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24

Processes Underlying Metacognitive Judgments

INFORMATION-BASED AND EXPERIENCE-BASED MONITORING OF ONE'S OWN KNOWLEDGE

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There has been extensive work in recent years on a variety of metacognitive operations that supervise and control different aspects of cognitive processing and behavior (see Koriat, 1998b; Metcalfe & Shimamura, 1994; Nelson & Narens, 1990; Reder, 1996; Schwartz, 1994). This work has been motivated by both theoretical and practical considerations. Metacognitive operations take place at different stages of learning and remembering. For example, when studying new material, students normally monitor the likelihood of remembering different pieces of this material and control the allocation of learning resources accordingly. Of course, whether they ultimately succeed in remembering the material depends not only on their memory, but also on their "metamemory"—that is, on the extent to which they can monitor the state of their knowledge and regulate their time and effort accordingly. Similarly, people can often feel whether a solicited piece of information is available or unavailable in memory, and on the basis of their "feeling of knowing," they may decide either to spend time and effort searching for-it or simply to pass. Finally, a person on a witness stand generally exercises some censorship over what he or she reports, withholding information about which he or she is not sure. Here too, the accuracy of the report depends not only on the accuracy of the person's memory, but also on the extent to which the person can discriminate between correct and incorrect pieces of information and control his or her reporting correspondingly.

In this chapter we propose a dual-process framework for the analysis of metacognitive monitoring, focusing on the question of how people know that they know. We make a distinction between metacognitive *feelings,* based on nonanalytic processes, and metacognitive *judgments,* based on analytic processes. Metacognitive feelings have much in common with certain forms of affective responses. In fact, they represent a blend between affective and cognitive processes, as implied by such terms as "knowing feelings" (see Clore, 1992) and "feelings of knowing" (Koriat, 1993; Nelson & Narens, 1990).

Metacognitive judgments, on the other hand, are more purely cognitive or informational in nature. We begin by drawing an analogy between metacognitive processes and certain forms of affective responses. This analogy-helps bring to the fore the unique function of metacognitive and affective feelings in mediating judgments and behavior (see also Clore, 1992; Schwarz & Clore, 1996); it also elucidates the distinction between experience-based and information-based processes in general.

AFFECTIVE EXPERIENCE AS A BASIS OF BEHAVIOR: AN EXAMPLE

Consider the following example of affect-based behavior, taken from Asher Koriat's student days (Koriat is the "I" m what follows). One of the fortunate jobs that I held during my days as an undergraduate student at the Hebrew University was that of an elevator boy in the administration building of the university. There was actually little work involved. In fact, there were two elevators, one of which was automatic; the other had to be operated manually. Usually I would spend my time sitting on a chair reading, unless an elderly lady insisted on riding with me, or unless the other elevator was busy and the person was in a hurry. Then, I would stop reading, leave my book on the chair, take the person to whichever floor he or she wanted, and then go back to my own business. In most cases, however, people did not want to disturb me; they simply took the stairs or waited for the other elevator.

During my work I saw many new people, most of whom I could not remember. However, I had an interesting experience that repeated itself several times. A person who looked like a complete stranger to me would walk to my elevator. I would drop my book, enter the elevator, and close the door; before the person had a chance to indicate his or her destination, I would push the "1" button for the first floor. Typically, the person would express surprise: "How do you know?" or "How do you remember?" In fact, I too would be quite surprised, because I usually did not have the faintest memory that I had seen that person before. However, I was quite confident that he or she was heading for the first floor.

After some reflection and introspection, I realized what was going on. Because people could generally manage without my help, I was normally annoyed when someone insisted on using my service, stopping me in the middle of my reading, and having me go through my routine (closing my book, getting into the elevator, closing the door, pushing the button, etc.). However, I was particularly annoyed when after this ordeal, the person announced, "First floor, please." After all, the stairs were nearby. Apparently, then, after one or more such experiences with such a person, I developed a sort of conditioned emotional response that was associated with that person. So next time, when the person walked toward me, the negative feeling tone that he or she evoked served as a sufficiently potent cue that this individual was going to say "First floor" again.

I have not done any systematic experimentation on the subject, but I suspect that such an affective association would not have been formed if the need to use the elevator to the first floor had somehow been justified. Thus, perhaps if the person m question had been an elderly lady, such an affectively mediated memory would not have occurred, and I would not have been spared the need to ask for the desired floor. Possibly the same would have been true if the person had gone to the fifth floor.

We may tentatively propose that the process underlying my reaction can be expressed as follows: Cognitive content —> Affective feeling —» Inference. The first component of this process is the cognitive or informational content that gives rise to the feeling tone. In my case, this was the correlation between the person's appearance and the fact that he or she wanted to go to the first floor. This correlation could be expressed in a prepositional form: "The person who looks so-and-so goes to the first floor."

The second component is the affective association. In my case, a negative feeling tone was attached to the person's look because of the reasons described above.

The third component is again cognitive. In my case, my affective response to the person served as a mnemonic cue that the person apparently wanted to get to the first floor.

One obvious question that arises is this: Why are subjective feelings necessary for mediating between one cognitive content and an-

other? Why doesn't the first cognitive content feed directly into behavior? We propose that affective reactions can code limited, shallow aspects of the information in the environment, and can be formed unconsciously without (or before) a full articulation of the specific informational content on which they are based. Therefore, although the content of the information that originally gave rise to the feeling tone is not available to consciousness, the subjective feeling itself can serve as a basis for judgment and behavior, and can even help reconstruct certain aspects of the original content.

