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A New Look at Feeling of Knowing: Its Metacognitive Role in Regulating Question Answering

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This book has approached metacognition, control strategies and knowledge about the process of knowing, from various perspectives ranging from neurological to developmental. This chapter is going to focus on one particular metacognitive process in adults, the "feeling of knowing" process. The discussion of feeling of knowing will begin by examining the phenomenon itself, beginning with early explorations leading to present research, then will explore underlying mechanisms, and, finally, will consider the functional utility of this process. Our argument will be that feeling of knowing should be reconceptualized as a rapid, pervasive process beginning prior to actual memory retrieval. Such a reconceptualization should clarify the metacognitive role of feeling of knowing and emphasize its importance as a central rather than an incidental process in cognition.

What Is Feeling of Knowing?

Early Interest in Feeling of Knowing

The classic definition of feeling of knowing is that it is the state of believing that a piece of information can be retrieved from memory even though that information currently cannot be recalled. It is this insistent impression that intrigued William James more than a century ago (James, 1890/1950). He deliberated at length concerning the *tip-of-the-tongue* phenomenon, which is defined as the frustrating

experience of being aware of having knowledge but not being able to retrieve that knowledge on demand. In his words,

Suppose we try to recall a forgotten name. The state of our consciousness is peculiar. There is a gap therein; but no mere gap. It is a gap that is intensely active. A sort of wraith of the name is in it, beckoning us in a given direction, making us at moments tingle with the sense of our closeness, and then letting us sink back without the longed-for term. If wrong names are proposed to use, this singularly definite gap acts immediately so as to negate them. They do not fit into its mould. (p. 251, James, 1890).

The process that James described as coming from "consciousness" and as being "intensely active" piqued the interest of a few subsequent psychologists, but it was Harts' doctoral dissertation in 1965 from which modern research on feeling of knowing traces its roots. He changed the focus of interest beyond the intense impressions following retrieval failure to instead inquire about the degree of predictive validity of these impressions. That is, he did not examine how subjects searched for information they could not retrieve, but instead scrutinized the actual accuracy of the feeling-of-knowing impression. Hart perceived that earlier psychologists had treated feeling-of-knowing judgments and actual knowing as almost redundant concepts (see Woodworth & Schlosberg, 1954, for a summary of early work) and he decided to examine that assumption (Hart, 1965a, 1965b).

His paradigm involved three steps. First, he administered a recall test. Second, for those items that were not correctly recalled, subjects were required to give a feeling-of-knowing rating. Third, these ratings were followed by a recognition test to measure the accuracy of the feeling-of-knowing assessment. This design has typically been labeled the RJR (recall–judgment–recognition) paradigm. His experiments demonstrated that subjects who could not recall answers were able to successfully predict correct recognition and recognition failure of those answers on a subsequent multiple-choice recognition test. His results also suggested that the feeling-of-knowing experience operates at various graded strengths ranging from strong affirmative to strong negative judgments. When subjects felt that they did not know an answer, their scores on such items were at chance, but when they felt that they did know the answer, their scores were roughly three times the level of chance.

Recent Investigations on Feeling of Knowing

Since Hart's seminal work, other researchers, most notably Nelson (e.g., Nelson & Narens, 1980b; Nelson, Gerler, & Narens, 1984), have extended his findings. Given that the focus has remained on the accuracy of the feeling-of-knowing state, researchers have shown that feeling of knowing ratings can be used to reliably predict more types of behavior than just recognition performance. For example, feeling of knowing ratings were highly related to performance on cued-recall tests (e.g., Gruneberg & Monks, 1974), relearning rates (Nelson et al., 1984), and feature identification (Schachter & Worling, 1985).

It has also been demonstrated that as feeling-of-knowing ratings increased, perceptual identification latencies for tachistoscopically presented answers to previously unrecalled general information questions decreased (Nelson et al., 1984). The conclusion that this metacognitive system is more sensitive to perceptual information than a high-threshold task such as recall is qualified by a later study, however. Jameson, Narens, Goldfarb, and Nelson (1990) found that feeling of knowing ratings were not influenced by the perceptual input from a near-threshold prime, while that same perceptual input increased recall for previous recall failures, if the information had been recently learned. The caveat of this finding is consistent with an earlier study from the same laboratory; Nelson et al. (1982) reported that feeling-of-knowing ratings were not accurate for word pairs learned only to a criterion of one successful recall, while accuracy increased significantly beyond chance for overlearned word pairs. It is an interesting question why feeling of knowing was not a good predictor of performance in a verbal learning paradigm where word pairs were only learned to criterion. An important overall conclusion from this entire line of research is that the accuracy of feeling-of-knowing judgments is well above chance yet "far from perfect" (Leonesio & Nelson, 1990).

Distinguishing between Feeling of Knowing and Confidence

The broad definition of feeling of knowing as the state of believing that a particular piece of information can be retrieved from memory shares aspects with the definition of confidence, the state of believing

that a particular piece of information has been correctly retrieved from memory. Similarly, subjects are reasonably accurate in predicting recognition performance as well as in judging the correctness of their complete or partial reports (see Schacter & Worling, 1985). One distinction is that feeling of knowing is a prospective judgment, a rating that reflects an opinion about an event yet to occur, while confidence is a retrospective judgment, a rating regarding an event that has already occurred. A second distinction is that memory accuracy is an implicit issue in research on feeling of knowing (see Koriat, 1993), while it is explicitly addressed with confidence ratings.

