# Perceptual Fluency and Recognition Judgments

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Items seen for the second time in an experiment (old items) can be perceived more readily (fluently) than items seen for the first time (new items) (e.g., Jacoby & Dallas, 1981). We hypothesized that perceptual fluency is used as a cue for discriminating old from new items. In the test phase of a recognition task, each item was gradually clarified until it was identified, at which time subjects made an old/new judgment. We expected that fluently perceived (quickly identified) items would tend to be judged old regardless of their actual old/new status. In Experiment 1, words were more likely to be judged old both if they were quickly identified and, independently of this, if they actually were old. The latter finding implicates a factor (e.g., directed memory search) other than perceptual fluency in recognition judgments. Experiment 2 succeeded in reducing the contribution of this additional factor by using nonwords rather than words. Recognition judgments for nonwords were much more dependent on speed of identification than they were on actual old/new status. We propose that perceptual fluency is the basis of the feeling of familiarity and is one of two important factors that make variable contributions to recognition judgments.

For some time, recognition memory was attributed to a single, rather vaguely defined, familiarity factor (e.g., Parks, 1966). When a stimulus elicits a sufficiently intense "feeling of familiarity," the subject calls the stimulus old. More recently, recognition has been conceptualized as involving two factors: a familiarity factor and a directed search of memory (e.g., Atkinson & Juola, 1973; Mandler, 1980). Stimuli eliciting very high feelings of familiarity are called old, those eliciting very low feelings of familiarity are called new, and those eliciting more ambiguous feelings of familiarity prompt the implementation of the search factor. The search factor entails some sort of controlled memory search for specific episodic representations of the stimulus. This factor is thought to play an even larger role in recall tasks than in recognition tasks (e.g., Gillund & Shiffrin, 1984). Although our research also addresses the search factor, our primary focus is on the nature of the somewhat neglected familiarity factor in recognition memory. Specifically, we examine what may be a measureable underpinning of the feeling of familiarity.

On what might the feeling of familiarity depend? Mandler (1980) suggested that familiarity depends on memory for the perceptual characteristics of an item; repetition is assumed to produce integration of the ". . . perceptual, featural, and intrastructural aspects of the event" (p. 255). Jacoby and his colleagues (e.g., Jacoby & Brooks, in press; Jacoby & Dallas, 1981; Jacoby & Witherspoon, 1982) linked familiarity more directly to perception by claiming that perceptual fluency serves as a basis for the feeling of familiarity. Perceptual fluency is usually measured in terms of how well an item can be identified under impoverished presentation conditions. These investigators noted that a prior presentation of an item in an experimental context makes the item easier to perceive if it is presented again in the same context. The net effect is that perceptual fluency is greater for previously studied items (old items) than it is for new items. They went on to speculate that subjects can detect relative ease of perception of an item and can use the fluent perception of old items as part of the basis for recognition memory judgments. By this view, the feeling of famil-

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iarity is an attribution based on perceptual fluency. This use of fluency of perception to judge prior occurrence is similar to the use of the availability heuristic to estimate probabilities (Kahneman & Tversky, 1973). When using the availability heuristic, a person infers that a class of events is a probable one if an instance of that class can be readily brought to mind. When using the fluency heuristic, the person infers than an item is an old one if it can be readily perceived. Whether this attribution is conscious or unconscious is a moot issue that we do not address in this article.

Strict reliance on a perceptual fluency heuristic for recognition memory judgments would result in a high correlation between a measure of perceptual fluency for items and the probability of calling the items old. However, this relation would diminish to the extent that subjects relied on a search factor in addition to, or in lieu of, the perceptual fluency factor. Indeed, low correlations between measures of perceptual fluency and recognition judgments have been found in some studies (e.g., Jacoby & Dallas, 1981). Our goal in the present research was to discriminate empirically between the perceptual fluency (familiarity) and search factors and to manipulate their relative contributions to subjects' recognition judgments.