DISTINGUISHING BETWEEN AFFECT-BASED AND INFORMATION-BASED JUDGMENTS

A second question that we wish to address involves the difference between the affect-based process described above and the more common process in which the decision relies directly on informational content (see, e.g., Epstein & Pacini, Chapter 23, this volume, and Strack, 1992, for similar distinctions). Clearly, after repeated encounters with a particular person who used the elevator, I could simply have remembered that that person generally went to the first floor. Or else, if I knew what the person's job was, I could easily have inferred that his or her office was on the first floor. If that person walked into my elevator, I might still have experienced negative affect toward him or her, but that affect would not have served as the basis for pressing the first-floor button. Rather, the basis for my action would have been an explicit cognitive content. Affective mediation, then, apparently circumvents the need to rely explicitly on such associated informational-associative content.

What, then, are the differences between the affect-based and information-based processes? There are three differences that we wish to stress, because they also apply to the difference between experience-based and information-based metacognitive judgments.

1. Mediation. The information-based process is uniform: The informational content in explicit memory feeds into judgment and behavior (though it may also give rise to an affective reaction). That is, explicit beliefs and explicit knowledge retrieved from memory serve to guide behavior. The affect-centered process, in contrast, is composed of two qualitatively different processes whose junction lies at the experiential, feeling state. The process that gives rise to the affective reaction is essentially implicit and unconscious, whereas the process that uses this reaction as a source of information is part and parcel of explicit and controlled modes of thought. Hence, affective feelings are seen to serve a crossover function, mediating between implicit/automatic and explicit/controlled modes of operation (see Koriat, 1998b).

2. *Content.* In the information-based process, the basis of the judgment lies in domain-specific content retrieved from memory. In contrast, in the affect-centered process, the content of the information underlying the feeling is not available to consciousness. All that is available to consciousness is a feeling state.

3. *Phenomenal quality.* In the information-based process, an aware mode of operation is maintained throughout: A person retrieves a certain belief and behaves accordingly in a controlled, deliberate manner. In the affect-mediated process, in contrast, the decision or judgment has an intuitive quality; it comes as a "hunch." In part, this distinction parallels that between "know" and "remember" responses (Gardiner & Java, 1993): In the affect-mediated process, the effect of stored information has the quality of a "know" response, whereas in the information-based process, it has a quality more like that of "remember." The distinction also parallels in part that between "familiarity" and "recollection" (Jacoby, 1991; Jacoby, Lindsay, & Toth, 1992).

Koriat, Edry, and De Marcas (1998) noted a similar phenomenological distinction between the retrieval of a complete entry from memory (e.g., recalling the word "love") and the retrieval of partial information about it (e.g., judging that the nonrecalled word has a positive emotional tone). It was proposed that access to partial information shares certain features with implicit memory: It has the quality of an intuitive guess; it elicits more "know" than "remember" states of awareness (see Gardiner & Java, 1993); and it is less sensitive to manipulations of attention and retention interval.

Our distinction between affect-based and information-based processes also overlaps with that of Smith and DeCoster (Chapter 16, this volume; see also Sloman, 1996) between automatic associative processing and rule-based processing. They propose that the products of associative processing are experienced as intuitive and affective responses, whereas those of rule-based processing are regarded as the derivatives of logical reasoning.

As will be further clarified later, our distinction accords particularly well with that of Epstein and Pacini (Chapter 23, this volume; see also Epstein, 1994; Epstein, Lipson, Hoistein, & Huh, 1992) between an experiential system and a rational system. Consistent with our analysis of the elevator example, Epstein and Pacini propose that connections in the experiential system are made through associations, whereas those in the rational system are made through logical inference. Importantly, they maintain that whereas processing in the rational system is affect-free, the experiential system is emotionally driven and is intimately associated with the experience of affect.

Let us now turn to metacognitive judgments. We begin our analysis with the feeling of knowing that accompanies retrieval failure, and use this analysis to illustrate some of the basic issues concerning metacognitive judgments in general. Then we examine these issues with regard to judgments of learning elicited during study and subjective confidence in the correctness of one's answer. Finally, we point out some of the similarities between affective and "noetic" (knowing) feelings.

PROCESSES UNDERLYING THE FEELING OF KNOWING

A common experience in everyday life is that we fail to retrieve some piece of information from memory—for example, the name of an acquaintance—and yet we are absolutely sure that we know the name and that we can immediately recognize it when it is presented to us, or can even retrieve it at some later time. Such episodes have attracted the interest of memory researchers because they seem to suggest that people can monitor the information stored in memory even when they fail to recall it.

In studies on the feeling of knowing, participants are typically presented with vocabulary or general-information questions asking for a particular name or a particular term (e.g., "What is the name of the architect who designed Brasilia?"). When they fail to recall the answer, they are asked to judge how likely they are to recognize the solicited memory target when it is presented among distractors, and are then given a recognition memory test. In most studies a positive correlation has been found between feeling-of-knowing judgments and recognition performance, suggesting that people can accurately monitor memory.