A third distinction is empirical; dissociations between these two phenomena have been reported. In a study with climbers on Mount Everest (Nelson, Dunlosky, White, Steinberg, Townes, & Anderson, 1990), altitude had no effect on recall or recognition accuracy or latency, nor was self-confidence about retrieval affected by altitude. Feeling-of-knowing judgments, on the other hand, declined at extreme altitudes and remained lower even after returning to Kathmandu. Another dissociation was reported earlier by Nelson et al. (1984), who found a positive relationship between feeling-of-knowing ratings and search duration for retrieval failures, while no relationship was found between search duration and confidence ratings for incorrect responses (retrieved answers that were wrong). Costerman, Lories, and Ansay (1992) demonstrated two additional dissociations between feeling of knowing and confidence. First, they found that feeling-of-knowing judgments were more highly correlated with a set of inferential questions (i.e. is this question familiar, has it been seen recently, under what circumstances was it seen, and can other people answer this question) than were confidence judgments. Second, they reported that feeling of knowing is positively related to search duration, while confidence level was negatively correlated with the amount of time allocated for searching memory. This last distinction foreshadows the final section of this chapter regarding the functions of the feeling-of-knowing process.

A Revised Definition of Feeling of Knowing

Several researchers have recently suggested expanding the original definition of feeling of knowing as a phenomenon that operates only

after retrieval failure. This modified perspective instead suggests that feeling of knowing is a rapid, preretrieval stage during which individuals judge the expected retrievability of a queried piece of information (Reder, 1987, 1988; Reder & Ritter, 1992; Schreiber & D. Nelson, 1993), a stage that occurs frequently but becomes salient only in those instances when successful retrieval does not occur.

This definition also clarifies the distinction between feeling of knowing and tip of the tongue. The intense and frustrating experience that an answer is known but not currently retrievable, the tip-of-the-tongue experience, is one example of a situation in which an early judgment of retrievability is discordant with the results of the subsequent retrieval attempt. In most instances, however, processes proceed more smoothly and more quickly and such a mismatch does not occur.

Empirical Support for This Revision

A line of research by Reder (Reder, 1987, 1988; Reder & Ritter, 1992) motivated this conceptualization of feeling of knowing as a rapid, preretrieval process. For example, Reder (1987) devised a game-show paradigm in which subjects were given questions of varying difficulty and, depending on condition, either answered the question immediately or estimated whether or not they could answer it. As with typical game shows, response speed was stressed in the instructions. If subjects judged that they knew the answer in the estimate condition, then they were expected to demonstrate that knowledge, a determination of how accurate their initial feeling of knowing had been. This paradigm differs from the RJR design used by Hart (1965a) since subjects estimate answer retrievability *before* attempting to recall the answer.

Subjects in the estimate condition were more than 25% faster to respond than those in the answering condition, a mean difference of over 700 milliseconds. This difference existed regardless of whether subjects were responding affirmatively or negatively. Because subjects in the estimate condition attempted fewer questions than those in the answering condition yet answered the same number of questions correctly, they were 10% more accurate in their judg-

ments. Thus, the greater response speed of subjects in the decision condition was not the result of a speed accuracy trade-off.

Another piece of data from the same experiment further supports the notion that feeling of knowing may be a general process preceding retrieval attempts. The total time in the decision condition, the time to estimate that one can answer the question plus the time to then come up with the answer, was equal to the total time in the straightforward answering condition. This finding suggests that the feeling of knowing stage occurred automatically in the answer condition and took the same amount of time as in the forced judgment condition.

In the experiments by Reder and Ritter (1992), subjects were not assigned to answer or estimate conditions. Instead, subjects had a 850-millisecond deadline for *choosing* a strategy after seeing an arithmetic problem. If they believed that they had learned the answer to this problem from previous exposures to it during the experiment, they could chose direct retrieval, in which case they had about one second to recall the correct answer. If the problem seemed unfamiliar, they could choose to calculate the answer, in which case they were given ample time to compute it (more time than anyone required to finish calculating).

Quick strategy selection was accomplished by all subjects with a little practice at the task. The appropriateness of the chosen strategies, as measured by d' and gamma scores, was quite high even at the beginning of the experiment. The finding that subjects can judge quickly and accurately was taken as evidence for the conceptualization of feeling of knowing as a rapid, metacognitive process beginning prior to the stage during which retrieval occurs (or might occur). Other data described later in this chapter nail down this interpretation.

Schreiber, Nelson, and Narens (unpublished data cited in Nelson & Narens, 1990) also investigated the preliminary feeling-of-knowing judgment as a metacognitive monitoring process that begins prior to memory search. Subjects in their experiment were presented with general-information questions and were required to quickly indicate their degree of feeling of knowing for each item using a six-point Likert scale. By examining response latencies, they discovered a nonmonotonic function: extreme feeling-of-knowing judgments had the

shortest latencies. In other words, subjects could respond very quickly when they strongly felt that they did or did not know an item. Schreiber et al. concluded that there exists (1) an affirmative feeling-of-knowing process that determines the presence of information in memory and (2) a negative feeling-of-knowing process determining the absence of information in memory, a process analogous to Kolers and Palef's (1976) concept of "knowing not." These findings are reminiscent of Hart's (1965b) report that feeling of knowing predicted recognition failure as well as recognition success.