We shall outline a tentative, qualitative conceptualization of the manner in which the search and perceptual fluency factors combine to determine recognition judgments. The key components of the theory are the respective utilities of the two factors for discriminating new from old items. We assume that subjects are reasonably sensitive to these utilities and will rely on the two factors accordingly. Thus, if perceptual fluency is high or low for a given word in comparison with other test words, but ambiguous episodic information is retrieved regarding the possible prior occurrence of the word, then the person will make an old/new judgment primarily on the basis of the perceptual fluency factor. On the other hand, if the episodic information retrieved is highly indicative of either a new word or an old word but perceptual fluency is uninformative, then the judgment will primarily be based on the search factor. If the two factors are of comparable utility, then

the individual is likely to rely on both factors. Because the two factors are assumed to be processed in parallel and to determine conjointly a recognition judgment, our conceptualization differs from two-stage models in which the search factor is mobilized only when the familiarity factor does not yield a judgment (e.g., Atkinson & Juola, 1973). Mandler (1980) has also argued that the two factors operate in parallel rather than sequentially. Parallel operation of the two factors accommodates evidence (considered in the general discussion section) that the search factor dominates for some items in a list (e.g., ones repeated at short lags), whereas perceptual fluency dominates for other items (e.g., ones repeated at long lags).

Our theory is similar qualitatively to the one proposed by Gillund and Shiffrin (1984). They assume that recognition judgments are determined by the simultaneous operation of two processes: an interitem associative process (analogous to our search factor) and a selfcoding process (analogous to our perceptual fluency factor). We extend the Gillund and Shiffrin approach by attempting to measure directly the latter factor and by examining the extent to which the two factors contribute to recognition performance.

A brief preview of our methodology will facilitate exposition of the general experimental logic. The subject's task was composed of two phases: a reading phase and a test phase. Subjects simply read a series of words in the first phase. During the test phase, these old words were presented along with new words. When a word was presented in the test phase it was severely degraded at first but was gradually clarified until the subject identified it. The time taken to identify the word correctly was our principal measure of perceptual fluency; fluency of perception was assumed to be an inverse function of latency of identification. A subsidiary measure of perceptual fluency was accuracy of identification. After the word was identified it was made completely clear and the subject made an old/ new recognition judgment. This procedure allowed us to compute, for each subject, mean perceptual fluency for hits (old words judged to be old), misses (old words judged new), false alarms (new words judged old), and correct rejections (new words judged new). Different contributions of perceptual fluency and search should yield different patterns of perceptual fluency across these four recognition outcomes.

To the extent that perceptual fluency is generally greater for old items than for new items, then hits will necessarily surpass correct rejections in terms of perceptual fluency. However, this difference would not, by itself, indicate that subjects use perceptual fluency in making old/new judgments. One must also consider misses and false alarms in order to assess reliance on the perceptual fluency cue. If perceptual fluency is used as a cue, then it should tend to be greater for items called old than it is for items called new, regardless of the actual repetition status (old vs. new) of the items. Thus, perceptual fluency should be greater for hits than for misses and for false alarms than for correct rejections.

Let us consider some limiting cases. In each case, the typical relation between actual repetition status and perceptual fluency (old > new in terms of perceptual fluency) is assumed to obtain.<sup>1</sup> The cases differ in terms of the relation between judged repetition status and perceptual fluency. Suppose that subjects relied only on perceptual fluency in making recognition judgments. This would be tantamount to setting a perceptual fluency criterion level above which subjects respond old and below which subjects respond new. Thus, perceptual fluency would be greater for all items called old (hits and false alarms) than for all items called new (correct rejections and misses). However, because perceptual fluency might also vary independently as a function of the actual repetition status of the items, then it might be greater for hits than for false alarms and for misses than for correct rejections. The resultant pattern of recognition outcomes in terms of perceptual fluency would be hits > false alarms >misses > correct rejections.