Our focus in the present chapter is not on the accuracy of metacognitive judgments, but on the basis of these judgments. How do people know that they know? We propose that a feeling-of-knowing judgment may be based on two sources of information: first, domain-specific knowledge retrieved from memory; and, second, a sheer subjective experience. In the former case, the process is more like that of a probability judgment: A person engages in an effortful retrieval and evaluation of relevant information to reach an educated assessment of the likelihood that he or she may possess the solicited name or term. This information-based process leads to what might be better described as "judgment of knowing" than as "feeling of knowing" (Koriat, 1993). In some cases the person may in fact prefer to phrase the judgment as "I ought to know the answer," rather than "I feel that I know the answer" (see Costermans, Lories, & Ansay, 1992).

The second process, in contrast, is mediated by a subjective feeling. The person may have the experience of directly detecting the presence of the solicited target and its imminent recall (see Brown & McNeill, 1966). This feeling may sometimes be so strong as to be accompanied by a feeling of tension and frustration. The feeling-of-knowing judgment in this case is based on an effortless, direct readout of that noetic feeling.

What is the mechanism responsible for feelings of knowing as opposed to judgments of knowing? Current theoretical discussions generally distinguish between two classes of mechanisms for the feeling of knowing: inferential/analytic mechanisms on the one hand, and trace access mechanisms on the other (Nelson, Gerler, & Narens, 1984; see also Krinsky &: Nelson, 1985). Inferential mechanisms are those in which the person analyzes

different types of information in order to deduce the likelihood that the solicited target is indeed available in memory. Trace access mechanisms, on the other hand, are based on the direct detection of the presence of the solicited target in store. A simple hypothesis, then, is that inferential mechanisms give rise to "judgments" of knowing, whereas unmediated "feelings" of knowing are based on trace access mechanisms.

The idea that a trace access mechanism underlies feelings of knowing has been most explicitly argued by Hart (1965, 1967a, 1967b). According to Hart, the feeling of knowing is based on a special memory-monitoring module that has privileged access to memory traces and can directly monitor their availability in memory. This mechanism can help to ascertain that a solicited target is indeed stored in memory before a retrieval attempt is initiated. A similar trace access mechanism has been also implied to underlie judgments of learning—that is, judgments that a studied item has been committed to memory and will be remembered in the future (e.g., Cohen, Sandier, & Keglevich, 1991; see Koriat, 1997). The assumption is that people can directly read out the strength of the memory trace that is formed following study, and can also assess on-line the increase in trace strength that occurs as more time is spent studying an item.

Trace access mechanisms would seem to be best suited to explain feeling-based judgments. They capture the phenomenal quality that is sometimes associated with the "tip-of-the-tongue" state—the feeling that one directly monitors the presence of the elusive target in memory and its emergence into consciousness (James, 1890). This phenomenal quality, together with the observation that metacognitive judgments are generally predictive of actual memory performance, lends credence to the idea that feeling-based metacognitive judgments rest on direct access to memory traces, as opposed to information-based judgments, which may rely on inferential processes.

The view advocated in this chapter, in contrast, denies the possibility of direct trace monitoring. Rather, it is proposed that tion metacognitive judgments, both feeling-based and information-based, are inferential in nature (see Benjamin & Bjork, 1996). The difference between them lies in the nature of the inferential process: Whereas information-based judgments rely on analytic inferences, feeling-based judgments rest on nonanalytic inferences. This is true for feeling-of-knowing judgments, as well as for other types of metacognitive judgments that are discussed below. Let us examine this idea more closely,

ANALYTIC AND NONANALYTIC DETERMINANTS OF METACOGNITIVE JUDGMENTS

The distinction between analytic and nonanalytic processes was first proposed by Jacoby and Brooks (1984). These terms are borrowed here to distinguish between two different bases of metacognitive judgments, although they do not capture all aspects of the distinction (but see Brown & Siegler, 1993; Jacoby &C Kelley, 1987; Kelley & Jacoby, 1996a; Koriat, 1994, 1997; Smith & DeCoster, Chapter 16, this volume). Analytic/inferential bases entail the conscious, deliberate utilization of specific beliefs and information to form an educated guess about one's own knowledge. Nonanalytic bases, in contrast, entail the implicit application of some global, general-purpose heuristics to reach a metaeognitive judgment. Although these heuristics are inferential in nature, they operate unconsciously and automatically to influence and shape subjective experience. Hence they can explain precisely the type of noetic feelings for which trace access mechanisms have appeared to provide the most suitable account.

Several nonanalytic heuristics have been invoked in explaining feelings of knowing, judgments of learning, and subjective confidence, and it is not entirely clear whether they imply the same or different mechanisms. All of them involve reliance on mnemonic cues-internal, experiential cues that accompany thought and retrieval (see, e.g., Schwarz & Clore, 1996; Strack, 1992). Among these are the mere accessibility of pertinent information (Dunlosky & Nelson, 1992; Koriat, 1993; Morris, 1990), the ease with which informa- comes to mind (Kelley & Lindsay, 1993; Koriat, 1993; Mazzoni & Nelson, 1995), the familiarity of the cue that serves to prompt retrieval (Metcalfe, Schwartz, & Joaquim,

1993; Reder, 1987; Reder & Schunn, 1996), and the fluency of processing (Begg, Duft, Lalonde, Melnick, & Sanvito, 1989; Benjamin &C Bjork, 1996; Kelley & Jacoby, 1996b). Each of these internal cues can serve as the basis for a noetic feeling.

