

# Attribute Information and the Feeling-of-Knowing\*

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**ABSTRACT** It has been demonstrated that feeling-of-knowing judgements about unrecalled items predict subsequent recognition performance with above-chance accuracy, but little is understood about the basis of the feeling of knowing. The present experiment examined the hypothesis that subjects' tendency to make positive feeling-of-knowing judgements depends upon gaining access to attribute information concerning unrecalled items. Results indicated that when subjects made positive feeling-of-knowing judgements, attribute identification was more accurate than when subjects made negative feeling-of-knowing judgements. However, it was also observed that subjects tended to make positive feeling-of-knowing judgements when they were confident that they had retrieved an attribute of an unrecalled item, even when attribute retrieval was inaccurate. Implications for an attribute view of the feeling of knowing are discussed.

**RÉSUMÉ** Il a été montré que les jugements d'impression-de-savoir portés sur des items que l'on ne parvient pas à se rappeler président une performance subséquente de reconnaissance avec une exactitude au-delà du hasard. Cependant, on connaît peu les bases de cette impression-de-savoir. La présente recherche examine l'hypothèse selon laquelle la tendance des personnes à porter des jugements affirmatifs d'impression-de-savoir dépend de leur capacité d'avoir accès à de l'information concernant les attributs des items non rappelés. Les résultats indiquent que quand les participants portent des jugements affirmatifs d'impression-de-savoir, l'identification des attributs est plus précise que lorsqu'il portent des jugements négatifs. Cependant, les participants tendent à porter des jugements affirmatifs quand ils croient avoir recouvert un attribut d'un item non rappelé même si l'attribut recouvert est erroné. La discussion porte sur les implications d'une vue des attributs dans l'impression de savoir.

When people fail to recall a bit of recently studied information, they often feel that they could recognize it. Subjective convictions concerning recognition of unrecalled items are referred to as *feeling-of-knowing judgements*. It has been demonstrated that feeling-of-knowing judgements predict subsequent recognition with above-chance accuracy: Items assigned a positive feeling-of-knowing judgement are recognized more frequently than items assigned a negative feeling-of-knowing judgement (Blake, 1973; Hart, 1967; Nelson, Leonesio, Shimamura, Landwehr, & Narens, 1982; Nelson & Narens, 1980; Schacter, 1983). The fact that subjects can accurately predict recognition of unrecalled items suggests that they

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have access to some information concerning the unrecalled targets. A fundamental and as yet unresolved issue concerns the exact nature of the information that can be used to make feeling-of-knowing judgements.

Several investigators have suggested that subjects make positive feeling-of-knowing judgements when they gain access to partial information concerning attributes or features of an unrecalled item (e.g., Blake, 1973; Brown & McNeill, 1966; Eysenck, 1979; Yarmey, 1973). Supportive evidence derives largely from studies of word definitions: When people make positive feeling-of-knowing judgements about words that they cannot define, they produce more partial information about the words than when they make negative feeling-of-knowing judgements (Eysenck, 1979; Koriat & Lieblich, 1974). It is not certain, however, that such findings hold when people make feeling-of-knowing judgements about recently studied materials. Relevant data were reported by Blake (1973, 1975), who found that people tended to make positive feeling-of-knowing judgements when they recalled semantic or orthographic attributes of unrecalled items.

The purpose of the present experiment was to explore further the relation between access to partial attribute information and the tendency to make a positive or negative feeling-of-knowing judgement about an unrecalled item from a recent study episode. Three aspects of this relation were examined. First, we evaluated whether subjects are more likely to make a positive feeling-of-knowing judgement when they have access to attribute information about an unrecalled item than when they do not. To examine attribute recall, we exposed subjects to lists of unrelated paired associates in which target items differed in connotative meaning – some targets were “good” words (e.g., HAPPY) and some targets were “bad” words (e.g., TERRIBLE). The results of previous research (Yavuz & Bousfield, 1959), as well as our own pilot work, indicate that subjects can determine whether unrecalled items are good or bad at above-chance levels. By a partial attribute hypothesis, subjects should make more positive feeling-of-knowing judgements when they correctly identify the goodness/badness of an unrecalled item than when they do not (e.g., Eysenck, 1979). Second, we compared accuracy of attribute identification when overall level of recall is high and when it is low. Several studies have found that the probability of making a positive feeling-of-knowing judgement about an unrecalled item is greater when overall level of recall is high than when it is low (Nelson et al., 1982; Schacter, 1983). If feeling-of-knowing judgements are based upon access to partial attribute information, subjects should also be more accurate at identifying the attributes of unrecalled items when overall level of recall is high than when it is low. Level of recall was manipulated by varying presentation time of to-be-remembered items. Third, we assessed whether access to attribute information influences the accuracy of feeling-of-knowing judgements. After subjects made feeling-of-knowing judgements, an associative matching task was given in which they saw randomly ordered lists of cues and targets, and attempted to match each cue with its list target. We expected that more items would be matched correctly following a positive feeling-of-knowing judgement than following a negative feeling-of-knowing judgement. However, we were particularly concerned with the kind of

