

Feeling of Knowing in Episodic Memory

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Feeling of knowing judgments can be viewed as one mode of expressing knowledge of stored information. The present experiments explored the relation of the feeling of knowing to two other modes of expressing knowledge, recall and recognition, by examining how manipulations of encoding, storage, and retrieval conditions affected the relative frequency of positive and negative feeling of knowing judgments and feeling of knowing accuracy. Relative frequency of positive and negative feeling of knowing judgments, like recall and recognition, was influenced by experimentally induced changes in encoding, storage, and retrieval conditions. In contrast, feeling of knowing accuracy was not sensitive to changes in encoding and storage conditions but was affected by changes in retrieval conditions. The results are discussed with regard to methodological and theoretical issues raised by the present experiments that bear on feeling of knowing research in general.

One of the major problems that has been confronted in human memory research during the past decade concerns how people are able to use what they know. A large number of studies have examined the processes by which stored information is used and have also attempted to specify the psychological conditions that affect them. Experimental investigations of the utilization of knowledge have tended to focus on two processes: recall and recognition. These studies have yielded a good deal of information about the properties of recall and recognition, have examined their function in the memory system, and have clarified some of the ways in which recall and recognition are similar to and different from each other (Brown, 1976).

Recall and recognition, however, are not the only ways in which people can express what they know. It has been known, for instance, since the time of Ebbinghaus (1885/1964) that subjects show *savings* when relearning experimentally acquired information. Recent research has demonstrated significant savings even when recall and recognition fail: Although information about the study items is not accessible to conscious recall or recognition, relearning of them proceeds more rapidly than does the learning of entirely new materials (Nelson, Fehling, & Moore-Glascock, 1979). In these situations, subjects' knowledge of the target information is not directly expressed; it is indirectly expressed through the facilitation of relearning.

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Another way in which people can express knowledge about stored information is to indicate how sure they are that some specified bit of information is available in memory. Consider a case in which a person cannot recall a designated item. Although the person does not possess enough information about the item to recall it, he or she may still know enough to indicate whether or not he or she would be able to recognize it. This mode of expressing knowledge about unrecalled information is referred to as a *feeling of knowing judgment*. A number of experimental studies have demonstrated that feeling of knowing judgments predict with above-chance accuracy which unrecalled items

will be recognized and which will not be recognized.

The observed accuracy of feeling of knowing judgments can derive from at least two sources. First, it might reflect the fact that a person possesses some specific information about the unrecalled item. For example, a baseball fan who cannot recall the name of the man who played second base for the New York Yankees in 1962 might remember that the player caught the final out in the World Series that year and on that basis might predict accurately that he or she could recognize the name (Bobby Richardson). Second, as pointed out by Koriat and Lieblich (1974), feeling of knowing accuracy can derive from an assessment of one's general knowledge. A person who had no interest in baseball, for example, could predict accurately that he or she would not recognize the name of the Yankees' 1962 second baseman. This prediction could be made on the basis of the person's assessment of his or her general knowledge of baseball and need not involve searching for specific information about the unrecalled name. In the present study, feeling of knowing accuracy is discussed largely in terms of item-specific knowledge about unrecalled information. It should be noted, however, that accurate feeling of knowing judgments do not necessarily imply knowledge about specific unrecalled items.

Previous studies concerning the feeling of knowing can be broadly classified into two types. In one kind of study, the experimenter investigates the feeling of knowing by requiring subjects to make judgments about the future accessibility of unrecalable information and then tests subjects in a manner that permits assessment of the accuracy of the judgments. In studies of the feeling of knowing in *episodic* memory (Tulving, 1972), judgments are made about experimentally presented study materials; in studies of the feeling of knowing in *semantic* memory, judgments are made regarding knowledge of word meaning and other items of general knowledge. A second type of feeling of knowing study is concerned with the kinds of information that subjects possess about what they cannot recall; no predictions are required. Such studies frequently focus on the

"tip-of-the-tongue" phenomenon; that is, cases in which subjects cannot recall some desired information but claim that the information seems to be on the tip of their tongues.

Studies using these two approaches to the feeling of knowing have yielded a number of reliable findings. First, subjects recognize more unrecalable items as the certainty of their feeling of knowing ratings increases, both in semantic-memory paradigms (Freedman & Landauer, 1966; Gruneberg & Monks, 1974; Hart, 1965, 1966, 1967b; Kozlowski, 1977) and episodic-memory paradigms (Blake, 1973; Hart, 1967a; Nelson, Leonesio, Shimamura, Landwehr, & Narens, 1982; Nelson & Narens, 1980). In almost all of these studies, the size of the feeling of knowing effect has been rather modest; subjects fail to recognize many items assigned a feeling of knowing "yes" prediction and recognize many items assigned a feeling of knowing "no" prediction. Second, when subjects claim that they know an inaccessible item, they are able to produce more information about it than when they claim little or no knowledge (Blake, 1975; Eysenck, 1979; Koriat & Lieblich, 1974). Third, it has been found that many different types of information about unrecalable items can be produced: phonological (Brown & McNeill, 1966; Koriat & Lieblich, 1974), orthographic (Brown & McNeill, 1966; Koriat & Lieblich, 1974), semantic (Eysenck, 1979; Yarmey, 1973), and temporal (Yarmey, 1973). Fourth, developmental studies have indicated that older children make more accurate feeling of knowing judgments than do younger children (Brown & Lawton, 1977; Wellman, 1977).

Taken together, these studies have described and delineated a number of the properties of the feeling of knowing. However, the results of the various studies are only rather loosely related to each other and do not clearly point to any particular view of the feeling of knowing. Indeed, many of the foregoing studies have approached the feeling of knowing as a "special" feature of memory and have not attempted to identify its function in the memory system or to specify how the feeling of knowing is related to other memory processes.

Feeling of Knowing in Episodic Memory: Three Experiments

The present experiments are concerned with the relation of the feeling of knowing to other modes of expressing knowledge. Because most previous research on the feeling of knowing has treated it as an isolated feature of the memory system, the similarities and differences between the feeling of knowing and other features of human memory have not yet been systematically explored. One of the major purposes of the present study is to cast the feeling of knowing in a broad conceptual framework that encourages questions about its place in the memory system. More specifically, the feeling of knowing is viewed as one way of expressing knowledge of stored information, and the relation of the feeling of knowing to two frequently studied modes of expressing knowledge, recall and recognition, is experimentally examined.

It should be noted that recall and recognition are grouped together for heuristic purposes; no theoretical position about the relation between the two is implied. It seems clear that recall and recognition are in several respects similar to, and in others, different from, each other: They are sometimes affected in the same way by experimental variables, and sometimes they are affected differently (see Brown, 1976). In the present experiments, variables that have roughly parallel effects on recall and recognition were used in order to initiate comparison of these processes with the feeling of knowing. However, it should be acknowledged that recall and recognition are not always affected in the same way by experimental variables and that their differences may be as important as are their similarities.