Unlike analytic inferences, nonanalytic heuristics are used unconsciously, and their effects are automatic. These effects are often experienced as intuitive feelings rather than as logical deductions, and their validity is generally taken for granted by the person. Epstein and Pacini (Chapter 23, this volume) make a similar point: Distinguishing between the experiential and rational systems, they note the self-evident quality of the experiential system, in contrast to the logical justification that characterizes the rational system. Thus, we propose that the nonanalytic basis of noetic feelings is responsible for their direct, unmediated quality and for their perceived validity.

HEURISTIC-DRIVEN FEELINGS OF KNOWING

Let us now return to feeling-of-knowing judgments, focusing on two candidate heuristics that have received experimental attention in recent years as potential determinants of the feeling of knowing: cue familiarity and accessibility. According to the cue familiarity hypothesis (e.g., Metcalfe, 1993; Reder, 1987), feeling-of-knowing judgments are based on the overall familiarity of the stimulus that is designed to cue the memory target. Thus, when a person is presented with a question, a rapid feeling of knowing is computed, based on the overall familiarity of the question rather than on the retrievability of the answer. Support for the cue familiarity hypothesis comes from studies indicating that the feeling of knowing associated with a cue is enhanced by advance priming of that cue or of elements thereof. This occurs even when cue priming does not improve actual memory performance. Thus, in Reder's (1987, i988) studies, advance priming of some of the words of a general-information question was found to enhance the feeling of knowing associated with that question, without affecting subsequent recall or recognition of the answer. Similarly, Schwartz and Metcalfe (1992), using a paired-associates task, found that feeling-of-knowing judgments were enhanced by advance cue priming but not by advance target priming. Metcalfe et al. (1993) found that repetition of the cue word across two lists of paired associates increased feeling-of-knowing judgments, whereas repetition of the response word did not.

In other studies by Reder and her associates (Reder Sc Ritter, 1992; Schunn, Reder, Nhouyvamsvong, Richards, & Stroffolino, 1997), participants were presented with arithmetic problems, and were asked to judge rapidly whether they knew the answer to each and could produce it without having to compute it. As would be expected, the probability of "know" responses increased with repetition of a problem. However, it also increased when only some of the components of the problem were repeated, and even when participants were given little opportunity to solve the problem. Thus feeling-of-knowing judgments are affected by the mere familiarity with the question.

A second heuristic that has received experimental attention is the accessibility heuristic. Koriat (1993) proposed that feeling-of-knowing judgments are based on the overall accessibility of partial information pertaining to the target. When recall fails, many partial clues often come to mind. Some of these may stem from the target itself and hence represent correct partial clues, whereas others may derive from irrelevant activations (such as those emanating from neighboring targets or from priming), and constitute wrong partial clues. Because participants cannot monitor the accuracy of the information that comes to mind, both correct and wrong partial clues contribute to the enhancement of feeling-of-knowing judgments. Nevertheless, these judgments tend by and large to be accurate, because of the high output-bound accuracy of memory (Koriat & Goldsmith, 1994, 1996): Information that comes to mind is much more likely to be correct than wrong. For example, the probability of providing an answer to a certain memory question may be quite low, but given that a person does retrieve an answer, the probability is quite high that the answer provided is correct. The implication is that there is no need to postulate a trace access mechanism to explain the accuracy of the feeling of knowing. Rather, the accuracy of

metamemory simply stems from the general accuracy of memory itself.

Support for the accessibility account of the feeling of knowing came from a study (Koriat, 1993) in which participants memorized a letter string on each trial, and were then asked to recall it or to report as many letters as they could remember. Feeling-of-knowing judgments about the future recognition of the target increased systematically with the overall number of letters reported, regardless of the accuracy of these letters, Thus, both number of correct letters recalled and number of wrong letters recalled were positively and strongly correlated with feeling-of-knowing judgments. Nevertheless, feeling-of-knowing judgments were accurate in predicting subsequent recognition memory, simply because the reported letters had a .90 probability of being correct. Additional findings indicated that feeling-of-knowing judgments also increased with the ease with which partial clues came to mind: When the number of letters reported was controlled, feeling-of-knowing judgments increased with decreasing retrieval latency. In parallel, ease of access was also predictive of the correctness of the partial information retrieved, as well as the success of subsequent target recognition. These results suggest that the accuracy of feeling-of-knowing judgments in predicting actual memory performance derives from the implicit utilization of cues that are generally valid, rather than from privileged access to stored traces.