error subjects made on the matching test. When subjects matched a cue with an incorrect target, they could choose a word with the *same* or *different* connotative meaning than the correct target. If subjects made more same-meaning errors after a positive feeling-of-knowing judgement than after a negative feeling-of-knowing judgement, there would be further evidence that information concerning the connotative attribute of the unrecalled item plays a role in the making of feeling-of-knowing judgements.

## METHOD

### *Subjects*

Twenty-four University of Toronto undergraduates were paid \$6.00 each for their participation in the experiment.

### *Materials*

The critical target items were either words selected from the extremes of the evaluative dimension of the semantic differential (Heise, 1965), or words rated as extremely good or bad by a panel of four judges. Twenty-six items were designated good words (e.g., WONDERFUL, BEAUTY); all had ratings greater than +0.99 on the evaluative scale, or were given the maximum goodness rating on a five-point scale by three of the four judges. The 26 items chosen as bad words (e.g., DEATH, EVIL) had evaluative ratings less than -1.89, or were given the maximum badness rating on a five-point scale by three of the four judges. Each target item was randomly paired with an unrelated cue that was connotatively neutral (e.g., *speech*, *center*), so that subjects could not guess the connotative dimension of an unrecalled target from its list cue. Twenty-eight connotatively neutral buffer pairs (e.g., *arm* - DOLL) were interspersed among the critical cue-target pairs to mask the fact that targets were either positive or negative words. This was done to prevent subjects from deliberately coding the critical items as good or bad.

The 80 cue-target pairs were presented on an Apple II + microcomputer. The cue words appeared in small letters next to the target words, which appeared in capital letters. For the cued-recall test, the 52 critical cues were displayed in succession on the screen of the microcomputer.

### *Design and Procedure*

Presentation rate (5 sec vs. 1.5 sec) was a within-subjects variable. Input materials were divided randomly into four sets. Sets A and B were each comprised of 26 critical pairs (half with good targets, half with bad targets) and 14 buffer pairs. Two additional sets of equal size (A' and B') were formed by pairing each of the cues in Set A and Set B with a target of the alternate connotative meaning (i.e., if a cue was paired with a good word in Set A, it was paired with a bad word in Set A'). Items in each of the four sets were completely counterbalanced so that each pair appeared equally often at the 5-sec rate and the 1.5-sec rate and in the first-presented set or the second-presented set. The sets were presented in a blocked manner.

Subjects were instructed to try to remember each cue-target pair, and were informed that the word appearing in small letters would be provided as a cue for the target at the time of test. Subjects were also informed as to which of the two presentation rates would come first. The first three and last three pairs in both sets were buffer pairs. The remaining buffers appeared at random points within each set, with the constraint that no more than three pairs of any one type (i.e., good, bad, or neutral) appeared sequentially. Following presentation of the first set of 40 pairs, there was a 10-sec delay. Subjects were then informed of the presentation rate for the second set of pairs.

Immediately following presentation of the last pair, subjects were given 10 minutes to complete a distractor task in which they listed names of acquaintances. The subjects were then

given the cued-recall test. Only the critical pairs were tested for recall. The cues were presented randomly with respect to presentation order, and subjects were given 10 sec to try to recall each target. Guessing was encouraged. Subjects were also instructed that when they failed to recall a target within the allotted 10 sec, they would be asked to make a feeling-of-knowing judgement regarding whether or not they thought they could match the unrecalled target to its list cue on a subsequent test in which they would be given one sheet that contained the cues and a second sheet that contained the targets.

The 52 list cues appeared on the screen of the microcomputer in one of two random orders. After completion of recall and feeling-of-knowing judgements, subjects were informed that half of the critical targets had been good words and that half had been bad words. Examples of what constituted good words (PLEASANT, FUN) and bad words (HORROR, CORRUPT) were provided. None of the words used as examples had appeared in the original list. The cues from the unrecalled pairs were then presented in the same random order as in the cued-recall test, and subjects were instructed to state whether they thought that the unrecalled targets that had been paired with each of the cues were either good words or bad words. In addition, they were instructed to indicate on each judgement whether they were "reasonably sure" of their choice or whether they were guessing. Subjects were then given 5 sec to make each good/bad judgement. They were also told that if they recalled a target item at any time during the good/bad test, they should report this immediately to the experimenter. Any target items produced during the good/bad test were counted as recalled, and hence were excluded from the analysis of unrecalled items.