Thus, this definition of feeling of knowing as a rapid, preliminary process is consistent with a metacognitive function where this early stage controls actions as duration of retrieval efforts (e.g., Reder, 1987, 1988) and, as will be discussed later, retrieval strategy selection (e.g., Reder, 1987).

What Mechanisms Underlie Feeling of Knowing?
Diverse Speculations

Several researchers exploring the feeling-of-knowing phenomenon have speculated on which underlying mechanisms are involved in this process. One viewpoint that has received a great deal of attention is the *trace access hypothesis*, which presumes that subjects have partial access to, and are able to monitor some aspects of, the target item during feeling-of-knowing judgments (Nelson et al., 1984; Schreiber & D. Nelson, 1992). Several studies have shown that even when subjects cannot recall a target item such as a word, they can still identify information such as the beginning letter or the number of syllables it contains (e.g., Blake, 1973; Koriat & Lieblich, 1974). However, different researchers have interpreted trace access somewhat differently (for example, see Koriat, 1993), and a considerable number of other mechanisms have been proposed.

Nelson et al. (1984) brought order to this proliferation by subsuming the dozen mechanisms advocated up to that time under two main categories, *trace access* mechanisms and *inferential* mechanisms. What Nelson was summarizing can be described as the classical feeling-of-knowing research with accuracy as the typical dependent variable. Because Reder (1987, 1988; Reder & Ritter, 1992) employs a revised definition of feeling of knowing, she has suggested a different di-

chotomy. She distinguishes between partial retrieval of the answer to a question, a mechanism that most researchers refer to as trace *access*, and a feeling of familiarity with the question itself, which we refer to as the cue *familiarity* mechanism. Reder's viewpoint (see Reder & Ritter, 1992) pays particular attention to the functional utility of the feeling-of-knowing process and is less concerned with the accuracy of feeling of knowing in predicting recognition after recall failure. Both perspectives will be articulated in this section.

Trace Access versus Inferential Mechanisms

Nelson et al. (1984) have identified six frequently overlapping types of explanations that can all be subsumed within the *trace access* category. Two explanations use the mechanism of association between the question and the answer. The *subthreshold strength explanation* specifies that when there is a high strength of association between the question and the answer, the subject recalls the answer. With an intermediate strength of association, the subject cannot immediately retrieve the answer but believes that he/she knows the answer. With a minimal degree of association, the subject neither recalls the answer nor believes than the answer can be retrieved at a later point. The *forward-backward associations explanation* suggests that the degree of forward association from the question to the answer may be different than the backward association between the answer and the question. The feeling of knowing judgment might be based just on the forward association, while memory performance such as recognition might be based on both associations.

Three additional trace access explanations suggest that retrieval failure along with positive feeling-of-knowing judgments occur when (1) the subjects has only partial recall of the label for the target item, (2) the subject has access to other information relevant to the target but not access to the label itself, or (3) the subject retrieves the wrong semantic referent. The sixth and final explanation in this category assumes that the target is a multidimensional item and, even if the subject cannot retrieve information from enough dimensions for the correct recall of an answer to occur, the subject will still experience a strong feeling of knowing.

Nelson et al. (1984) give the label of *inferential mechanisms* to the major group of mechanisms assumed to oppose the trace access category in accounting for the feeling of knowing process. Here too, six subcategories are identified. Subjects might base a feeling of knowing judgment on related episodic information in their personal memories or on perceptions of those episodes. It was also suggested that feeling-of-knowing judgments might be based on impressions of the normative difficulty of an item (although a later study by Nelson, Leonesio, Landwehr, & Narens, 1986, casts doubt on the adequacy of this explanation). Social desirability, the urge to claim to know what one believes should be known, is another factor that could account for feeling-of-knowing ratings.

The final two types of feeling-of-knowing mechanisms outlined by Nelson et al. (1984) in the inferential category seem to be driven by the content of the questions posed in the experimental session. First, subjects may base a feeling-of-knowing judgment on their presumed expertise on the topic of the question, whether this expertise was induced in the experiment (Koriat & Lieblich, 1974, 1977) or existed prior to the experiment (Bradley, 1981). Second, feeling of knowing for an unrecalled item may be based on the subjects' degree of recognition of the cue. If the cue seems familiar then the subject may infer that the unrecalled item is known. A study by Koriat and Lieblich (1977), which demonstrated that cue redundancy (repeating questions verbatim or with altered wording) increased feeling-of-knowing ratings without increasing ability to actually answer the questions, lends credence to this position.

Trace Access versus Cue Familiarity Mechanisms

Reder and Ritter's (1992) consideration of whether feeling of knowing is determined by partial retrieval of the answer matches Nelson et al.'s (1984) use of the term trace *access* in assuming that subjects have partial access to the target and, therefore, are able to monitor some aspects of the target item during feeling-of-knowing judgments. In a 1990 publication, Nelson and Narens presented a "No magic" hypothesis in which they asserted that feeling-of-knowing judgments were driven by retrieved information. Despite failure to retrieve the actual target, subjects are often still able to access other information

concerning the target item. Koriat (1993) makes a similar proposal, that an accessibility heuristic tapping retrieved target-relevant information is the basis of feeling of knowing.