Because the validity of feeling-of-knowing judgments depends on the validity of the cues on which these judgments rest, it should be possible to find dissociations between knowing and the feeling of knowing. Such dissociations should occur when the overall amount of information that comes to mind is not diagnostic of the availability of the correct target. Indeed, Koriat (1995) obtained results indicating that the accuracy of feeling-of-knowing judgments in predicting subsequent recognition of the target varied strongly with the quality of the partial clues precipitated. When these clues were predominantly correct, which is true of typical memory questions, feeling-of-knowing judgments were valid in predicting actual recognition performance. However, when deceptive questions were used (Fischhoff, Slovic, & Lichtenstein, 1977), which tend to bring to mind more incorrect than correct answers, a dissociation was found between feeling-of-knowing judgments and actual memory performance. First, feeling-of-knowing judgments following recall failure were inflated considerably relative to actual recognition memory performance, thus evidencing a strong illusion of knowing stemming from the heightened accessibility of wrong partial clues (see Koriat, 1998a). Second, the correlation between feeling-of-knowing judgments and subsequent recognition memory performance was *negative:* The higher one's feeling of knowing, the greater the likelihood that one's answer in the recognition test was wrong, In sum, the recent work on feelings of knowing suggests that these feelings and their accuracy can be explained in terms of nonanalytic heuristics that utilize certain mnemonic cues. These cues have a certain degree of predictive validity. For example, because questions and answers generally occur together in our experience (e.g., "The capital of Argentina is Buenos Aires"), familiarity with the question ("What is the capital of Argentina?") is predictive of the familiarity of the answer (see Metcalfe, 1996). Indeed, Kelley and Jacoby (1996b) observed that familiarity with a cue term was predictive of the probability of recognizing the corresponding response term in a paired-associates task. In a similar manner, the number of partial clues retrieved in response to a question, and the ease with which they come to mind, are generally predictive of the recallability of the correct target,

HEURISTIC-DRIVEN JUDGMENTS OF LEARNING

Let us now turn to "judgments of learning"—that is, judgments made by a person during the encoding of information about the likelihood of remembering the encoded material in the future. As noted earlier, these judgments are important because they generally mediate the allocation of time and effort. For example, when making a note to oneself about a prospective action (e.g., to call the doctor, to return a book to the library, to take a cake out of the oven), one must also assess the likelihood that one will remember to perform the

planned action at the appropriate time. On the basis of that assessment, one may decide to take some special measures so as not to forget to perform the act (see Brandimonte & Ellis, 1996).

In a typical experiment on judgments of learning, participants study a list of paired associates, and after studying each pair they are asked to assess its future recallability—that is, to assess the chances that they will be able to provide the second word of the word pair (target word) when presented with the first word (cue word) in a later phase of the experiment. Research findings indicate that judgments of learning are generally accurate in predicting memory performance (e.g., Dunlosky & Nelson, 1994; Lovelace, 1984; Mazzoni & Nelson, 1995), and that under self-paced learning conditions participants allocate study time in accordance with their judgments of learning, spending more time studying those items that are associated with lower judgments (Mazzoni & Cornoldi, 1993; Nelson & Leonesio, 1988).

What is the basis of judgments of learning? How do people assess their competence during study? As noted earlier, a simple hypothesis about judgments of learning is that they are based on the direct readout of the strength of the applicable memory traces. If participants can monitor an item's memory trace on-line, they should be able to allocate more study time to the item until a desirable strength is reached. Such a trace-monitoring account can readily explain the predictive validity of judgments of learning.

In contrast, a cue utilization approach assumes that these judgments are inferential in nature, rather than being based on a direct readout of the strength of memory traces (see, e.g., Begg et al., 1989; Koriat, 1997). According to this view, judgments of learning utilize a variety of cues, and apply different heuristics and beliefs to infer the future recallability of the studied information. One mnemonic cue that has been proposed to underlie judgments of learning is ease or fluency of processing (Begg et al., 1989; Benjamin & Bjork, 1996; Bjork, 1998). This cue is generally diagnostic of the future recallability of the studied item, because easily processed items have a better chance to be recalled or recognized in the future. However, in some cases ease of processing may be invalid, resulting in dissociations between judgments of learning and memory performance. Thus, Begg et al. (1989) observed that whereas concrete words yielded both higher judgments of learning and better recognition memory than abstract words, common words yielded higher judgments of learning but poorer recognition memory than rare words. Their explanation is that both concrete words and common words are easier to process, and therefore produce relatively high judgments of learning. Indeed, in their study concrete and common words were rated as easier to imagine, easier to pronounce, and easier to understand than abstract and rare words. The implication, then, is that variables that make similar contributions to ease of processing (at the time of making judgments of learning) and to eventual memory performance should enhance the validity of judgments of learning. In contrast, those that affect these variables differentially (e.g., word frequency) should impair the validity of judgments of learning. Dissociations between judgments of learning and memory performance have also been reported by others. Narens, Jameson, and Lee (1994) found that a subthreshold presentation of the target in a paired-associates task increased judgments of learning without affecting final recall. Perhaps advance priming facilitated the processing of the target without affecting its subsequent recall. In Ztchmeister and Shaughnessy's (1980) study, words presented twice produced higher judgments of learning when their presentation was massed than when it was distributed, although the reverse pattern was observed for recall. Perhaps massed repetition of a word enhances its ease of processing more than its distributed repetition does.