Two questions concerning the feeling of knowing are of primary interest in the present study: (a) How do variables known to influence recall and recognition affect subjects' tendency to make a "yes" or "no" feeling of knowing judgment? (b) How do these variables affect the accuracy of feeling of knowing judgments? Little information concerning these questions exists in the literature. Hart (1967a) found that the number of presentations of study items, a variable that

is known to influence recall and recognition, did not affect feeling of knowing accuracy. Hart did not present data concerning the relative frequency of feeling of knowing "yes" and "no" judgments. More recently, Nelson et al. (1982) found that degree of overlearning of study items was positively related to proportion of feeling of knowing "yes" responses and to level of feeling of knowing accuracy. A major purpose of the present experiments is to extend our knowledge of the feeling of knowing by examining the effect of variables that influence the *encoding*, *storage*, and *retrieval* stages of memory on relative frequency of feeling of knowing judgments and their validity.

The three reported experiments share two features in common. First, the study-recall-prediction-recognition procedure developed by Hart (1967a) was used throughout. Subjects in all three experiments (a) studied lists of cue-target pairs, (b) attempted to recall the target in response to an intralist or extralist cue, (c) made feeling of knowing predictions concerning the incorrectly recalled items, and (d) attempted to recognize the targets on multialternative forced-choice recognition tests. Second, feeling of knowing accuracy was evaluated in all three experiments by comparing probability of recognition of items given "yes" predictions and items given "no" predictions: The larger the difference between recognition of "yes" and "no" items, the greater the evidence of feeling of knowing accuracy. Although questions concerning this measure have been raised (Nelson & Narens, 1980), existing evidence indicates that it yields patterns of data that are similar to data obtained with other feeling of knowing measures (Nelson et al., 1982). In addition, the previous usage of this measure in the literature permits relatively straightforward comparison of the present results with published data.

Experiment 1

In Experiment 1, feeling of knowing predictions were made immediately after studying a list of cue-target pairs, and 1 week after studying the pairs. Numerous studies conducted in the experimental psychology of

memory during the past 100 years have shown that both recall and recognition performance decline over the course of a retention interval (see Crowder, 1976, and Murdock, 1974, for reviews). The purpose of the present experiment was to determine whether the tendency to make a "yes" or "no" feeling of knowing judgment, as well as the accuracy of such judgments, is influenced by length of the retention interval between study and test.

Method

Subjects. Sixteen University of Toronto undergraduates took part in the experiment and were paid \$4 for their participation.

Design and procedure. The design of the experiment was a 2 (feeling of knowing judgment) \times 2 (retention interval) within-subjects design. All subjects studied 72 critical cue-target pairs. For each subject, half of the items were tested just after presentation of the study list, and half were tested 1 week later. The 72 cue-target pairs were randomly divided into two sets of 36, Set A and Set B. Order of testing the two sets was counterbalanced so that half the subjects were tested immediately on Set A and 1 week later on Set B, whereas half the subjects were tested in the reverse order.

Recall was tested by presenting list cues and asking subjects to produce the target that had been shown with a particular cue on the list. Feeling of knowing judgments were either "yes" or "no": When subjects thought that they would be able to recognize a target, they made a "yes" prediction; when they thought that they would not be able to recognize a target, they made a "no" prediction. Recognition was tested by a six-alternative forced-choice procedure. The list cue was presented along with the target word and five semantically similar distractors. The position of the target was randomly determined for each item. The order of testing items was the same on both the cued-recall and recognition tests.

Subjects were tested in small groups of two to five. All subjects were shown the 72 critical cue-target pairs and were told that their memory for the target would later be tested by presenting the list cue. Four buffer pairs preceded the critical pairs, and an additional four buffers appeared after the target items. The pairs were presented on slides at a 5-sec rate by a Kodak carousel projector with an automatic timer. The cue words were printed in small letters directly above the target words, which were printed in capital letters. After list presentation, subjects engaged in two distractor tasks for a total of 20 min. First, they crossed out specified numbers on a sheet containing a long series of numbers. They were then given a list of cities and told to write down the country that the city is located in and one fact that they knew about the city.

After completion of the distractor tasks, subjects were instructed about the cued-recall, feeling of knowing, and recognition tasks. They were told that they would be given 5 sec to make their feeling of knowing predictions: "yes" when they thought that they would recognize the target and "no" when they thought that they would not.

Subjects were told to make feeling of knowing predictions for all items, not just the unrecalled ones. This procedure was necessary because subjects did not know if the items that they wrote down on the cued-recall test were in fact correct. However, only predictions for unrecalled or incorrectly recalled items were included in the analyses of feeling of knowing accuracy. Subjects were then instructed about the forced-choice recognition test and were provided with several illustrative examples. All questions concerning the procedure were answered before beginning the cued-recall test.

The subjects were then given a 21.59- \times 27.94-cm sheet on which 36 list cues were typed. A cardboard mask with a slit that exposed one cue at a time was used by each subject. Subjects were given 15 sec to recall the target to a given cue. They were also told to write down any guesses, because the experimenter could not provide individual feedback about the correctness of the guesses in the group situation. At the end of the 15-sec period, the experimenter indicated to subjects that they should make their feeling of knowing predictions; they were allowed 5 sec to do so. After completion of the cued-recall and feeling of knowing tasks for 36 items, the forced-choice recognition task for those items was administered. Subjects completed this task at their own pace.

When all subjects finished the recognition test, the experimenter told them that they would be tested for the remaining 36 items in exactly 1 week. Subjects returned to the laboratory 1 week later. The experimenter first reminded them of the task requirements and then answered any questions concerning the procedure. The cued-recall, feeling of knowing, and recognition tests were then given in the same manner that they had been administered 1 week earlier.

Materials. The critical pairs were 72 low-to-moderately associated pairs of common English words. The materials have been previously used and described in studies reported by Tulving and Thomson (1973) and Wiseman and Tulving (1976). In addition, eight buffer pairs were constructed from the same materials. The distractor items chosen for the recognition test were semantically similar to the target items.

Results and Discussion

Consider first the data concerning cued-recall and recognition performance. In accordance with many previous studies, these data demonstrate substantial decrements in both recall and recognition accuracy as a function of delay. Proportion of items correctly recalled on the cued-recall test declined from .53 at immediate test to .09 at 1-week delay. Overall probability of recognition was .81 at the immediate test and .43 after the 1-week retention interval. Correlated *t* tests confirmed that performance significantly declined during the retention interval in both cued recall, $t(15) = 9.43, p < .001$, and recognition, $t(15) = 8.18, p < .001$.