The opposing argument that feeling-of-knowing judgments rely on the familiarity of cues in the questions themselves (e.g., Reder, 1987, 1988; Reder & Ritter, 1992; Schreiber and D. Nelson, 1993; Schwartz & Metcalfe, 1992) would seem to include both the expertise and cueing mechanisms mentioned by Nelson et al. (1984). (Other mechanisms identified by Nelson et al., 1984, such as social desirability, seem pertinent only with the classic feeling-of-knowing research where subjects have longer to respond than with the revised feeling-of-knowing paradigm.) Reder (1987, 1988) has suggested that individuals make feeling-of-knowing judgments using cue familiarity, a heuristic that employs information provided by or associated with the question /cues presented. As cue familiarity increases, so should feeling of knowing. For instance, Reder (1987) reported the following dissociation between feeling of knowing and accuracy: subjects believed they could answer questions after the terms in those questions had been primed, yet such beliefs were not supported by increases in recall rates. Conversely, another study has reported that when answers were primed, the availability of the answers increased but feeling-of-knowing ratings were not influenced (Jameson, et al. 1990).

This realignment of the issues fits well with the redefinition of feeling of knowing as a general process in which a rapid, preliminary judgment to guide retrieval actions is made (e.g., Reder, 1987, 1988; Reder & Ritter, 1992; Schreiber & D. Nelson, 1993). This faculty is assumed to operate automatically as soon as a question is seen and before retrieval is actually attempted. Refining the feeling-of-knowing concept in this way should make identifying the underlying mechanisms easier, since classic feeling-of-knowing paradigms such as the RJR or tip-of-the-tongue experiences extend over a relatively long period of time and may therefore incorporate additional mechanisms, such as the inferential ones postulated by Nelson et al. (1984).

An early study conducted by Koriat and Lieblich (1977) seems pertinent to the trace access versus cue familiarity discussion. Subjects were presented with word definitions and asked to judge whether or not they knew the word being defined. Definitions containing more

redundant information triggered higher feeling-of-knowing ratings, while ability to provide the target words was not increased. This research team interpreted their findings as support for the trace access position because redundancy of cue information allowed for more partial target information to be retrieved. These redundant cues, however, probably increased cue familiarity and therefore also increased feeling-of-knowing ratings. Several recent studies (e.g., Reder & Ritter, 1992; Schreiber & D. Nelson, 1992; Schwartz & Metcalfe, 1992) that have deliberately pitted the trace access hypothesis against the cue familiarity heuristic are discussed in the following section.

Empirical Evidence on Trace Assess versus Cue Familiarity

Two experiments by Reder and Ritter (1992) examined whether feeling of knowing is due to partial retrieval of an answer or to a feeling of familiarity with a question. They used unfamiliar arithmetic problems such as "29 × 32" as stimuli in order to control the associative strength between problem questions and answers. They varied how often subjects were exposed to one of these previously unlearned math facts. They also chose math problems because they could independently vary familiarity with the terms in the questions. First, subjects were trained on novel 2-digit by 2-digit arithmetic problems. Over the course of the experiment, the level of exposure to problems varied from once to 20 times. Problems were individually displayed on a computer screen and subjects had to quickly choose whether (1) to directly retrieve the answer or (2) to calculate the answer. The payoffs were adjusted to encourage selection of direct retrieval when the answer was known. After deciding, subjects then had to perform the chosen action.

During the last fourth of the test trials, new problems began to appear that might seem old in the sense that they consisted of old operands and operators rearranged into new combinations. For example, a subject might have been tested on "18 + 23" 20 times, and now be asked to rapidly judge "18 × 23." If feeling of knowing is based on a partial retrieval of the answer, then feeling of knowing should be no stronger for these posttraining problems than for genuinely new problems; subjects could not retrieve an answer not already in memory. On the other hand, if feeling of knowing is instead

based on familiarity with the terms of a question, then the posttraining problems should entice subjects into higher feeling of knowing ratings. Because frequency of exposure to problems and parts of problems was varied independently, they could examine which contributed more to rapid feeling-of-knowing judgments.

As the number of previous exposures to entire problems increased, subjects increasingly chose to retrieve rather than calculate answers. In this condition, however, exposure to the problems was confounded with exposure to the answers. For the posttraining problems, frequency of exposure to *parts* of problems also had a positive correlation with choice of the retrieval strategy. In other words, subjects were indeed misled by the posttraining problems, thereby supporting the cue familiarity explanation, not the hypothesis that feeling of knowing is based on partial retrieval of the answer.

The two contrasting explanations discussed by Reder and Ritter (1992) have also been the focus of recent research by Metcalfe and associates (Schwartz & Metcalfe, 1992; Metcalfe, Schwartz, & Joaquim, 1993). To test the trace access hypothesis, that feeling of knowing results from partial access to the answer or target, a manipulation that has been shown to affect target memorability was employed by Schwartz and Metcalfe (1992). Target words were always the second word in a pair of rhyming associates; in the read condition the target was complete, while the target was missing letters in the generate condition. (Studies have shown that generated words are recalled better than read words, e.g., Slamecka & Graf, 1978.) To test the cue familiarity hypothesis that feeling of knowing is triggered by the cues/questions presented to the subjects, a cue priming technique (from Reder, 1987) was used. In an ostensibly unrelated task, subjects made a pleasantness rating on half of the cues prior to learning. Cue familiarity was therefore enhanced without rehearsal of the cue-target pair.