Benjamin and Bjork (1996) have distinguished between perceptual fluency and retrieval fluency as two possible bases of metacognitive judgments. "Perceptual fluency," like Begg et al.'s "ease of processing," refers to the ease with which the stimulus is perceived and the sense of familiarity it evokes. "Retrieval fluency," on the other hand, refers to the ease with which information comes to mind, as indicated, for example, by the latency of retrieving responses to a certain cue, the persistence with which the cue tends to elicit the same response, and the amount of information accessed. Both percep-

tual fluency and retrieval fluency are influenced by a .variety of factors that also affect memory performance, thus contributing to the validity of fluency-driven metacognitive judgments. For example, information that is well learned, or that has been frequently or recently accessed, tends to lead to fluent retrieval. However, fluent retrieval may sometimes misinform metacognitive judgments, as nicely demonstrated by Benjamin, Bjork, and Schwartz (1998). In one experiment, they capitalized on the finding that the more difficult the generation of an answer is, the higher the probability that the answer will be recalled in a later free-recall test (Gardiner, Craik, & Bleasdale, 1973). Accordingly, they had participants answer general-information questions and make judgments of learning about the likelihood of recalling the answer in a later free-recall test. Whereas the probability of eventual recall increased with the latency of retrieving the answer, judgments of learning actually decreased with retrieval latency. Thus retrieval fluency can sometimes be counterdiagnostic.

In a second experiment, participants studied a series of six lists of words, recalled each list immediately after study, and then recalled the words from all six lists in a final free-recall test. In addition, after recalling each word in the immediate test, participants indicated their judgments of learning regarding its future retrievability in the final test. Judgments of learning were higher for items recalled in the first part of the recall output in immediate recall, but these items were in fact less likely to be recalled in the final test than those that occurred in later output positions. Thus retrieval fluency as indexed by output position in immediate recall seems to enhance judgments of learning while reducing the probability of final recall.

THE ROLE OF THEORY-BASED AND EXPERIENCE-BASED PROCESSES IN JUDGMENTS OF LEARNING

Koriat (1997), elaborating a cue utilization approach to judgments of learning, has proposed a model that distinguishes three classes of cues (intrinsic, extrinsic, and mnemonic) and two types of inferential processes (theory-based and experience-based) (see also Jacoby &: Kelley, 198/). Intrinsic cues pertain to inherent characteristics of the study items that disclose their *a priori* ease or difficulty of learning or remembering (e.g., word frequency, associative relatedness between paired associates). Extrinsic cues, in contrast, pertain to the conditions of learning (e.g., number of presentations) or to the encoding operations applied by the learner (e.g., level of processing). Koriat has proposed that both intrinsic and extrinsic factors can affect judgments of learning directly, through the explicit application of a particular rule or theory. For example, a person may believe that memory performance in a paired-associate task should be better for associatively related pairs than for unrelated pairs (an intrinsic factor), or that it should be better when a pair is presented three times than when it is presented only once (an extrinsic factor). However, both intrinsic and extrinsic cues may also influence judgments of learning indirectly, through their effects on the third class of cues—mnemonic cues.

Mnemonic cues are internal, subjective indicators that may signal to the person the extent to which an item has been mastered. These may include any of the cues discussed earlier, such as perceptual fluency and retrieval fluency. An important advantage of mnemonic cues as predictors of memory performance is that they are generally sensitive to both intrinsic and extrinsic factors that affect degree of learning. Thus, for example, Jacoby and his associates have provided evidence suggesting that fluency of processing and experienced familiarity are enhanced by a previous exposure to a stimulus (Jacoby & Kelley, 1987; Whittlesea, Jacoby, & Girard, 1990).'

The direct and mediated effects of intrinsic and extrinsic cues are assumed to involve an analytic and a nonanalytic process, respectively. The direct effects involve an analytic inference based on the person's *a priori* theory about the memory-related consequences of various factors. The mediated effects, in contrast, rest on the implicit use of a nonanalytic inference rather than on a logical, conscious deduction. They are based on the utilization of mnemonic cues that provide an experiential basis for judgments of learning.

Koriat has proposed that the relative weight of different cues in determining judgments of learning may differ from one condi-

tion to another, and may also change with practice studying the same list of items. A series of experiments using paired-associates learning has supported the following two propositions. First, judgments of learning focus on the relative recallability of different items within a list, and are less sensitive to factors that affect overall performance (see Shaw & Craik, 1989). Therefore they tend to discount the effects of extrinsic factors relative to those of intrinsic factors (see also Carroll, Nelson, & Kirwan, 1997). Second, and more pertinent to the focus of the present chapter, is that with repeated practice studying a list of items, the basis of judgments of learning changes from a theory-based analytic inference toward greater reliance on heuristic-driven subjective experience. Thus the direct contribution of intrinsic cues to judgments of learning diminishes with practice studying the same set of items, whereas that of mnemonic cues increases.

For example, in one experiment (Experiment 2), a list of paired associates was shown for four study-test presentations, and during study participants indicated their judgments of learning for each item. The results yielded divergent effects of practice on calibration and resolution. On the one hand, practice impaired calibration by increasing underconfidence. This impairment resulted from the tendency to discount the extrinsic cue of number of presentations. At the same time, it increased resolution (i.e., the discrimination between items that were likely to be recalled and those that were not). This improvement apparently reflected a shift from theory-based to experience-based judgments. Thus, during initial study, the judgments of learning associated with different items reflected primarily the direct assessment of their preexperimental difficulty on the basis of some preconception about the memory-related consequences of different stimulus attributes. With increased practice learning these items, participants became increasingly sensitive to internal cues that disclose their relative memorability.

Whereas theory-based judgments of learning tend to rely on commonly shared beliefs about the possible memory-related consequences of different factors, mnemonic cues tend to be idiosyncratic, reflecting the person's unique processing of the items. The result is that participants tend to make similar judgments of learning to the same items during their initial study, but with increased practice they tend to diverge.