Subjects made feeling of knowing judgments both when they made errors of omission and commission on the cued-recall test in all three of the present experiments. The data are collapsed across these two types of errors because analyzing them separately did not reveal any notable differences. When subjects did not recall an item correctly, they provided incorrect responses for approximately 10% to 15% of the items in each of the three experiments, indicating that subjects did not frequently guess. For these commission errors, 9% to 17% of the feeling of knowing judgments were "no" in the various experimental conditions ($n < 25$ in each condition). Because of the small number of "no" predictions made about incorrectly recalled items, meaningful comparisons between recognizability of "yes" and "no" items could not be made. In addition, the relative frequency of "yes" and "no" judgments made about incorrectly recalled items did not systematically vary with experimental conditions.

Table 1 presents data concerning the patterns of feeling of knowing judgments made during the immediate and delayed tests. Many more predictions were made in the delayed test, reflecting the much lower level of cued recall in this condition. The data also indicate that the relative frequency of positive and negative feeling of knowing judgments substantially changed as a function of the retention interval manipulation: Subjects' tendency to predict "yes" showed a large drop from the immediate (.57) to the delayed (.42) test. The change in the relative frequency of feeling of knowing "yes" and feeling of knowing "no" predictions was statistically reliable, $t(15) = 2.85$, $p < .05$.

Table 1
Number of Feeling of Knowing "Yes" and "No" Predictions as a Function of Time of Test in Experiment 1

Time of test	Feeling of knowing prediction		
	Yes	No	Total
Immediate	153	115	268
Delayed	222	301	523
Total	375	416	791

Table 2
Probability of Target Recognition as a Function of Feeling of Knowing Prediction and Time of Test in Experiment 1

Time of test	Feeling of knowing prediction		
	Yes	No	<i>M</i>
Immediate	.66	.52	.62
Delay	.44	.32	.37
<i>M</i>	.53	.37	.45

The feeling of knowing accuracy data, displayed in Table 2, present a different picture.¹ Recognition of feeling of knowing "yes" items was higher than was recognition of feeling of knowing "no" items but by about the same amount at both retention intervals. There was a main effect of feeling of knowing judgment, $F(1, 15) = 12.02$, $p < .01$, $MS_e = .038$, and a main effect of retention interval, $F(1, 15) = 15.37$, $p < .01$, $MS_e = .062$, but no interaction between these variables, $F(1, 15) < 1$, $MS_e = .478$. The main effect of feeling of knowing judgment indicates that recognition of feeling of knowing "yes" items was significantly higher than was recognition of feeling of knowing "no" items at both retention intervals; the main effect of retention interval simply confirms that overall recognition performance declined from the immediate to the 1-week test. The failure to find a significant interaction, however, indicates that feeling of knowing accuracy was not affected by the retention interval manipulation.

The foregoing data, then, suggest that subjects' tendency to make feeling of knowing "yes" or "no" judgments, like recall and recognition, was affected by the retention interval manipulation. In contrast, the accuracy of feeling of knowing judgments did not change over the course of the retention interval. It is interesting to note, however, that considered separately, recognition of "yes" and "no" items did indeed change as a func-

¹ The conditional probabilities representing feeling of knowing accuracy data that appear in the tables are based on proportions that are weighted by the different numbers of observations contributed by each subject to particular experimental conditions.

tion of retention interval. Subjects recognized 66% of "yes" items immediately and 44% after 1 week; similarly, they recognized 52% of "no" items immediately and 32% after 1 week. Although these changes may be attributable to overall decline in recognition performance, they suggest that feeling of knowing judgments were not related to recognition accuracy in an identical manner on the immediate and delayed tests.

A potential difficulty in interpreting the present data is raised by the within-subjects design of the experiment. It is possible that familiarity with the test procedures gained during the initial session may have in some way altered subjects' feeling of knowing responses in the second session: Having acquired some knowledge of the nature of the recognition test, and perhaps of their own level of performance, subjects may have altered the distribution of their feeling of knowing "yes" and "no" predictions on the delayed test. Such a "learning" process, if it indeed occurred, could have masked any decline in feeling of knowing accuracy as a function of retention interval. Although there is no evidence that directly supports this conjecture, the need for some interpretative caution should be acknowledged.

Experiment 2

Experiment 1 examined the relation between the feeling of knowing, and recall and recognition, by manipulating storage conditions. In order to extend the range of the investigation, encoding and retrieval conditions were manipulated in Experiment 2. Encoding conditions were varied by manipulating the amount of time that subjects studied a list of cue-target pairs. Many studies in the literature have shown that both recall and recognition benefit from increased exposure time to the study items (e.g., Cooper & Pantle, 1967), but we do not yet know if and how the feeling of knowing is affected by this variable.

Retrieval conditions were manipulated by varying the type of retrieval cue presented to the subjects. A number of studies have found that the accuracy of both cued recall (e.g., Light, 1972; Thomson & Tulving, 1970; Tulving & Pearlstone, 1966) and recognition

(e.g., Light & Carter-Sobell, 1970; Thomson, 1972; Tulving & Thomson, 1971) is critically dependent on the presence of appropriate retrieval cues at the time of test. Two types of cue were used in the present experiment: Intralist cues that had weak preexperimental associations with their respective targets and extralist cues that had strong preexperimental associations with the targets. Thomson and Tulving (1970) found that when target items were encoded with respect to weakly associated cues, these intralist cues were more effective aids to subsequent retrieval of the targets than were strong extralist associates. Thus, after subjects studied a cue-target pair such as *glue*-CHAIR, the normatively weak cue *glue* was a more effective cue for CHAIR than was the normatively strong cue *table*. In Experiment 2, the relative frequency and accuracy of feeling of knowing judgments made in the presence of weak intralist cues and strong extralist cues were compared.

Method

Subjects. Thirty-two University of Toronto undergraduates took part in the experiment. The subjects were paid \$4 for their participation.

Design and procedure. The design of the experiment was a 2 (feeling of knowing judgment) \times 2 (presentation time) \times 2 (type of cue) mixed design. Type of feeling of knowing prediction, "yes" or "no," and type of retrieval cue, intralist or extralist, were within-subjects variables. Presentation time, 5 or 1½ sec, was the between-subjects variable. Subjects were randomly assigned to the two presentation time conditions. For each subject, half of the study pairs were tested with intralist cues, and half were tested with extralist cues. There were two forms of the cued-recall test. Each form was randomly assigned to half of the subjects in each of the two presentation time conditions. A given target was tested by its intralist cue on one form and by its extralist cue on the other form. Thus, all targets were tested by intralist and extralist cues an equal number of times in each study group.