After all good/bad judgements had been made, subjects were given a sheet that contained 52 list cues and a sheet that contained the 52 good and bad targets (both in random order). They were instructed to try to match each cue with its target. Subjects were required to indicate a match for each item, even if they had to guess. There was no time limit for completion of the matching task.

## RESULTS

### *Item Recall*

Proportion of items recalled correctly was influenced significantly by the presentation rate manipulation, declining from 27% at the slow rate to 12% at the fast rate,  $t(23) = 3.55$  ( $p < .05$  for this and all subsequent statistical tests).

There were no differences in recall of good and bad words: In the 5-sec condition, 27% of both good words and bad words were recalled, and in the 1.5-sec condition, 12% of good words and 11% of bad words were recalled.

### *Feeling-of-Knowing Judgements and Attribute Identification*

Table 1 displays the raw numbers of feeling-of-knowing judgements, attribute identifications, and matching responses that were made about unrecalled items. All of the conditional probabilities discussed in subsequent analyses were calculated on the basis of these data. Table 1 indicates that a significantly larger proportion of positive feeling-of-knowing judgements were made in the 5-sec condition (.46) than in the 1.5-sec condition (.32),  $t(23) = 2.58$ . This result constitutes a replication of previous findings that more positive feeling-of-knowing judgements are made when level of recall is high than when it is low.

Consider next the data concerning accuracy and confidence of attribute identification. Overall, subjects correctly identified the goodness/badness of 59% of unrecalled items. When subjects stated that they were guessing, attribute

TABLE I  
Distribution of Attribute Identifications, Feeling-of-Knowing Judgements,  
and Matching Responses as a Function of Presentation Rate

Presentation Rate	Feeling of Knowing	Attribute Correct				Attribute Incorrect				Total
		CM	SM	DM	T	CM	SM	DM	T	
"Sure" Attribute Identification										
5 sec	Yes	27	64	12	103	4	12	14	30	133
	No	5	25	11	41	3	7	9	19	60
	Total	32	89	23	144	7	19	23	49	193
1.5 sec	Yes	16	54	16	86	0	7	13	20	106
	No	3	25	9	37	0	11	14	25	62
	Total	19	79	25	123	0	18	27	45	168
Total		51	168	48	267	7	37	50	94	361
"Guessing" Attribute Identification										
5 sec	Yes	6	21	13	40	2	12	19	33	73
	No	8	44	43	95	7	41	43	91	186
	Total	14	65	56	135	9	53	62	124	259
1.5 sec	Yes	1	18	15	34	3	16	17	36	70
	No	7	78	67	152	2	73	86	161	313
	Total	8	96	82	186	5	89	103	197	383
Total		22	161	138	321	14	142	165	321	642

Note. CM indicates that a cue was matched to its correct target; SM indicates that a cue was matched incorrectly to a word that had the same connotative meaning as the target; DM indicates that a cue was matched to an incorrect word with a different connotative meaning than the target.

identification was only 50% and hence did not differ from chance expectation. However, when subjects said they were sure of their response, identification accuracy was 74%, significantly above chance,  $t(23) = 6.73$ . Both accuracy and confidence of attribute identification were influenced by presentation rate. Overall accuracy of attribute identification was significantly higher in the 5-sec condition (62%) than in the 1.5-sec condition (56%),  $t(23) = 2.04$ . In addition, subjects were sure about 43% of their attribute identifications in the 5-sec condition, whereas they were sure about only 32% of them in the 1.5-sec condition,  $t(23) = 2.49$ . In conjunction with the aforementioned finding that more positive feeling-of-knowing judgements were made in the 5-sec condition than in the 1.5-sec condition, these data are consistent with the hypothesis that feeling-of-knowing judgements depend upon access to attribute information.

The next analyses examine more directly the relation between accuracy and confidence of attribute identification on the one hand, and distribution of feeling-of-knowing judgements on the other. The percentage of attributes identified correctly was significantly higher for items assigned a positive feeling-of-knowing judgement (69%) than for items assigned a negative feeling-of-knowing

judgement (52%),  $t(23) = 4.80$ . The effect was apparent in both the 5-sec condition (69% vs. 55%) and the 1.5-sec condition (68% vs. 50%). Accuracy of attribute identification given a feeling-of-knowing No did not exceed chance,  $t(23) = 1.28$ , whereas identification accuracy given a feeling-of-knowing Yes did,  $t(23) = 6.19$ .