By contrast, suppose that subjects relied exclusively on the search factor. Although perceptual fluency might still be related to the actual repetition status of the items, it would not be related to their judged status, and perceptual fluency would vary across recognition outcomes in the following manner: hits = misses > false alarms = correct rejections. That is, actual repetition status might affect perceptual fluency, but perceptual fluency might not affect judged repetition status.

To the extent that both perceptual fluency and the search factor contributed to recognition judgments, the resultant pattern of perceptual fluency across recognition outcomes would be different from these two extremes. One such pattern is hits > misses = false alarms > correct rejections. Note that the comparison of misses and false alarms in terms of perceptual fluency is critical in assessing the relative contributions of the two factors. Greater dependence on perceptual fluency would tend to yield false alarms > misses as in the first hypothetical case presented earlier. Greater dependence on the search factor would tend to yield misses > false alarms as in the second case. The use of both factors would tend to vield misses = false alarms as in the third illustration. In short, a manipulation that affects the relative utility of, and reliance on, the two factors should affect the relation between misses and false alarms in terms of perceptual fluency.<sup>2</sup>

In summary, as long as there is a repetition effect on perceptual fluency and as long as subjects rely to some extent on the perceptual fluency factor in making recognition judgments, then average perceptual fluency should be greatest for hits and least for correct

<sup>&</sup>lt;sup>1</sup> The present rationale is developed for the situation in which the distributions of perceptual fluency for new and old items are overlapping. The distribution for old items may be displaced toward higher levels of perceptual fluency from the distribution for new items but not so high as to leave no region of overlap. Nonetheless, the rationale could be extended to cover the unlikely case in which perceptual fluency is greater for all old items than for all new items.

<sup>&</sup>lt;sup>2</sup> It may be noted that the estimation of the contribution of the search factor is made by default. Only to the extent that recognition judgments are not attributable to perceptual fluency do we attribute them to the search factor. This is a necessary consequence of the fact that we measure perceptual fluency and its utility as a cue for discriminating new and old items, but we do not measure the possible underpinnings of the search factor (e.g., reinstatement of list context and activation of interitem associations). Indeed, more than one factor may contribute to the variance that cannot be accounted for by the perceptual fluency factor. We do not speculate about the nature of the additional factor or factors other than to suggest that some sort of controlled memory search may be involved.

rejections with misses and false alarms falling somewhere in-between. Experiment 1 was conducted to test this prediction and to observe the relation between misses and false alarms in terms of perceptual fluency. Experiment 2 was conducted in an effort to alter the observed relation between misses and false alarms by altering the utility of the search factor.

#### Experiment 1

# Method

Subjects. Subjects were 40 male and female students at the University of Utah. In return for their participation, subjects received credit toward a raise in their grade in an introductory psychology class.

Materials and apparatus. One-hundred and seventysix words were selected from the Kučera and Francis (1967) norms. They were all low-frequency (between 8 and 14 occurrences per million) nouns between four and five letters in length (e.g., curb, flute, gorge, and herb). These words were divided randomly and evenly into two sets. One set served as reading (old) words and one as distractor (new) words, and the assignment of the two sets to these functions was counterbalanced across subjects. An additional 12 words were used: four as primacy buffers in the reading list, four as recency buffers, and four as buffer distractors at the beginning of the test list.

The presentation of words and recording of response latencies were controlled by a Terak 8510/A computer system. Subjects viewed the words on a Zenith (Model ZVM 121) TV screen. Subjects spoke into a microphone that was connected to both a voice key and the experimenter's headsets. This arrangement allowed the subjects' vocal responses during both the reading phase and the test phase of the experiment to be timed by the computer and scored for accuracy by the experimenter.

The subjects served individually in a sound-deadened room. They were seated approximately 45 cm from the viewing screen but were free to adjust this distance. At 45 cm viewing distance, the words subtended approximately 0.5 degrees of visual angle vertically and 2.0 degrees horizontally. The experimenter, computer, and voice key were located in a nearby room.