Type of cue was identified on the cued-recall test sheets. The letters IL were typed in parentheses next to each intralist cue; the letters EL were typed in parentheses next to each extralist cue. On each of the two forms, ordering of intralist and extralist cues was random. On the recognition test, the intralist cue was always presented alongside of the target and five semantically similar distractors. Order of testing on the cued-recall and recognition tests was identical.

Subjects were tested in small groups of two to six. They studied a list of 80 cue-target pairs that included eight buffer items at the beginning, and eight at the end of the list. The pairs were presented at a 5-sec rate to 16 subjects and at a 1½-sec rate to the other 16 subjects. All

pairs were presented on slides by an automatically timed Kodak carousel projector.

After list presentation, subjects engaged in distractor tasks for 20 min. The tasks were the same ones as previously described in Experiment 1.

The subjects were then instructed about the cued-recall and feeling of knowing tasks. They were informed that there would be two types of cues on the test. It was made clear to the subjects that each of the extralist cues was strongly associated with one target item and that the extralist cues would be explicitly identified on the test. They were told that they would have 15 sec to recall a target to each cue, after which they were to make their feeling of knowing predictions. Subjects were also informed that on the recognition test, all target items would be presented with their intralist cues. Thus, subjects were told to ask themselves the following question when making feeling of knowing predictions to extralist cues: *Would I be able to recognize the target if I saw it with its original cue?* As in Experiment 1, subjects were required to make feeling of knowing predictions for both unrecalled and recalled items, although only the data on unrecalled items were used to evaluate feeling of knowing accuracy. This procedure was adopted because in the group testing situation, subjects did not know whether their responses were correct or incorrect.

Subjects completed the cued-recall, feeling of knowing, and recognition tests in much the same manner as described in Experiment 1. They proceeded from item-to-item on the cued-recall and feeling of knowing tasks by using a cardboard mask that exposed one item at a time. Feeling of knowing predictions were made after the 15 sec allotted for cued recall had elapsed; 5 sec were allowed for the predictions. When the cued-recall and feeling of knowing tasks were completed, subjects immediately proceeded to the six-alternative forced-choice recognition test. For each cue, they circled the one item that they thought was the target. Subjects completed the recognition test at their own pace.

Materials. A new set of materials was used in this experiment to ensure that the basic feeling of knowing effect was not specific to the materials used in Experiment 1. The study pairs and corresponding extralist cue for each pair were chosen from the materials published by McKoon and Ratcliff (1979). These materials consist of a series of target words, along with one weak associate and strong associate for each target. Semantically similar distractor items for the recognition test were generated by the experimenter.

Results and Discussion

In experiments using extralist cues, subjects frequently recall list targets to cues other than the one intended by the experimenter. Thus, depending on the scoring criterion used, a "correct" response could be either a list target recalled to the wrong cue (lenient criterion) or a list target recalled to the correct cue, that is, the one intended by the experimenter (strict criterion). The data from this experiment were scored in both ways,

Table 3
Probability of Cued Recall as a Function of Presentation Rate and Retrieval Cue in Experiment 2

Type of cue	Presentation rate		
	5 sec	1½ sec	<i>M</i>
Intralist	.53	.37	.45
Extralist	.23	.21	.22
<i>M</i>	.38	.29	.35

and very little difference in the overall pattern of results was found. Accordingly, all data reported in the following analyses were scored using a strict criterion.

Cued-recall performance varied as a function of the encoding and retrieval manipulations. The cued-recall data, which are presented in Table 3, indicate that the retrieval manipulation had a substantial effect on performance: Subjects recalled only about half as many targets to extralist cues as they did to intralist cues. The effect of presentation rate was not as large, but subjects did recall fewer items in the 1½-sec condition than in the 5-sec condition. Analysis of variance revealed a significant main effect of both type of cue, $F(1, 15) = 65.72, p < .001, MS_e = .012$, and presentation rate, $F(1, 15) = 4.55, p < .05, MS_e = .012$. There was also a significant interaction between type of cue and presentation rate, $F(1, 15) = 5.93, p < .05, MS_e = .012$. The interaction reflects the fact that level of intralist cued recall declined more than did extralist cued recall between the 5- and the 1½-sec rate. Indeed, recall to extralist cues remained nearly constant across the two presentation rates. Recognition performance was also different in the two encoding conditions. Overall recognition (including both recalled and unrecalled items) in the 5-sec condition (.76) exceeded overall recognition in the 1½-sec condition (.65). However, the effect fell just short of statistical significance, $F(1, 15) = 2.97, MS_e = .081$.

Table 4 presents the distribution of feeling of knowing judgments in the various experimental conditions. The fact that subjects made many fewer feeling of knowing judgments when they did not recall items to intralist cues (565) than when they did not re-

Table 4
Number of Feeling of Knowing Predictions as a Function of Presentation Rate and Retrieval Cue in Experiment 2

Feeling of knowing prediction	Presentation rate		Total
	5 sec	1½ sec	
Intralist cue			
Yes	161	174	335
No	80	150	230
Total	241	324	565
Extralist cue			
Yes	217	197	414
No	174	208	382
Total	391	405	796

call to extralist cues (796) is a function of the higher levels of recall associated with the intralist cues. Similarly, subjects in the 5-sec condition made fewer judgments (632) than did subjects in the 1½-sec condition (729) because of the higher levels of recall in the 5-sec condition.

The data in Table 4 also indicate that subjects distributed their predictions differently across the experimental conditions. When target pairs were presented at a 5-sec rate, 60% of feeling of knowing judgments were "yes," whereas there were 51% "yes" judgments in the 1½-sec condition. Likewise, subjects made 59% "yes" judgments to intralist cues and 52% "yes" judgments to extralist cues. There was a marginally significant effect of presentation rate on the proportion of "yes" scores, $F(1, 15) = 3.78, p > .05 < .10, MS_e = .049$, a significant effect of type of cue, $F(1, 15) = 6.69, p < .05, MS_e = .013$, and no interaction between these two variables, $F(1, 15) < 1, MS_e = .013$.