Subjects' confidence in the accuracy of their attribute identifications was also related to the distribution of feeling-of-knowing judgements. For those items assigned "sure" responses on the attribute identification task, 66% of feeling-of-knowing judgements were positive. In contrast, for those items assigned "guessing" responses on the attribute test, only 22% of feeling-of-knowing judgements were positive,  $t(23) = 7.51$ . This substantial difference was observed in both the 5-sec condition (69% vs. 28%) and in the 1.5-sec condition (63% vs. 18%), and even when only the incorrect attribute identifications are considered. For incorrectly classified items assigned a "sure" response, 53% of feeling-of-knowing judgements were positive, whereas for incorrectly identified items assigned a "guessing" response, 21% of feeling-of-knowing judgements were positive,  $t(23) = 4.81$ . Thus, even when subjects did not have access to accurate attribute information, they tended to make positive feeling-of-knowing judgements if they believed that they did.

#### *Feeling-of-Knowing Accuracy*

Performance on the final associative matching test that was used to test feeling-of-knowing accuracy was generally poor. Thirty-five per cent of all items in the 5-sec condition were matched correctly, whereas 16% of the items in the 1.5-sec condition were matched correctly,  $t(23) = 4.06$ . Only 9% of unrecalled targets were matched to their list cues. Proportion of correctly matched unrecalled items was significantly higher when items had been presented for 5 sec (.14) than for 1.5 sec (.06),  $t(23) = 3.05$ .

Accuracy of feeling-of-knowing judgements was assessed by comparing the proportion of correctly matched items that had previously been assigned a Yes prediction with the proportion of correctly matched items that had been previously assigned a No prediction. In the 5-sec condition, matching of feeling-of-knowing Yes items (.19) was higher than matching of feeling-of-knowing No items (.09). Similarly, in the 1.5-sec condition, correct matching of feeling-of-knowing Yes items (.11) exceeded correct matching of feeling-of-knowing No items (.03). Statistical analysis of feeling-of-knowing accuracy was achieved by using the gamma correlation suggested by Nelson (1984, p. 117), which provides an index of the strength of relation between feeling-of-knowing judgements and recognition performance. The gamma correlation in the 5-sec condition was +.41, and in the 1.5-sec condition it was +.60. Both correlations differ reliably from zero.

Information concerning the relation between feeling-of-knowing accuracy and access to attribute information is provided by considering the kinds of errors that were made on the matching task. Consider first the data from the 5-sec condition. Sixty-six per cent of the incorrectly matched cues that had been given a positive

feeling-of-knowing prediction were matched to words with the same connotative meaning as the target, whereas only 52% of the cues that had been given negative feeling-of-knowing predictions were matched to same-meaning targets. The corresponding numbers in the 1.5-sec condition were 62% and 51%. The gamma correlation between feeling-of-knowing judgements and matching to same-meaning cues was +.28 in the 5-sec condition and +.22 in the 1.5-sec condition; both values differ reliably from zero. These data provide further evidence that feeling-of-knowing judgements are associated with the accessibility of attribute information.

## DISCUSSION

The results of the present experiment provide three converging lines of evidence in support of a partial attribute interpretation of the feeling of knowing: (1) when level of recall was low, subjects made fewer positive feeling-of-knowing judgements and made less accurate and less certain attribute identifications, than when level of recall was high; (2) subjects were more accurate at identifying attributes of unrecalled items assigned a feeling-of-knowing Yes than they were at identifying attributes of items assigned a feeling-of-knowing No; and (3) incorrectly matched feeling-of-knowing Yes items were paired more often with words of the same connotative meaning than were incorrectly matched feeling-of-knowing No items.

The foregoing results are consistent with the idea that access to an attribute of an unrecalled item can constitute a basis for a feeling-of-knowing judgement, but they do not support it conclusively. Much of the data in the present experiment are correlational. It is thus possible that feeling-of-knowing judgements do not depend upon partial attribute information; they may be mediated by some other, as yet unspecified, variable that also underlies attribute recall. In addition, the present experiment examined only the connotative attribute of goodness/badness; other kinds of attribute information (e.g., acoustic, orthographic) could and should be investigated. We focussed on the connotative attribute because it is an easily measurable dimension that yields above-chance levels of performance; we are not hypothesizing, and do not wish to imply, that access to the connotative attribute of an unrecalled item constitutes the sole basis of a feeling-of-knowing judgement. Indeed, our data speak against this possibility. Following a positive feeling-of-knowing judgement, 38% of attribute identifications were guesses. Because attribute identification for guessing responses was at chance, this finding indicates that subjects based some of their positive feeling-of-knowing judgements on sources other than the connotative attribute.