*Procedure.* In the reading phase, the words were displayed one at a time in the center of the viewing screen and subjects read each word aloud. Word exposure was 1,667 ms and stimulus onset asynchrony was 2,000 ms. Subjects were not informed about the impending test phase until the conclusion of the reading phase.

Old and new words were presented one at a time in the test phase. The first eight test words were buffer words: four were old and four were new. Two different random orders of the remaining words were used equally often. When a word was first presented, it was obscured by 300 randomly positioned dots. These dots were then randomly removed at the rate of one dot every 20 ms. Subjects were urged to identify the word before it became completely clear. When the subject spoke into the microphone, any remaining dots were instantly removed and the word remained in clear view until the subject said old or new according to whether or not she or he judged the word to have been a member of the reading list. A 500-ms interval separated the recognition response to one word from the presentation of the next word. Following the test phase, subjects were debriefed and dismissed. The entire experimental session lasted approximately 30 min.

# **Results and Discussion**

The significance level was set at .05 for all statistical tests reported in this article. The data are summarized in Table 1. The first column of data shows the mean probability of occurrence of the recognition outcomes. Two features of these data are noteworthy. One is that performance was not limited by a ceiling; each recognition outcome occurred frequently enough that perceptual fluency associated with that outcome could be reliably assessed. The second feature is that there was a bias toward responding new, F(1, 39) = 9.14,  $MS_e = .040$ .

Our main interest centered on the pattern of perceptual fluency across the four recognition outcomes. Latency and accuracy of identification are summarized in the third and fifth columns of data in Table 1. Both measures of perceptual fluency were subjected to a  $2 \times 2$  analysis of variance in which one factor was the actual word status (old vs. new) and the other factor was judged word status (old vs. new). Both main effects attained significance in these analyses but the interaction did not, F < 1.00. In comparison with new words, old words were identified at shorter latencies (3,827 vs. 4,137 ms), F(1, $39) = 9.37, MS_e = 274,220$ , and with higher accuracy (74% vs. 66%), F(1, 39) = 6.73,  $MS_{\rm e}$  = .009. This result illustrates the standard repetition effect on perceptual fluency. In addition, in comparison with words judged to be new, words judged to be old were identified at shorter latencies (3,856 vs. 4,085 ms), F(1, 39) = 4.30,  $MS_e = 106,677$ , and with higher accuracy (75% vs. 66%), F(1,39) = 18.81,  $MS_e = .008$ . This result was independent of the actual word status, and it suggests that subjects used perceptual fluency in making recognition judgments.

A comparison of misses and false alarms indicates that perceptual fluency was not the only contributor to recognition judgments. If it had been, then perceptual fluency would

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Conditional Probability, Identification Latency, Per Cent Accuracy, Reading Latency, and Standard Deviations for Each Recognition Outcome in Experiment 1		

Actual status	Judged status	Recognition outcome	Conditional probability <sup>a</sup>		Identification latency <sup>b</sup>		% Accuracy		Reading latency (ms)	
			М	SD	М	SD	M	SD	M	SD
Old	Old	Hit	.70	.13	3807	554	.76	.22	648	221
Old	New	Miss	.30	.13	3875	661	.68	.23	653	246
New	Old	False alarm	.21	.13	4022	599	.70	.21		
New	New	Correct rejection	.79	.13	4167	659	.65	.23	_	

\* Probabilities of hits and misses are conditionalized on old items and those of false alarms and correct rejections are conditionalized on new items.

<sup>b</sup> Only correctly identified words are included.

Table 1

have tended to be greater for all words judged to be old, including false alarms, than for all words judged to be new, including misses. In fact, the reverse ordering of misses and false alarms in terms of identification performance was obtained, and the difference was statistically significant by a Newman-Keuls test in the case of latency of identification (3,875 ms vs. 4,022 ms). The tendency for misses to exceed false alarms in perceptual fluency implies the operation of a rather potent, but fallible, search factor. That is, some old words were perceived with rather high fluency but were still misjudged to be new, and some new words were perceived with rather low fluency but were still misjudged to be old. These misjudgments suggest the operation of a factor (e.g., search) other than perceptual fluency.