In sum, the study of judgments of learning also suggests a distinction between two different underlying processes: an analytic, theory-based process that involves a deliberate inference, and a nonanalytic, experience-based process that is mediated by the application of global heuristics.

PROCESSES AFFECTING SUBJECTIVE CONFIDENCE

Subjective confidence in the correctness of a proposition or an answer represents yet another kind of metacognitive judgment. Confidence judgments are generally elicited retrospectively, after participants have produced or chosen an answer to a question or after they have reached some decision. Although a large amount of work has been carried out on subjective probabilities and confidence judgments (see Wright & Ayton, 1994), only a small part of this work has any bearing on the distinction addressed in the present chapter between information-based (or theory-based) and experience-based judgments. In fact, much of the work on confidence judgments conducted in the area of decision making has centered on the "calibration of confidence judgments, rather than on the processes underlying subjective confidence as such. The most widely documented phenomenon is that of overconfidence, as reflected, for example, in the tendency of people to overestimate the correctness of their answers (Keren, 1991; McClelland & Bolger, 1994).

Nevertheless, it may be noticed in the work on subjective confidence that whereas some researchers imply that confidence judgments are based on an analytic process, others imply that they rest on experiential-mnemonic cues. For example, a study by Koriat, Lichtenstein, and Fischhoff (1980) addressed the question of why people are overconfident in the correctness of their knowledge. It was proposed that the assessment of subjective confidence is generally biased by attempts to justify the decision: When answering forced-choice two-alternative questions, participants initially interrogate their memories for perti-

nent considerations (i.e., considerations that speak for and against each of the alternatives) and evaluate the implications of these considerations until a decision is reached. Once a decision is made, the evidence is reviewed to assess the likelihood that the answer is correct. This retrospective review tends to be biased by the decision already reached: It tends to focus on evidence that is consistent with that decision and to disregard evidence contradicting it, thereby resulting in overconfidence in the decision. Thus subjective confidence rests on a process of self-justification. This account of overconfidence implies that subjective confidence is based on an analytic process that considers the information retrieved from memory to reach a reasonable assessment of the probability that the answer is correct. A similar view seems to underlie the theoretical framework proposed by Gigerenzer, Hoffrage and Kleinbolting (1991). In this framework, confidence judgments represent the outcome of a well-structured inductive inference. When participants encounter a problem such as "Which city has more inhabitants, Heidelberg or Bonn?," they will assign a 100% confidence to their answer if they can retrieve the number of inhabitants in each city. Otherwise they form a probabilistic mental model, which puts the specific task into a larger context and enables its solution by inductive inference. This model contains a reference class (all cities in Germany), a target variable (number of inhabitants), and several probability cues with their respective cue validities (e.g., the perceived probability that one city has more inhabitants than the other, given that it is the only city of the two that has a soccer team in the German Bundesliga). People base their answer on the probability cue, and their confidence on the respective cue validity.

In contrast to the view of confidence judgments as being determined by information-based inference, other work emphasizes the contribution of mnemonic cues, such as perceptual fluency and retrieval fluency. As for retrieval fluency, Nelson and Narens (1990) found that people express stronger confidence in the answers that they retrieve more quickly, whether those answers are correct or incorrect. Similarly, in a study by Kelley and Lindsay (1993), retrieval fluency was manipulated through priming. Participants were asked to answer general-information questions and to express their confidence in the correctness of their answers. Prior to this task, participants were asked to read a series of words, some of which were correct and some of which were plausible but incorrect answers to the questions. This prior exposure was found to increase the speed and probability with which the answers were provided in the recall test, and, in parallel, to enhance the confidence in the correctness of these answers. Importantly, these effects were observed for both correct and incorrect answers. These results support the view that retrospective confidence is based on a simple heuristic: Answers that come to mind easily are more likely to be correct than those that take longer to retrieve.

Processing fluency also seems to underlie an interesting effect observed by Chandler (1994). In her experiments participants were presented with a series of target and nontarget stimuli, each consisting of a scenic nature picture. In a subsequent recognition memory test for the targets, two opposing effects were found: Targets for which there existed a similar stimulus in the nontarget series (e.g.,, both depicted a lake) (1) were recognized less often, and (2) were endorsed with stronger confidence than targets for which no similar nontarget counterpart was included. Thus seeing a related target impaired participants' memory accuracy. However, it increased their confidence in the correctness of their choices, presumably because it enhanced fluent processing of the stimulus. Chandler's effect is analogous to one noted by Koriat and Lieblich (1977) with regard to feeling-of-knowing judgments: When people fail to retrieve a word that fits a certain definition, their feeling of knowing about the future recognition of that word is inflated by the presence in memory of "close neighbors"—that is, incorrect answers that partly fit the definition (see Koriat, 1998a).

The results of an experiment by Busey, Tunnicliff, Loftus, and Loftus (1995) may also point to the role of perceptual fluency in confidence judgments. Their participants studied a series of faces. Each face was seen under one of five luminance conditions, and its recognition was tested under a bright or a dim condition. When a face was studied in a dim condition, its testing in a bright condi-

tion reduced recognition accuracy but increased confidence. Possibly the fluent perceptual processing of the faces in the bright condition inflated participants' confidence judgments.

