposure to the stimulus gave rise to a feeling of clarity rather than familiarity, an effect mediated by its influence on the fluency of identification.

We conclude that when sources of fluency other than the past are not evident (Exps. 1 and 2), differences in fluency due to physical characteristics of the task feel like differences in familiarity: but when attention is focused on physical characteristics of the current task, then differences in fluency due to differences in past experience feel like differences in physical quality, such as clarity. We also conclude that the interchangeability of feelings of perceptual quality and familiarity with changes in the focal task means that both feelings are attributions of fluency to whichever source (an influence of the past or of current physical variables) is currently evident to the subject.

GENERAL DISCUSSION

Although highly reliable, the effects

taken as evidence of illusions of immediate memory and perception were numerically small. The smallness of those effects might be taken to mean that the illusions are not very important. Alternatively, it may mean only that we have not yet managed to invent a set of procedures that can forcefully manipulate perceptual fluency without the subject becoming aware of our manipulation and consequently avoiding misattribution of fluency, or that subjects in our experiment were still able to rely on resources other than familiarity, such as retrieval of list context, as a basis for recognition. Another possibility is that perceptual fluency is only one of a number of processing characteristics that contribute to feelings of familiarity. For example, the clarity of an idea may be another criterion used to judge that it is a memory (e.g., Johnson, Foley, Suengas, & Raye, 1989). To produce a powerful illusion of remembering, it may be necessary to combine perceptual fluency with manipulations of other cognitive processes that typically accompany true remembering.

However, even illusions that are not terribly powerful are useful for revealing the cues that underlie subjective experience. As shown by the results of our experiments, familiarity does not appear to be a direct consequence of the use of a memory trace. Effects of prior experience can be misattributed to a change in the physical stimulus (Experiment 4). Also, a feeling of familiarity can arise without a corresponding memory trace. Manipulation of the physical characteristics of a stimulus can give rise to a false sense of familiarity (Experiments 1 and 2). Moreover, familiarity is not an attribute of fluency, occurring whenever a stimulus is easily processed (Experiment 3). Instead, the feeling of familiarity arises from fluent processing only if sources of fluency other than the past are not evident, and if the task focuses attention on the historical status of the stimulus rather than its physical characteristics. The attribution process is a complex one, taking into account whatever constraints on processing are evident and evaluating the source of fluency in terms of expectations aroused by a current situation. The process seems best described as unconscious attribution resting on an intuitive theory of memory and perception that is used to interpret their effects on performance.

In our claim that subjective experience reflects an unconscious attribution process, we join others (e.g., Gazzaniga, 1988; Marcel, 1983) who adopt a constructivist view of conscious experience. Marcel (1983) argued that unconscious processes always precede awareness and "make sense of as much data as possible at the most functionally useful level" (p. 238). Our approach is also similar to analyses provided by social psychologists for attributions to causes other than the past (e.g., Kelley & Michela, 1980; Nisbett & Wilson, 1977), including the experience of emotions (e.g., Schachter & Singer, 1962). Ross (1989) has recently provided evidence that people's responses to questions about their personal history are often based on an implicit theory of memory, rather than directly reflecting some veridical record of the past. A more extensive discussion of memory attributions is provided by Jacoby, Kelley, and Dywan (1989).

An attribution analysis of subjective experience differs from the approach that has dominated research on memory. The feeling of familiarity has typically been treated as directly reflecting some characteristic of a memory trace, such as its strength or degree of integration (e.g., Mandler, 1980). Even when a correlation between performance on a perceptual task and recognition memory performance has been noted, others have not taken that correlation as evidence of a causative relation between perceptual fluency and the feeling of familiarity. For example, Humphreys and Bain (1983) suggested that it is more parsimonious to claim that correlations between performance on the two types of task arise from a common underlying memory representation than it is to claim that differences in perceptual fluency are the underpinning for the feeling of familiarity. However, an account in terms of a common memory representation is not sufficient to explain results from our experiments. By an account of that sort, there is no reason to expect that an illusion of memory can result from differences in perceptual fluency produced by varying factors other than that of prior experience.

The traditional approach of ascribing the feeling of familiarity to the activation of a memory trace amounts to a "naive realist" view of memory, a claim that familiarity results from an influence of past experience on one's current state. The approach is the same as would be a claim that the subjective experience of depth is due to the distance across which objects are viewed. Although both claims are ordinarily justified, they ignore the mechanism of influence and may mislead one into thinking that subjective experience results from direct sensitivity to the object of the experience. It is ordinarily very practical to believe that one is in direct contact with a "real" present and a "real" past. However, the possibility of illusions of perception and memory indicate that one should not become too comfortable in that belief. Appearances of familiarity can be deceptive.

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(Received March 28, 1990)

(Revision received June 20, 1990)