One might argue that the relation that was obtained between perceptual fluency and recognition judgments arose because of a preexperimental correlation between the perceptibility of a word and the tendency to judge it as an old word. That is, some words may possess semantic or other characteristics that render them both more easily perceived and more familiar or retrievable than other words. Evidence against this line of reasoning, at least with respect to old words, is given in the next to last column of Table 1. Specifically, reading latency in the reading phase of the experiment was not predictive of whether words would become hits or misses in the test phase. If reading latency can be regarded as a valid measure of a word's preexperimental fluency of perception, then this null finding undermines an appeal to item effects in attempting to account for the difference between hits and misses in terms of perceptual fluency in the test phase.

If our two-factor interpretation of the results of Experiment 1 has merit, then any manipulation that reduces the utility of the search factor should reduce or even reverse the observed advantage of misses over false alarms in terms of perceptual fluency. Experiment 2 constituted a test of this hypothesis.

## **Experiment** 2

A manipulation is required that reduces the relative degree of reliance on the search factor. Item meaningfulness seemed to conform to these requirements. Witherspoon (1984) examined the perceptual fluency (accuracy of identification at brief exposure durations) of items that had been judged as old or new on an earlier test of recognition memory. Perceptual fluency and recognition judgments were stochastically independent when words were used but were correlated when nonwords were used. Nonwords apparently curtail the utility of the search factor perhaps by curtailing depth of processing and the formation of interitem associations. Moreover, Feustel, Shiffrin, and Salasoo (1983) measured perceptual fluency in much the same way that we did, and they found that the repetition effect was as large with nonwords as with words. Apparently, the use of nonwords does not curtail the utility of the perceptual fluency factor. Consequently, we transformed the words of Experiment 1

Table 2

Actual status	Judged status	Recognition outcome	Conditional probability <sup>a</sup>		Identification latency <sup>b</sup>		% accuracy		Reading latency (ms)	
			М	SD	М	SD	М	SD	М	SD
Old	Old	Hit	.57	.09	4863	560	.65	.14	945	160
Old	New	Miss	.43	.09	4967	528	.57	.15	955	145
New	Old	False alarm	.29	.10	4874	548	.63	.18		
New	New	Correct rejection	.71	.10	5002	465	.52	.15	<del></del> _	

Conditional Probability, Identification Latency, and Per Cent Accuracy, Reading Latency, and Standard Deviations for Each Recognition Outcome in Experiment 2

<sup>a</sup> Probabilities of hits and misses are conditionalized on old items and those of false alarms and correct rejections are conditionalized on new items.

<sup>b</sup> Only correctly identified words are included.

into nonwords. In comparison with Experiment 1, we expected that subjects in Experiment 2 would be faced with a weaker search process by which to make recognition judgments, that this would cause them to rely more on the perceptual fluency cue, and that the net effect would be an alteration in the relation between misses and false alarms in terms of perceptual fluency.

#### Method

Experiment 1 was replicated precisely except that words were turned into pronounceable nonwords by transposing letters and only 24 subjects were tested.

#### **Results and Discussion**

The data are summarized in Table 2. Two features of the data stand in marked contrast with the findings of Experiment 1. First, recognition accuracy was noticeably inferior in Experiment 2 (d' declined from 1.33 to 0.73). Second, the repetition effect on perceptual fluency (old > new) held up in terms of accuracy of identification in the test phase  $(62\% \text{ vs. } 55\%), F(1, 23) = 4.57, MS_e = .008,$ but not in terms of latency of identification (4,908 vs. 4,965 ms), F < 1.00. The first contrasting finding indicates that the use of nonwords reduced the composite utility of whatever cues subjects used to discriminate old from new items, and the second suggests that this reduction in cue utility is at least partially attributable to the reduced cue value of perceptual fluency. The reduction in the repetition (old/new) effect on perceptual fluency with nonwords does not replicate

prior findings (e.g., Feustel et al., 1983). We do not know the reason for this replication failure, but it is potentially attributable to a number of methodological differences between the studies.