Finally, the finding that subjects sometimes made positive feeling-of-knowing judgements when they believed that they knew the connotative attribute of the unrecalled item, even when they were in fact inaccurate, raises questions about the exact nature of the relation between attribute information and the feeling of knowing. Many previous discussions have tended to assume that subjects make positive feeling-of-knowing judgements when they possess accurate attribute information about an unrecalled item (e.g., Blake, 1973; Brown & McNeill,

1966; Eysenck, 1979; Koriat & Lieblich, 1974; Yarmey, 1973). Although the present data are partly consistent with this notion, they also lend support to the idea that there are multiple sources of the feeling of knowing, as pointed out recently by Nelson and his colleagues (Krinsky & Nelson, in press; Nelson, Gerler, & Narens, 1984). One of the sources suggested by Nelson et al. was referred to as a *wrong referent*: A cue may sometimes elicit a bit of stored information that is related to it, but does not represent the target item. In such cases, subjects may express unwarranted certainty that they could recognize the target. It is possible that wrong referents were sometimes elicited by recall cues in the present experiment, thus leading to positive feeling-of-knowing judgements without access to accurate attribute information. An important task for future research will be to delineate more precisely the conditions under which wrong referents are elicited and, more generally, to identify other possible sources of a mistaken conviction that one has retrieved an attribute of an unrecalled item. Such research could illuminate the hitherto unanswered question of why feelings of knowing are often poor predictors of subsequent performance (see Nelson et al., 1984 and Schacter, 1983, for discussion). If subjects sometimes make positive feeling-of-knowing judgements when they mistakenly believe that they have retrieved attributes of an unrecalled item, inaccurate prediction of subsequent performance would be an inevitable consequence.

## REFERENCES

- Blake, M. (1973). Prediction of recognition when recall fails: Exploring the feeling of knowing phenomenon. *Journal of Verbal Learning and Verbal Behavior*, **12**, 311-319.
- Blake, M. (1975). *Human memory and the "feeling of knowing."* Unpublished doctoral dissertation, University of Toronto.
- Brown, R., & McNeill, D. (1966). The "tip of the tongue" phenomenon. *Journal of Verbal Learning and Verbal Behavior*, **5**, 325-337.
- Eysenck, M.W. (1979). The feeling of knowing a word's meaning. *British Journal of Psychology*, **70**, 243-251.
- Hart, J.T. (1967). Memory and the memory-monitoring process. *Journal of Verbal Learning and Verbal Behavior*, **6**, 685-691.
- Heise, D.R. (1965). Semantic differential profiles for 1,000 most frequent English words. *Psychological Monographs*, **79**, (8, Whole No. 601).
- Koriat, A., & Lieblich, I. (1974). What does a person in a "TOT" state know that a person in a "don't know" state doesn't know? *Memory & Cognition*, **2**, 647-655.
- Krinsky, R., & Nelson, T.O. (in press). The feeling of knowing for different types of retrieval failure. *Acta Psychologica*.
- Nelson, T.O. (1984). A comparison of current measures of the accuracy of feeling-of-knowing predictions. *Psychological Bulletin*, **95**, 109-133.
- Nelson, T.O., Gerler, D., & Narens, L. (1984). Accuracy of feeling-of-knowing judgements for predicting perceptual identification and relearning. *Journal of Experimental Psychology: General*, **113**, 282-300.
- Nelson, T.O., Leonesio, R.J., Shimamura, A.P., Landwehr, R.F., & Narens, L. (1982). Overlearning and the feeling of knowing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **8**, 279-288.
- Nelson, T.O., & Narens, L. (1980). A new technique for investigating the feeling of knowing. *Acta Psychologica*, **46**, 69-80.
- Schacter, D.L. (1983). Feeling of knowing in episodic memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, **9**, 39-54.

- Yarmey, D. (1973). I recognize your face but I can't remember your name: Further evidence on the tip-of-the-tongue phenomenon. *Memory & Cognition*, *1*, 287-290.
- Yavuz, H.S., & Bousfield, W.A. (1959). Recall of connotative meaning. *Psychological Review*, *5*, 319-320.

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