Schwartz and Metcalfe's (1992) findings were quite consistent with the cue familiarity hypothesis: the generation manipulation significantly improved recall but had no impact on feeling-of-knowing judgments. The cue priming manipulation, on the other hand, had no effect on recall but did affect feeling-of-knowing ratings. They concluded that increasing the familiarity of a cue by priming it resulted in enhanced feeling of knowing.

Metcalfe et al. (1993) applied a classic interference theory paradigm to contrast the trace access and cue familiarity accounts of feeling of knowing. Stimulus materials were paired associates for which subjects were then given a cued-recall test. At encoding, the cue word "A" was initially presented with the target word "B." Later in the same list, the word A would then be paired with either (1) the original B, (2) a similar B', or (3) an unrelated word D. A fourth of the time, the cue A would not be given again and a new cue–target pair, C and D, would be presented instead. The word "A" was then presented during the cued recall test and subjects typed in the targets.

The expected pattern of findings with this paradigm is that memory is superior for the identical condition (A presented both times with B), almost as good for the similar condition (A-B then A-B'), moderate for the new pair (A-B and C-D), and very poor for the unrelated word condition (A-B and A-D). If feeling of knowing is primarily based on access to the target/answer, then the rank ordering of feeling-of-knowing judgments should be identical to this list of recall/recognition ordering. Cue familiarity makes a different prediction, however. Since the cue is presented twice in the A later paired with D condition, feeling of knowing judgments should not be as low there as in the C with D condition, where the cue (A) was seen only once. Specifically, cue familiarity predicts that feeling of knowing in all three of the conditions in which the cue A was presented twice should be roughly equivalent and should be significantly greater than feeling of knowing when the cue is only seen once. This is precisely what they found.

Although Schreiber and D. Nelson (1993) did not vary the strength of the relationship between cues and targets as did Metcalfe et al. (1993), they did manipulate the strength of the cue and of the target separately. To test the trace access hypothesis, they examined whether feelings of knowing were sensitive to the encoding strengths of targets. Those targets that had been studied during one trial were considered to have a low strength of encoding, while targets that had been studied twice were considered high in strength. To test the cue familiarity hypothesis, they examined whether feelings of knowing were affected by the amount of competing information linked to test cues. Competing information was operationalized as *cue set size,* the

number of associates preexperimentally linked to test cues as determined by earlier normative studies (D. Nelson & McEvoy, 1979). Recall has been shown to be higher when cues and targets are linked to fewer associates, while recognition does not seem to be reliably affected by cue set size.

Schreiber and D. Nelson's manipulation of target strength did not reliably affect feeling-of-knowing judgments, but did affect the probability of both correct recall and recognition. On the other hand, each of their three experiments demonstrated a robust effect of cue set size on feeling of knowing. Feeling-of-knowing ratings were lower for cues from large sets (i.e., that could cue many words besides the target) than for small sets, regardless of whether these sets were operationalized as category names or word endings. In other words, a characteristic of the cue (test question) repeatedly influenced feeling-of-knowing ratings while a characteristic of the target (answer) rarely did. From these findings, they concluded that their work provided no support for the trace access hypothesis but instead lent credence to the cue familiarity explanation.

More Empirical Evidence

Research by Yaniv and Meyer (1987) could be interpreted as support for the trace access hypothesis rather than the cue familiarity explanation of feeling-of-knowing judgments. Subjects were presented with the definitions of rare words and were asked to generate the defined words. When retrieval failure occurred, subjects were asked to rate their tip-of-the-tongue and feeling-of-knowing states. These ratings were categorized into three accessibility categories: high, medium, and low. After each set of four rare word definitions, subjects were given a lexical decision task that contained target words from the set they could not generate and control words and nonwords. Unrecalled words given high accessibility ratings produced faster reaction times in the lexical decision task than unrecalled words with low accessibility ratings.

When a definition (cue) was presented it was assumed to activate the target word. If activation was above threshold, the target was successfully recalled. If the activation was below threshold, recall did not occur. Activation lingered in both cases, but was evaluated with

accessibility ratings only when recall had failed. Each accessibility rating was considered by to be an indicator of the potential retrievability of an item in the semantic network. An item that is highly retrievable is assumed to be more activated than an item that is not as retrievable. Yaniv and Meyer concluded that the increased activation of the traces of the unsuccessfully retrieved answers was triggering the fast reaction times on the lexical decision task.

Connor, Balota, and Neeley (1992) turned this activation explanation on its head. First, they conceptually replicated the finding that rare words at higher accessibility levels (a hybrid of feeling-of-knowing and tip-of-the-tongue ratings) had faster lexical decision times than words at lower levels of accessibility. Next, they found the same empirical relations held even when the lexical decision task preceded exposure to definitions and accessibility estimates by a full week. The trace access hypothesis, that subthreshold activation of answers to questions determines feeling-of-knowing ratings, simply cannot account for these data: the lexical decisions in this paradigm preceded the definition task. Based on their findings, they advocated a topic familiarity account. They argued that both accessibility estimates and lexical decision performance are influenced by the familiarity that a subject has with a particular topic. The subject recognizes that the topic seems familiar due to words in the question meshing or not meshing with well-learned information. The metacognitive judgment of accessibility reflects the subject's assessment of the level of expertise he/she has in a given area; response time in the lexical decision task is affected by whether an item comes from a category with which the subject is familiar (Balota & Chumbly, 1984). The presentation order of the feeling-of-knowing judgment and the lexical decision task is not critical for the relation to occur, because the correlation between these two tasks is caused by a third factor, level of expertise/familiarity with a topic.