Notwithstanding the diminished power of perceptual fluency to discriminate between old and new items, subjects evidently still relied more heavily on perceptual fluency than on the search factor in making recognition judgments. The basis for this conclusion is twofold: First, perceptual fluency continued to be higher for items called old than it was for items called new, regardless of whether they really were old or new; F(1,23 = 7.64,  $MS_e$  = 42411 for identification latency (4,867 ms vs. 4,989 ms), and F(1, 1)23 = 18.86,  $MS_e$  = .010 for identification accuracy (64% vs. 54%). Second, in direct contrast to Experiment 1, a Newman-Keuls test of both latency and accuracy of identification indicated that perceptual fluency was greater (93 ms faster and 6% more accurate) for false alarms than it was for misses. Hence, our attempt to reduce the relative reliance on the search factor by using nonwords instead of words was apparently successful.

Finally, in conformity with Experiment 1, subjects again showed a bias to respond new, F(1, 23) = 20.96,  $MS_e = .011$ , and reading latency in the first phase did not discriminate between items that ended up as hits and misses in the test phase (F < 1.00). As noted earlier, this latter finding weighs against the argument that items that became hits were inherently more perceptible than items that became misses.

# General Discussion

The present results support our primary hypothesis, namely, that perceptual fluency plays a significant role in recognition judgments and may be the basis of the feeling of familiarity. In what follows, we address first some possible counterarguments to this proposal and next the merits of our tentative two-factor theory.

# Counterarguments

We have already attempted to discount the argument that the observed relation between perceptual fluency and recognition judgments is based on preexperimentally established differences between items. As noted earlier, our principal rejoinder to this argument is that reading speed in the study phase, a possible measure of the preexperimental fluency of perception, was unrelated to recognition judgments in the test phase.

A related argument can be directed against our attributional interpretation of the observed relation between perceptual fluency and recognition judgments. Specifically, it might be argued that both perceptual fluency and recognition judgments are affected independently by the same underlying process, perhaps a search process. For example, it may be that both perceptual fluency and recognition judgments are based on the accessibility of episodic memory representations of the items. The more accessible a memory representation (experimentally established for old items and preexperimentally established for new items), the more fluent the perception and the more probable an old judgment. Indeed, the possibility that perceptual fluency is based on episodic memory traces has received substantial empirical support (e.g., Feustel et al., 1983; Jacoby, 1983; Jacoby & Dallas, 1981). However, by this line of reasoning, one would expect to always observe a close relation between perceptual fluency and recognition judgments. Counter to this expectation, the degree of relation was found to vary considerably across the present two studies and to be nil in other studies (e.g., Tulving, Schacter, & Stark, 1982; Witherspoon, 1984).

A final argument is that our causal inference about the correlation between perceptual fluency and recognition judgments is backward. Rather than perceptual fluency affecting recognition judgments, just the reverse might be the case. That is, during the perceptual identification test, subjects may be biased toward giving as responses items that they judge as having been previously studied. As an item is clarified, hypotheses with regard to its identity come to mind. If an hypothesized item is judged (correctly or incorrectly) as being old, then the subject outputs that item. If an hypothesized item is not judged as being old, then the subject requires further clarification (more information) before outputting the hypothesized item. A bias of this sort would cause false alarms to be identified with less clarification than misses. Furthermore, identification latency would be comparable for hits and false alarms as well as for misses and correct rejections. Roughly, this pattern of results was found in Experiment 2. However, a very different pattern of results was found in the first experiment. In the first experiment, misses were identified with less clarification than were false alarms, and neither hits and false alarms nor misses and correct rejections were comparable in terms of identification latency. That is, the effect of a prior presentation of an item on its later perception was observed even for items that subjects judged to be new. There was a main effect of actual word status (old vs. new) as well as of judged status. This pattern of results is incompatible with the claim that recognition memory mediates perceptual identification performance.