The feeling of knowing accuracy data, displayed in Table 5, show the conditional probabilities of recognizing unrecalled targets given feeling of knowing positive and negative predictions in the various experimental conditions. The most striking feature of these data is that feeling of knowing accuracy was markedly affected by type of cue, but not by the encoding condition. When subjects made their feeling of knowing judgments in the presence of intralist cues, a standard feeling

of knowing effect was observed in both the 1½- and the 5-sec conditions: Recognition of feeling of knowing "yes" items exceeded recognition of feeling of knowing "no" items. However, there was no evidence of feeling of knowing accuracy in either encoding condition when feeling of knowing judgments were made in the presence of extralist cues. Recognition of feeling of knowing "yes" items barely exceeded recognition of feeling of knowing "no" items in the 5-sec condition, and the reverse was observed in the 1½-sec condition. There was statistical support for this description of the data. A significant interaction was found between type of feeling of knowing judgment and type of cue, $F(1, 15) = 20.33, p < .001, MS_e = .031$, but not between type of feeling of knowing judgment and presentation rate, $F(1, 15) = 1.39, MS_e = .033$. In addition, the three-way interaction was nonsignificant, $F(1, 15) < 1$.

One further feature of the data merits comment. In the intralist cue condition, subjects recognized about the same proportion of feeling of knowing "yes" items at the two presentation rates (.51 vs. .53) and also recognized approximately the same proportion of "no" items at the two rates (.36 vs. .40). In the extralist cue condition, recognition of "yes" items differed at the two presentation rates (.74 vs. .55) as did recognition of the "no" items (.70 vs. .57). Overall recognition of unrecalled items did not differ as a func-

Table 5
Probability of Target Recognition as a Function of Feeling of Knowing Prediction, Presentation Rate, and Type of Retrieval Cue in Experiment 2

Feeling of knowing prediction	Presentation rate		<i>M</i>
	5 sec	1½ sec	
Intralist cue			
Yes	.51	.53	.52
No	.36	.40	.38
<i>M</i>	.46	.47	.47
Extralist cue			
Yes	.74	.55	.65
No	.70	.57	.63
<i>M</i>	.72	.56	.64

tion of presentation rate in the intralist cue condition (.46 vs. .47) but did in the extralist cue condition (.72 vs. .56), perhaps because item-selection effects were operating with intralist cues and were not operating with the generally ineffective extralist cues (see the discussion of item selection in the General Discussion section). These data suggest that observed differences in level of recognition of "yes" items as a function of experimental condition in this experiment, as well as in Experiment 1, are probably attributable to overall changes in level of recognition; the same would apply to differences in recognition of "no" items as a function of experimental condition.

In summary, the proportion of feeling of knowing "yes" and "no" judgments was affected by both experimental variables, whereas the accuracy of feeling of knowing judgments—the difference between recognition of "yes" and "no" items—was influenced by type of retrieval cue but not by presentation rate. Some caution may be necessary when interpreting the extralist cue data because level of extralist cued recall was quite low in this experiment. It is possible that beyond-chance feeling of knowing accuracy to extralist cues might emerge under experimental conditions in which extralist cues elicited higher levels of recall; this possibility is investigated in Experiment 3.

The effects of the presentation rate variable were similar to the effects of retention interval observed in Experiment 1. Because presentation rate was a between-subjects variable, it seems reasonable to suggest that the feeling of knowing data in Experiment 1 may not be entirely attributable to potential learning effects associated with the within-subjects manipulation of retention interval.

Experiment 3

There are many studies in the literature that demonstrate that recall and recognition performance depend jointly on the nature of the memory trace and the type of information used to gain access to it (e.g., Fisher & Craik, 1977; Light & Carter-Sobell, 1970; Tulving & Thomson, 1973). In Experiment 3, I explored the possibility that the distribution and accuracy of feeling of knowing

judgments are also influenced by the qualitative resemblance between encoding and retrieval conditions. The experiment was based on Experiments 2 and 3 in the study reported by Fisher and Craik (1977) in which subjects studied either associative or rhyme cue–target pairs and then attempted to recall the targets with either associative or rhyme cues. Fisher and Craik observed interactions between encoding and retrieval conditions: Associative cues were more effective aids to recall than were rhyme cues in the associative encoding conditions, but rhyme cues were more effective than were associative cues in the rhyme encoding conditions. The present experiment sought to determine whether the feeling of knowing is sensitive to such interactions.

Method

Subjects. Thirty-six University of Toronto undergraduates participated in the experiment and were paid \$4.

Design and procedure. A 2 (encoding condition) \times 2 (feeling of knowing prediction) \times 3 (type of cue) mixed design was used in this experiment. The between-subjects factor was the encoding condition: One group of subjects studied rhyme pairs, and a second group studied associative pairs. Feeling of knowing prediction and type of retrieval cue were the within-subjects variables. Recall of the target was tested by three different types of cue in each encoding condition. One third of the items were tested with the same cue that was present on the study list. In this *identical* cue condition, subjects who studied rhyme pairs were tested with intralist rhyme cues, and subjects who studied associative pairs received intralist associative cues. In the *similar* cue condition, subjects were tested for one third of the items with an extralist cue that shared the same relation to the target as did the intralist cue (it rhymed or was associated with the target, depending on the encoding condition). Thus, if subjects studied the pair *seat*–NEAT, *heat* would be a similar extralist cue, and if they studied the pair *blue*–PAINT, *color* would be a similar extralist cue. Finally, in the *different* cue condition, one third of the items in the rhyme encoding condition were tested with associative cues, whereas one third of the items in the associative encoding conditions were tested with rhyme cues. For example, *tidy* would be a different extralist cue for the target encoded in the pair *seat*–NEAT, and *saint* would be a different extralist cue for the target in the pair *blue*–PAINT.

Three forms of the cued-recall test were constructed; each form was given to six subjects in each of the encoding conditions. Each target was tested by an identical, similar, or different cue on one of the three forms of the cued-recall test. This procedure assured that each target was tested by each type of cue an equal number of times. On a given form of the cued-recall test, one third of the targets were tested with identical cues, one third were tested with similar cues, and one third were tested with

different cues. The relation of each cue to the target was specified on the cued-recall test.

Recognition was tested with a five-alternative forced-choice procedure. Each intralist cue appeared next to the target item and four distractors. In the associative encoding condition, the distractors were all strong associates of the intralist cue; in the rhyme condition, they all rhymed with it. Items were tested in the same order that they had been tested on the cued-recall test.

The procedure and instructions were similar to Experiment 2. Subjects were tested in groups of two to six. Subjects in each encoding condition were informed of the relation between the cues and targets (rhyme or associative) and were told to do their best to remember each pair. They then studied 88 cue-target pairs that were presented on slides at a 5-sec rate by a Kodak carousel projector. The lists consisted of 72 critical pairs and 16 buffer pairs. Eight buffer pairs were included at the beginning of the list and 8 at the end.

After list presentation, subjects completed the same distractor tasks described in previous experiments. The cued-recall and feeling of knowing tasks were then explained to the subjects. They were given examples of the different types of cues that they would encounter and were told that the type of cue would be identified on the cued-recall test. Subjects were also instructed that feeling of knowing predictions should be made with reference to their likelihood of recognizing the target when it was presented with the intralist cue. As in Experiments 1 and 2, the group testing procedure dictated that subjects be instructed to make feeling of knowing predictions for all items, because they could not know whether a response on the cued-recall test was correct or incorrect. However, only predictions concerning incorrectly recalled or unrecalled targets were included in the feeling of knowing analysis.