The relationship between feeling of knowing and topic familiarity was also the focus of a study by Reder and Fabri (reported in Reder, 1988). Subjects rank-ordered their own level of expertise in four domains: movies, sports, geography, and U.S. history. Questions were varied in terms of how many words in the question were associated with the topic. Of interest was whether the extent of sentence terms associated with a topic would influence feeling of knowing and speed

of judgment, and whether this would interact with self-rated expertise. Half of the subjects were assigned to the answer condition, i.e., immediately answered the questions or stated that they did not know the answer; the other half were asked to estimate their ability to answer the questions. If the subjects in the latter condition judged that they could answer a question, they were then given the opportunity to answer that question.

Reder and Fabri found, not surprisingly, that subjects attempted to answer more questions on those topics in which they felt they had the most expertise. More interesting was the finding that subjects' self-classification of expertise had a greater impact when they were making feeling-of-knowing ratings (the estimate condition) than when they were simply answering questions. That is, tendency to attempt to answer a question was more influenced by topic category and expertise in the estimate condition. These data suggest that the assessment of self-knowledge is an example of an inferential metacognitive strategy that may play an important role in making feeling-of-knowing judgments. A similar conclusion was reached by Nelson and Narens (1990) who found that a person's feeling of knowing was more strongly related to his/her claimed frequency of previous exposure than to the actual frequency of previous exposure. Although both Nelson and Narens (1990) and Connor et al. (1992) used the classical feeling-of-knowing paradigm defined in terms of retrieval failure while Reder and Fabri employed the revised paradigm in which rapid, feeling-of-knowing judgments are obtained irrespective of retrieval success or failure, their results are all consistent with the perspective that the metaknowledge of expertise operates at both speeds.

A complementary finding of Reder and Fabri was the markedly different influence of expertise on the time to say "don't know" in the estimate and answer conditions: Self-assessed expertise had more impact on the time to respond "don't know" in the answer condition than in the feeling-of-knowing condition. In other words, subjects searched longer in the answer condition before saying they did not know a fact if they rated themselves as being familiar with the topic. This type of pattern, that feeling-of-knowing judgments manifest themselves in longer "don't know" response times for the answer condition than for the estimate condition has been reported else-

where by Reder (1987). This dissociation is consistent with the other dissociations between feeling-of-knowing measures and trace retrieval measures already discussed in this section, such as the dissociation between feeling-of-knowing and recall accuracy when cue priming is manipulated (Reder, 1987; Schwartz & Metcalfe, 1992). By eroding the empirical evidence beneath the trace access hypothesis, such dissociations lend credence to the cue familiarity explanation of feeling of knowing.

Distinctions between Classic and Revised Feeling-of-Knowing Research

Nelson and Narens (1990) have suggested using different terminology depending on when a feeling-of-knowing rating is made. For a rating that is made before retrieval is attempted, such as in the estimate condition used in Reder's research (Reder, 1987, 1988; Reder & Ritter, 1992), Nelson and Narens (1990) prefer the term "preliminary feeling of knowing." Similarly, Schreiber and D. Nelson (1993) suggest the term "prediction of knowing." Both groups reserve the traditional "feeling-of-knowing" term for ratings made after retrieval failures, such as in Hart's (1965a) RJR paradigm.

When both the classic (predicting recognition after failing at a recall attempt) and the revised feeling-of-knowing ratings (simply predicting recall) were used in the same experiment, the same pattern of results obtained (Schreiber and D. Nelson, 1993). The only reliable difference between the two types of ratings in that study was that response latencies were shorter for the prediction-of-knowing ratings, presumably because the instructions emphasized speed of processing (consistent with Reder, 1987, 1988; Reder & Ritter, 1992).[1]

Despite this failure to find differences between prediction-of-knowing and traditional feeling-of-knowing ratings, it seems probable that some differences exist. Classic feeling-of-knowing rating tasks, those that occur after a failed recall attempt, may be influenced by a partial retrieval of the answer in a way that the prediction-of-knowing ratings are not. The tip-of-the-tongue phenomenon is an example of a feeling-of-knowing process that is unrelated to the prediction-of-knowing. A considerable body of research attests to the

partial availability of information about the answer to a question when subjects are in the tip-of-the-tongue state. For instance, subjects correctly guess the first letter of the target word about 50% of the time, can identify the number of syllables in the word 38% of the time (after guessing probabilities are removed), and spontaneously produce semantically related words between 40 and 70% of the time (see review in Brown, 1991).

An example of a conventional feeling-of-knowing study in which partial retrieval of the answer is the only logical explanation of the results is provided by Blake (1973). Subjects were shown three-letter trigrams, given a filler task, and then asked to recall the trigrams. When correct recall failed, subjects made feeling-of-knowing ratings and then completed a recognition test. Blake found that feelings of knowing systematically increased with the number of letters recalled. For instance, he reported in his first experiment that feeling-of-knowing ratings jumped from 32% when no letters had been recalled to 73% when two letters had been recalled. The cue familiarity hypothesis may not be irrelevant since these are slower judgments; however, the letters in a to be recalled trigram may serve both as part of the answer and as part of the retrieval cues (question).