#### Two-Factor Theory

The two-factor theory sketched out in the introduction provides a reasonable account of the present findings as well as relevant prior findings. The operation of a search factor in addition to perceptual fluency was evidenced by the partial independence between perceptual fluency and recognition judgments that was observed in Experiment 1. As noted earlier, perceptual fluency in Experiment 1 was less for false alarms than it was for misses. Had perceptual fluency been the only factor at work, then it would have been greater for items judged old than for those judged new, regardless of their actual repetition status.

The theory can potentially disambiguate the extant literature on the role of perceptual fluency in recognition memory. Subjects' apparent reliance on perceptual fluency as a cue for discriminating between new and old items has varied from no reliance (e.g., Tulving et al., 1982; Witherspoon, 1984) to virtually complete reliance (e.g., Experiment 2) with several degrees in-between (e.g., Experiment 1; Feustel et al., 1983, Experiment 5; Witherspoon, 1984). These variations can be described as variations in the relative utilities of the two factors. One potential source of such variations is item meaningfulness. The apparent reliance on perceptual fluency has been greatest with nonwords (e.g., Experiment 2; Witherspoon, 1984) and least with words (e.g., Experiment 1; Tulving et al., 1982; Witherspoon, 1984), especially high-frequency words (Feustel et al., 1983, Experiment 5), Whether a decrease in item meaningfulness does (Experiment 2) or does not (Feustel et al., 1983) reduce the cue utility of perceptual fluency, it clearly has a detrimental effect on the cue utility of the search factor.

Variations in relative cue value of the two factors can also be appealed to in countering an argument that has been leveled against the possible contribution of perceptual fluency to recognition judgments. The form of this argument is as follows: If a manipulation has a strong effect on recognition performance but a weak effect or no effect on perceptual fluency, then it may be concluded that perceptual fluency does not make an important contribution to recognition performance. This argument has been made with respect to at least two manipulations, namely, retention interval (Tulving et al., 1982) and repetition lag (Feustel et al., 1983, Experiment 5). The counter to the argument is that a manipulation might have differential effects on the utilities of the two factors. For example, an increase in repetition lag may not affect the disparity between new and old items in perceptual fluency but may drastically diminish the utility of the search factor. The joint discriminatory power of the two cues may yield high performance at short lags but may diminish at long lags, owing to a reduction in the potency of the search factor, and yield low performance. The same argument can be developed with respect to retention interval

and item meaningfulness. Thus, when a manipulation does not affect the cue value of perceptual fluency (old > new items) but does reduce recognition performance, it does not necessarily follow that subjects do not rely on perceptual fluency in making recognition judgments. The manipulation may reduce the utility of the search factor and force subjects to rely more heavily on perceptual fluency. The reduction in the composite utility of the two cues may cause a reduction in recognition performance.

Although the two-factor approach is one with some promise, we do not proffer it as a complete theory. It is only a rough, qualitative framework from which more finished, possibly quantitative theories might emerge. For example, our approach provides a way to account for observed variations in the apparent role of perceptual fluency in recognition judgments, but it does not, without the assistance of added assumptions and other theories, specify ahead of time the relevant independent variables (e.g., item meaningfulness and repetition lag). More theoretical attention must be paid to the underlying nature of the two factors. In addition, the two factors of the model are not expressed in quantitative form. However, these factors are analogous to two salient parameters (viz., b and c) of the Gillund and Shiffrin (1984) model of recognition memory and, therefore, are potentially quantifiable. Indeed, our approach and findings may suggest ways in which the Gillund and Shiffrin model can be refined and extended. In the meantime, our more qualitative model coupled with our research paradigm can serve as a useful framework for guiding and describing research on the possible role of perceptual fluency in the feeling of familiarity and in recognition judgments.

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