Subjects were also told that when they attempted to recall a target to an extralist cue, they might sometimes recall the intralist cue that was associated with a target word, without recalling the target itself. They were instructed to record all instances in which they thought they had recalled the list cue, but not the target, and to circle the words that they thought were intralist cues. This procedure was included in order to guard against the possibility of an inflated estimate of subjects' ability to make accurate feeling of knowing predictions in the presence of extralist cues. If the intralist cue is recalled, then the subject may be using that cue to make the feeling of knowing prediction. Whenever an intralist cue was recalled, and the target was not, the feeling of knowing prediction was scored as a prediction to the intralist cue.

The procedure used in the cued-recall, feeling of knowing, and recognition tasks was in all other respects identical to the procedure that was described in Experiment 2.

Materials. The materials used in this experiment were constructed from several sources. Fifty-four of the target words were drawn from the materials used by Fisher and Craik (1977). In addition, one associative and one rhyme cue that were paired with each target on the study lists were also taken from the Fisher and Craik materials. For each of the 54 Fisher and Craik cue-target pairs, the experimenter generated a second associative and second rhyme cue that were related to the target with a normative strength approximately equal to the

normative strength of the Fisher and Craik cues. These generated cues were presented to three judges, who indicated when one of the second cues seemed significantly more or less related to the target than did the Fisher and Craik cues. When two of the three judges agreed that a given cue was either too weak or too strong, the cue was eliminated, and a new one was suggested to the judges. This process continued until all the judges reached agreement on all cues. Eighteen of the targets were selected from the materials of McElroy (1980). McElroy also provided two strong associative cues and two rhyme cues for each of these targets; these cues were used in the present experiment.

Sixteen buffer items were also constructed for both the rhyme and associative lists. The items in the buffer pairs either rhymed or were associated with each other, depending on the list in which they were presented.

Distractor items for the recognition test were generated by the experimenter. Distractors in the associative condition were all strongly associated to the list cue, whereas distractors in the rhyme condition all rhymed with the list cue.

Results and Discussion

The cued-recall data are displayed in Table 6. These data were initially scored using both strict and lenient criteria, and the overall pattern of results was nearly identical in the two cases. All of the reported data were scored according to a strict criterion: A target had to be recalled to the cue intended by the experimenter in order to be counted as a correct response.

The pattern of results in Table 6 is similar to the cued-recall data reported by Fisher and Craik (1977, Experiment 3). Probability of recall systematically increased as a function of the similarity between encoding and retrieval conditions: Identical cues were more effective than were similar cues, which were in turn more effective than were different cues. Although identical cues were clearly the most effective aids to retrieval in both en-

Table 6
Probability of Cued Recall as a Function of Encoding Condition and Retrieval Cue in Experiment 3

Type of Cue	Encoding condition		
	Rhyme	Associative	<i>M</i>
Identical	.46	.59	.53
Similar	.24	.35	.30
Different	.20	.24	.22
<i>M</i>	.30	.40	—

coding conditions, there was a greater advantage of similar cues over different cues in the associative condition, as observed by Fisher and Craik. In addition, there was evidence of the overall superiority of associative encoding reported by Fisher and Craik.

Statistical analysis revealed a significant main effect of both encoding condition, $F(1, 17) = 5.45, p < .05, MS_e = .040$, and retrieval condition, $F(2, 34) = 115.88, p < .001, MS_e = .008$. The interaction between encoding and retrieval conditions was marginally significant, $F(2, 34) = 2.75, p > .05 < .10, MS_e = .008$. Post hoc Tukey test confirmed an asymmetrical pattern of cuing effects in the two encoding conditions. In the associative condition, identical cues were significantly more effective than were similar cues, which were in turn more effective than different cues were. In the rhyme condition, identical cues yielded significantly higher recall than did similar or different cues. However, similar and different cues were not significantly different from each other. Thus, the overall pattern of cued-recall data reported in the present experiment closely resembles the Fisher and Craik data and suggests that the effectiveness of a retrieval cue depended on the way that the target was encoded.

The distribution of feeling of knowing predictions is presented in Table 7.² Overall, more feeling of knowing predictions were made in the rhyme encoding condition (907) than in the associative encoding condition (782), reflecting the fact that fewer items were recalled in the rhyme condition. Similarly, there was a systematic increase in the number of predictions made, respectively, to identical, similar, and different cues in both encoding conditions, reflecting the different levels of recall associated with each type of cue.

The data in Table 7 also provide partial support for the hypothesis that relative frequency of "yes" and "no" judgments is influenced by similarity between encoding and retrieval conditions. Analysis of the proportion of feeling of knowing "yes" predictions revealed a significant main effect of retrieval condition, $F(2, 34) = 9.90, p < .001, MS_e = .039$. The effect of encoding condition was not significant, $F(1, 17) < 1, MS_e = .070$, nor was the interaction of encoding and retrieval conditions, $F(2, 34) = 1.08, MS_e = .039$.

Table 7
Number of Feeling of Knowing Predictions as a Function of Encoding Condition and Retrieval Cue in Experiment 3

Encoding condition	Type of retrieval cue			Total
	Identical	Similar	Different	
Rhyme				
Yes	173	166	168	507
No	91	145	164	400
Total	264	311	332	907
Associative				
Yes	136	128	123	387
No	65	127	203	395
Total	201	255	326	782

However, Tukey tests indicated that in the associative encoding condition, proportion of "yes" responses to identical cues (.68), similar cues (.50), and different cues (.38) all differed from one another. In the rhyme encoding condition, more "yes" judgments were made to identical cues (.66) than to similar cues (.53) and different cues (.51), which did not differ from one another.

The feeling of knowing accuracy data appear in Table 8. When subjects made feeling of knowing predictions to identical cues, recognition of feeling of knowing "yes" items exceeded recognition of feeling of knowing "no" items. The size of the effect was about the same as observed in Experiment 1 and the identical cue condition of Experiment 2. However, there was no evidence of feeling of knowing accuracy in either encoding condition when predictions were made in the presence of similar or different extralist cues; indeed, the differences between recognition of

² In Table 7, the number of feeling of knowing predictions made to similar and different extralist cues does not precisely correspond to the number of unrecalled items to each of these cues. This is because of the way that the extralist cue data were scored, as noted in the method section. When subjects recalled the intralist cue to an extralist cue, and not the target, feeling of knowing judgments were scored as predictions to the intralist cues. In the rhyme encoding condition, there were 17 such cases with similar extralist cues and 14 with different extralist cues. In the associative encoding condition, there were 26 cases of recalled intralist cues with similar extralist cues and 2 cases with different extralist cues.