What Is the Function of This Process?

As discussed in the initial section of this chapter, the research emphasis triggered by Hart's (1965a) doctoral dissertation has been on the accuracy of feeling-of-knowing ratings in predicting subsequent recognition. Three decades of research have firmly established feeling of knowing as a viable area of interest and have delineated many of the characteristics of this phenomenon. Current work, however, has begun to broaden the research focus beyond the overlap between feeling-of-knowing ratings and recognition to address this fundamental question: *why* do we have the feeling-of-knowing process?

Given the original definition of feeling of knowing as the state of believing that currently unrecallable information will be available at some later point, the usefulness of feeling of knowing as a metacognitive process is unclear. As a purely post hoc judgment following retrieval failure it seems incidental in directing future behavior. Possibly feeling of knowing could serve a self-protective function along

the same lines as other self-serving biases identified in social psychology. Or it could serve a corrective, after-the-fact function of eventually allowing individuals to correct lapses in memory. Both of these notions seem rather peripheral, however.

Monitoring and Controlling Functions

Such speculation on the usefulness of feeling of knowing becomes much less strained when feeling of knowing is redefined as a rapid, metacognitive stage that precedes retrieval attempts and becomes particularly salient only when retrieval fails. Since the two functions of a metamemory system are to *monitor* and to *control* cognition (see Nelson & Narens, 1990), a preliminary feeling-of-knowing judgment could logically perform both functions. When a person is presented with a question, we believe that person uses a heuristic based on cues in the question to quickly determine whether a memory search is warranted. Feeling of knowing proceeds rapidly with minimal effort, since it does not require careful inspection of the memory traces (e.g., consistent with research reported by Reder & Ritter, 1992). In other words, this initial evaluation is an automated process (Reder, 1987, 1988). Feeling of knowing could therefore be categorized as a *monitoring* process, a label also given to feeling of knowing by Nelson and Narens (1990).

The next point to consider is whether feeling of knowing also serves a *control* function. Assuming that the individual's feeling of knowing surpasses a certain threshold so that the affirmative decision to search memory is made, the issue centers on *how* memory should be searched. Feeling of knowing has been demonstrated to impact memory search in two ways: first, as a rapid, preliminary stage, feeling of knowing affects strategy choice (e.g., Reder, 1988), and second, feeling of knowing affects search duration (Gruneberg, Monks, & Sykes, 1977; Lachman & Lachman, 1980; Nelson et al., 1984; Reder, 1987, 1988; Ryan, Petty, & Wenzlaff, 1982; Schreiber & D. Nelson, 1993). On this issue of search duration, both the classic research on feeling of knowing and the research using the modified paradigms regarding feeling of knowing converge, since retrieval activities extend over time.

Support for the Existence of Strategy Choice

Reder (1987, 1988) empirically demonstrated that subjects do select among question answering strategies. In her research paradigm subjects choose between two strategies, direct retrieval and plausible reasoning. The direct retrieval strategy means searching memory for a close match to the query, or searching for a targeted fact that has been explicitly stored in memory. The plausibility strategy is defined as computing a plausible answer to a question given a set of facts stored in memory. A considerable body of research assumes that direct retrieval is preferred to an inferential or constructive strategy since retrieval is presumably more efficient than plausible reasoning (see Reder, 1982, for a more general discussion). On the other hand, a growing body of evidence attests to the fact that searching memory for a verbatim match is not necessarily done even in tasks that seem to mandate direct retrieval (e.g., Reder, 1982, 1988; Reder & Anderson, 1980; Reder & Ritter, 1992; Reder & Ross, 1983; Reder & Wible, 1984).

In the experiments of Reder (1979, 1982, 1987, 1988), subjects read stories and then were asked to make judgments about statements based on these stories. Subjects were asked to make either a verbatim recognition judgment ("Did you see this sentence when you read the story?") or a plausibility judgment ("Is this sentence plausible given the story you read?"). There were two plausibility categories, highly plausible or moderately plausible. Determination of subjects' propensity to use the plausibility strategy was operationalized as the difference in reaction time between the moderately plausible and highly plausible statements. Likewise, determination of subjects' use of the direct retrieval strategy was operationalized as the difference in reaction time between statements that had not previously been stated and those that had. When the difference between stated and notstated reaction times was large and the difference between moderate and highly plausible was small, that was taken as evidence for the direct retrieval strategy. When the opposite was true, namely the difference between stated and notstated reaction times was small and the difference between moderate and highly plausible was large, this was taken as evidence for the plausibility strategy. In addition, error rates served as converging measures. For example,

when subjects tended to use predominantly the plausibility strategy for a recognition task, there were many erroneous acceptances of highly plausible, notstated items.

Reder's line of research has shown that subjects are more likely to switch their strategy preference from direct retrieval to plausibility as the delays between study and test lengthen (Reder, 1982; Reder & Ross, 1983; Reder & Wible, 1984). Other studies demonstrated that people are sensitive to the requirements of the situation in which they find themselves; they can alter their strategy preference within the same testing session as the probability of success of each strategy is manipulated (Reder, 1987) and can deliberately choose one of the two strategies as advised before each question (Reder, 1987).

These and other related data led Reder (1988) to theorize that the strategy selection process involves two mechanisms, one sensitive to extrinsic factors and one sensitive to intrinsic factors. The mechanism sensitive to extrinsic factors does not respond to cues in the question itself, but to situational factors. For example, Reder (1988) found that official task instructions, an extrinsic factor, influence strategy choice even when either strategy would produce the correct response. The mechanism sensitive to intrinsic factors responds to cues within the question itself, such as the familiarity with the terms in the question, giving a quick feeling-of-knowing judgment. In other words, feeling of knowing is categorized as an intrinsic mechanism.

Empirical Support for the Role of Feeling of Knowing in Strategy Choice

There are three studies that support feeling of knowing as a rapid, preretrieval process involved in the selection of retrieval strategies. The first piece of evidence comes from the arithmetic study of Reder and Ritter (1992) discussed earlier. Carefully constructed new arithmetic problems containing parts from old problems gave subjects spurious feelings of familiarity at test. Although feeling-of-knowing ratings were not collected in this experiment per se, it has already been established that priming terms from questions increases feelings of knowing without improving retrieval (e.g., Reder, 1987). Reder and Ritter found that degree of familiarity with the problem significantly influenced whether subjects chose to calculate or retrieve an-

swers to the problems. There were many instances where subjects mistakenly believed they knew a problem because of the familiarity of the parts of the problem and chose to retrieve the answer. Of course, these impressions proved to be wrong.

It is not problematic that subjects' judgments are off the mark in these cases. This study was intended to illustrate the fallibility of a rapid, heuristic-based process as imperfect monitor, sensitive to some types of information and insensitive to other information. Our thesis is that this cue-driven heuristic is efficient in most situations.

The second piece of evidence comes from a conceptual replication of Reder and Ritter (1992). Reder and Richards (1993) also manipulated the frequency of exposure to arithmetic problems, but sometimes did not allow subjects to answer the problems after selecting a strategy. In this way, exposure to the answer was manipulated separately from exposure to the problem. Data showed that frequency of exposure to the problem, rather than frequency of exposure to the answer predicted explicit strategy choices by subjects, supporting the contention that feeling of knowing is a rapid, preretrieval stage involved in the selection of retrieval strategy.

The final and perhaps most compelling piece of evidence for the implication of feeling of knowing in strategy selection comes from a modification of the typical Reder paradigm in which subjects read some stories 2 days prior to testing and other stories on the same day as testing. Previous research (Reder, 1982) showed that subjects prefer the direct retrieval strategy for questions about stories just read and the plausibility strategy for questions pertinent to the older stories. In those experiments subjects knew the age of the to be queried information prior to seeing the question since subjects answered all questions on the same day or came back 2 days later to answer all of them. Thus, in the prior research, the decision to use one strategy or another could be based on extrinsic factors, namely explicit knowledge of how long ago the story had been read, as opposed to the apparent familiarity of the terms in the question (an intrinsic factor). The critical design change in Reder (1988) was that subjects did not know before seeing a question in the testing phase whether it referred to a story that had just been read or to a story from 2 days earlier. In this manner it was possible to determine if a rapid inspection of the question affected response strategy selection.

In fact, subjects did use different strategies depending on the age of the story to which the questions referred. The results included some intriguing interactions. Subjects who were asked to make plausibility judgments did use inferences when the questions referred to old stories, but were instead using a direct retrieval strategy for questions concerning new stories. When recognition was the dependent variable, error rates indicated that subjects tended to use the plausibility strategy for questions regarding older stories and only used direct retrieval for the new stories. Generally speaking, this study found evidence that subjects frequently employed strategies which did not match stated task requirements. In other words, immediate cue familiarity was often a stronger determinant of strategy selection than explicit task instructions.

Search Duration

The second control function that feeling of knowing has been assumed to perform is determining the length of time an individual is willing to spend in finding the answer to a question. A large body of literature attests that feeling of knowing has a positive correlation with search duration (Gruneberg et al., 1977; Lachman & Lachman, 1980; Nelson et al., 1984; Ryan et al., 1982). It is interesting to speculate, in light of the proposed two strategies, whether feeling of knowing would be related to the length of time subjects were willing to spend inferring an answer. To date, there is no research addressing this issue.

A study by Nelson et al. (1984) using a variation of the classic RJR paradigm illustrates the robust relationship between feeling of knowing and search duration. Subjects were given general-information questions, then made feeling-of-knowing judgments for the first 21 questions whose answers they could not recall. The two measures of subsequent retrieval were perceptual-identification and a multiple-choice recognition test. Half of each subject's retrieval failures were tested via perception and half via recognition. Nelson et al. (1984) found that the latency of incorrect recall, an error of comission, was not correlated with either recognition or perceptual identification. On the other hand, latency to say "don't know" was significantly

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correlated with feelings of knowing. In other words, when subjects experienced stronger feelings of knowing, they searched longer.

Conclusion

The contention of this chapter has been that feeling of knowing is a rapid metacognitive process that generally precedes the point at which individuals either retrieve or otherwise determine an answer to a question. This process becomes more salient to subjects and researchers alike when a question cannot be answered. This feeling-of-knowing process initially uses a heuristic based on the character-istics of a question, such as superficial familiarity of test cues, instead of partial retrieval of the actual answer itself. In addition, this feeling of knowing process has been shown to guide such metacognitive control actions as search duration and the selection of question-answering strategies.

Acknowledgments

Note

1. Note that both latencies were still significantly shorter than the mean latency to produce an incorrect recall response.