Table 8
Probability of Target Recognition as a Function of Feeling of Knowing Prediction, Encoding Condition, and Type of Retrieval Cue in Experiment 3

Feeling of knowing prediction	Encoding condition								
	Identical cue			Similar cue			Different cue		
	R	A	M	R	A	M	R	A	M
Yes	.54	.71	.61	.47	.73	.59	.60	.79	.68
No	.41	.60	.49	.52	.74	.62	.66	.77	.72

Note. R = rhyme encoding; A = associative encoding.

“yes” and “no” items are in the wrong direction in three of the four relevant comparisons.

The effect of type of retrieval cue on feeling of knowing accuracy is reflected in the significant Feeling of Knowing Prediction \times Retrieval Condition interaction, $F(2, 34) = 23.69, p < .001, MS_e = .042$.³ Tukey tests revealed that the identical cue conditions yielded significantly higher feeling of knowing accuracy than did the similar or different cue conditions in both the associative and rhyme encoding groups. No other comparisons approached significance. The Feeling of Knowing Prediction \times Encoding Condition interaction failed to achieve significance, $F(1, 17) = 2.48, MS_e = .033$, and the three-way interaction of Feeling of Knowing Prediction \times Encoding Condition \times Retrieval Condition was also nonsignificant, $F(2, 34) = 1.43, MS_e = .042$. There was, however, a significant main effect of encoding condition, $F(1, 17) = 18.33, p < .001, MS_e = .033$. This effect indicates that recognition performance was higher in the associative encoding condition than in the rhyme encoding condition.

Overall, the foregoing data provide limited support for the hypothesis that the feeling of knowing, like recall and recognition, depends on qualitative resemblance between encoding and retrieval conditions. In replication of Experiment 2, subjects made more “yes” responses, as well as more accurate predictions, to intralist than to extralist cues. However, with the exception of the feeling of knowing judgment data from the associative encoding condition, there was no evidence that type of extralist cue—similar or different—affected feeling of knowing performance.

Two interpretive cautions about these data should be noted. First, the failure to find a difference in feeling of knowing accuracy to similar and different extralist cues may be attributable to a floor effect: There was no evidence of feeling of knowing accuracy to either type of extralist cue in the present experiment. Indeed, the difference between recognition of items given positive and negative feeling of knowing judgments was not particularly large in the identical cue condition, and it is entirely conceivable that differential feeling of knowing accuracy to similar extralist and different extralist cues might have emerged under conditions that yielded greater feeling of knowing accuracy to identical cues. Second, it must be kept in mind that feeling of knowing predictions are made about unrecalled memory traces; little is known about the properties of such traces. For example, when a subject in the associative encoding condition failed to recall a target in response to a similar extralist cue, it could be argued that retrieval was unsuccessful because the information in the target trace was not similar to the information in the cue. The subject, then, would be attempting to make a

³ Statistical analysis of the feeling of knowing accuracy data was complicated by the fact that four subjects did not contribute data to all feeling of knowing categories. Two subjects failed to make any feeling of knowing “Yes” predictions to similar extralist cues in the rhyme encoding condition. One subject did not make any feeling of knowing “no” predictions to identical cues following associative encoding, and one failed to make feeling of knowing “yes” predictions to different extralist cues following associative encoding. In these cases, a procedure recommended by Winer (1971, p. 489) for estimating missing data was used.

feeling of knowing prediction about an unrecalled trace that was functionally dissimilar to the extralist cue. Thus, it may not make much sense to characterize the relation of the unrecalled trace to the cue in the same terms that are used to characterize the normative relation between cue and target.

General Discussion

The purpose of the present experiments was to explore the relation of the feeling of knowing to other modes of expressing knowledge by examining the effect of variables known to influence recall and recognition on (a) the proportion of feeling of knowing "yes" and "no" judgments and (b) accuracy of feeling of knowing judgments. The results indicated that the proportion of feeling of knowing "yes" and "no" judgments, like recall and recognition, was sensitive to manipulations of encoding (presentation time) and storage (retention interval) conditions. The only case in which an encoding or storage variable affected recall and recognition performance but did not influence relative frequency of feeling of knowing "yes" and "no" judgments was the rhyme versus associative encoding condition of Experiment 3. However, it is not entirely clear how to interpret this result because of lack of an appropriate scale on which to gauge differences between rhyme and associative encoding independent of experimental outcomes. Manipulation of retrieval conditions also had similar effects on relative frequency of feeling of knowing judgments and level of recall: There were more feeling of knowing "yes" judgments and higher levels of recall to intralist cues than to extralist cues in Experiments 2 and 3. In contrast to the foregoing results, feeling of knowing accuracy was not sensitive to changes in encoding and storage variables, but was influenced by alterations in retrieval conditions.

The results of the present experiments provide both extensions of and contrasts to studies that have also provided data concerning the relation of the feeling of knowing to recall and recognition. Hart's (1967a) finding that number of presentations of study items did not alter feeling of knowing accuracy is consistent with the present data. Similarly, the finding of Nelson et al. (1982) that subjects

made a larger proportion of feeling of knowing "yes" judgments with greater degrees of overlearning of study items fits well the present results. However, Nelson et al. (1982) also found that higher levels of overlearning yielded more accurate feeling of knowing judgments. One possible implication of this result is that different types of manipulations of encoding and storage conditions may affect feeling of knowing accuracy in different ways, and this an important issue that merits attention in future research.

What do the present data tell us about how subjects make feeling of knowing judgments and about how these judgments are related to recognition accuracy? Possible answers to this question emerge from consideration of several methodological and interpretative issues raised by the present study that are relevant to feeling of knowing research in general.

One such issue is concerned with the problem of *item selection*. Because level of cued recall varied as a function of experimental manipulations in the present study, different subsets of unrecalled items were selected for feeling of knowing judgments in different conditions. Unfortunately, little is known about the properties of unrecalled items in experimental conditions that produce differing levels of recall. Because these items were the objects of feeling of knowing judgments in the present study, our lack of knowledge about them places constraints on interpretation of the data. The general assumption that has been made throughout this study is that manipulations of what might be generally labeled *trace strength* (e.g., retention interval, presentation rate) affect not only proportions of items recalled but also similarly affect the nature of the unrecalled traces. Traces of unrecalled items in conditions that produced low levels of recall have been assumed to be somehow "weaker" than traces of unrecalled items in conditions associated with high levels of recall.

It should be acknowledged that there are few extant data that support such an assumption, although there are likewise few that argue against it. An unpublished pilot experiment by Schacter (Note 1) provides some relevant evidence. Subjects in this experiment studied cue-target pairs in which

target words were either "good" or "bad" words taken from the extremes of the semantic differential. When subjects did not recall a target to the list cue, they were required to judge whether the unrecalled word was a good or bad word. It was found that judgments of the goodness and badness of unrecalled words were less accurate after a 1-week delay than at an immediate test. These data provide suggestive evidence that unrecalled traces contain less information in a "weak trace" condition (1-week delay) than in a "strong trace" condition (immediate test).

If, in other experimental situations, similar data are obtained, then it would be plausible to argue that the observed differences in relative frequency of feeling of knowing "yes" and "no" judgments as a function of encoding and storage manipulations are at least partially attributable to variations in underlying trace strength. Such data might also provide clues concerning the apparent insensitivity of feeling of knowing accuracy to manipulations such as number of presentations, presentation time, and retention interval. If the relative frequency of "yes" and "no" judgments changes as a function of underlying trace strength (i.e., more "yes" and fewer "no" judgments are made when unrecalled traces are strong than when they are weak), and level of recognition of unrecalled traces changes in a corresponding manner (i.e., better recognition of strong than weak items), then it would not be surprising that the difference between recognition of "yes" and "no" items is little changed as a function of trace strength. However, the finding of Nelson et al. (1982) that degree of overlearning (which presumably influenced trace strength) affected both relative frequency and accuracy of feeling of knowing judgments suggests that the relation between these two aspects of the feeling of knowing may not be as straightforward as suggested previously. Clearly, an important task for future research is to delineate the properties of unrecalled items under experimental conditions that yield different levels of recall and to specify how feeling of knowing judgments are related to the nature of the unrecalled traces.

The item-selection problem may also be related to interpretation of the intralist versus

extralist cue data from Experiments 2 and 3. In both experiments, recall to intralist cues was considerably higher than to extralist cues, raising the possibility that items not recalled to extralist cues might be in some sense stronger than items not recalled to intralist cues: Because extralist cues were generally poor aids to retrieval, many items that presumably would have been retrieved to intralist cues went unrecalled to extralist cues. The fact that items not recalled to extralist cues were better recognized than were items not recalled to intralist cues in both Experiments 2 and 3 supports this hypothesis. However, in spite of these apparent selection effects, subjects made more feeling of knowing "yes" predictions and demonstrated greater feeling of knowing accuracy in the presence of intralist than extralist cues.

These findings may point to a difference in the way that intralist and extralist cues operate. When intralist cues failed to elicit recall, they provided subjects with enough information about the state of the unrecalled targets to make accurate feeling of knowing judgments. But when extralist cues failed, they apparently did not permit access to any reliable information about the state of the unrecalled target items. These data suggest that recall to intralist cues may be *graded*, whereas recall to extralist cues may be *all-or-none*. One speculative account of this difference concerns the strategies that subjects may have used to recall targets to intralist and extralist cues. In the presence of intralist cues, subjects may have attempted to use contextual information or to reconstruct their original encoding of the cue. When such a strategy did not result in recall of the target, it may nonetheless have elicited partial information about it. However, when confronted with extralist cues, subjects may have relied more on a strategy of *generating* target items from semantic memory. If they failed to generate the target, then they would be left with little useful information on which to base a feeling of knowing judgment.

There is, of course, no direct evidence to support the foregoing conjecture, and the observed differences in feeling of knowing to intralist and extralist cues might be accounted for in alternative manners. For instance, the design of the present experiments

dictated the presence of the intralist cue on the recognition test. It is entirely conceivable that more accurate feeling of knowing judgments to extralist cues might have been elicited had the extralist cues appeared on the recognition test. In addition, level of recall to extralist cues was generally low in this study, and experimental conditions that yielded higher levels of recall might also have uncovered greater feeling of knowing accuracy to extralist cues. However, it should be noted that recall to similar extralist cues following associative encoding in Experiment 3 was almost 50% higher than extralist cued recall in other conditions, but no evidence of feeling of knowing accuracy was observed. Thus, although the results of the intralist versus extralist cue manipulations in this study are not conclusive, they do suggest a potential similarity between the feeling of knowing, and recall and recognition: dependence on appropriate retrieval information. With the exception of a semantic-memory study by Koriat and Lieblich (1977), little attention has been paid to the role that retrieval conditions play in the feeling of knowing process, and the present results suggest the need for more research on this problem.

A further issue that is raised, although not explicitly addressed, by the present experiments concerns the observed inaccuracies in feeling of knowing predictions. Even when recognition of feeling of knowing "yes" items significantly exceeded recognition of feeling of knowing "no" items, the size of the difference was rather modest. In each of the three experiments, subjects recognized a large proportion of items that they predicted they would not and failed to recognize many of the items that they thought they would. One possible reason for the small size of the observed effects concerns the fact that the distractor items used on the recognition test did not appear anywhere on the study list. Thus, subjects could respond accurately on the recognition test purely on the basis of the familiarity of the target item, rather than on the basis of the cue-target relation. To the extent that subjects' judgments about recognizability of the unrecalled items were made with respect to specific list cues, the opportunity to choose the item that seemed familiar on the recognition test may have di-

minished the accuracy of the feeling of knowing judgment. It is also possible that such an effect could have obscured potential influences of encoding and storage manipulations on feeling of knowing accuracy. Indeed, it is interesting to note that Nelson et al. (1982), who found an effect of overlearning on feeling of knowing accuracy, used items from the study list as recognition distractors. The extent to which the nature of the distractor items influenced the patterns of results reported in the present study is an important issue, and investigation of it in future research will be necessary before the generalizability of the data can be ascertained.

A final issue that deserves mention in the context of this study pertains to the conceptualization of the feeling of knowing as one mode of expressing knowledge. It would be desirable to explore the relation of the feeling of knowing to modes of expressing knowledge other than recall and recognition. A number of recent studies have indicated that subjects can express knowledge acquired during a learning episode in many different ways: by making lexical decisions about recently studied words (McKoon & Ratcliff, 1979), by identifying target items from brief exposures (Jacoby & Dallas, 1981), by completing fragmented versions of study items (Tulving, Schacter, & Stark, 1982), and by making category judgments about study-list items (Anderson & Ross, 1980). It is not clear, however, how these modes of expressing knowledge are related to each other, to the feeling of knowing, or to recall and recognition. Future studies that attempt to elucidate the nature of and relations between the various modes of expressing knowledge are likely to sharpen our insight into many facets of human memory.

Reference Note

1. Schacter, D. L. *Recall of partial information*. Unpublished experiment, University of Toronto, 1980.

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