Postevent questioning, in which participants are asked to think about each of their responses in a memory test, has also been found to increase subsequent confidence ratings for these responses (Shaw, 1996; Wells, Ferguson, & Lindsay, 1981). In Shaw's study, this was found to be the case for incorrect answers made to misleading questions (questions referring to objects not presented) as well as those made to nonmisleading questions. Shaw has proposed that the retrieval attempt induced by postevent questioning increases subsequent retrieval fluency, which in turn results in enhanced confidence.

The imagination inflation phenomenon is probably yet another manifestation of the effects of retrieval fluency on confidence judgments. "Imagination inflation" refers to the observation that the mere act of imagining a past event increases one's confidence that the event did happen in the past. Garry, Manning, Loftus, and Sherman (1996) pretested their participants on how confident they were that a number of childhood events had happened, asked them to imagine some of those events, and then gathered new confidence judgments. Imagination instructions inflated confidence that an event had occurred in childhood. Moreover, merely asking about an event twice (on pretest and posttest) without instructing participants to imagine it led to an increase in subjective confidence, although not as large as the one produced by the act of imagination. Probably imagination of an event or even the mere attempt to recall it increases its retrieval fluency, which in turn contributes to the confidence that the event has occurred. Gregory, Burroughs, and Ainslie (1985; see also Gregory, Cialdini, & Carpenter, 1982; Sherman, Cialdini, Schwartzman, & Reynolds, 1985) have reported a similar effect of imagination on prospective probabilities (i.e., the perceived likelihood of future events).

Hastie, Landsman, and Loftus (1978) also found that repeated questioning about an imagined detail of a story increased confidence in that detail, and Turtle and Yuille (1994, Experiment 1) observed an increase in subjective confidence from one to two recall occasions (but see Ryan & Geiselman, 1991). In sum, the work on confidence judgments suggests the possibility that these judgments may be mediated both by an analytic, knowledge-based inference that takes into account domain-specific considerations retrieved from memory, and by a nonanalytic, experience-based process that relies on the application of general-purpose heuristics. Little is known about the relative contribution of these processes. Perhaps knowledge-based assessment is more strongly activated when the task is defined as involving the "assessment of probabilities" than when it is defined as that of reporting one's unmediated "subjective confidence."

NOETIC FEELINGS AND NOETIC JUDGMENTS COMPARED

The foregoing review has examined the processes underlying metacognitive judgments elicited at different stages of learning and remembering—during the encoding of a piece of information, during the attempt to retrieve it from memory, and following recall or recognition of the item. Theories and findings on all . three types of metacognitive judgments would seem to concur in suggesting two general propositions. First, metacognitive judgments are often based on the implicit application of general-purpose heuristics that make use of mnemonic cues. These heuristics give rise to an unmediated noetic feeling. The phenomenal immediacy of this feeling sometimes creates the sense of direct trace monitoring, as well as an illusion of validity.

Second, in addition to metacognitive judgments that are based on direct noetic feelings, we must recognize that such judgments may also be based on an analytic, deliberate inference that takes into account a variety of cognitive considerations. This type of judgment has been variously termed "theory-based" or "information-based," depending on the specific research context (e.g., Jacoby & Kelley, 1987; Kelley & Jacoby, 1996a; Konat, 1997; Strack, 1992). Unlike noetic feelings, noetic judgments rest on domain-specific, content-specific information, including theories and beliefs, semantic memory, recollected episodes, and so on.

In order to appreciate the important difference between the two types of metacognitive judgments, it is necessary to examine the role of these judgments in guiding behavior. A commonly held assumption among students of metacognition is that metacognitive judgments exert a causal role in governing behavior (see Barnes, Nelson, Dunlosky, Mazzoni, & Narens, 1998; Nelson, 1996). As noted earlier, judgments of learning seem to affect the amount of time spent studying a certain item in self-paced learning (e.g., Mazzoni & Cornoldi, 1993; Nelson & Leonesio, 1988). Feeling-of-knowing judgments associated with a question seem to guide the choice of a question-answering strategy, as well as the amount of time spent searching for the answer before giving up (e.g., Costermans et al., 1992; Gruneberg & Monks, 1974; Reder, 1987). Finally, confidence judgments in a piece of information that comes to mind appears to determine whether that information is volunteered or withheld under conditions that place a premium on accurate reporting (Koriat & Goldsmith, 1994, 1996). It is important to stress that the effects of metacognitive judgments on behavior occur whether these judgments are experience-based or information-based, and whether these judgments are accurate or inaccurate.

Koriat (1998b) has proposed a crude distinction between two modes of operation that can underlie behavior. The first is the explicit/controlled mode of operation: When a goal has to be reached, various considerations are consciously examined in an analytic fashion, and these come to govern controlled behavior, We associate this mode of operation with what is sometimes referred to as "rational behavior." Clearly, noetic judgments constitute an integral part of this mode of operation. For example, a student who is asked to answer one of two questions of his or her choice in a final exam may begin by assessing the probability that he or she can provide a correct and complete answer to each question, and then may choose to answer the question that has the higher assessed probability (see Koriat & Goldsmith, 1998).

In the implicit/automatic mode of operation, in contrast, unconscious activations may automatically affect and guide behavior. For example, stimuli registered below full consciousness may influence behavior directly and automatically without the mediation of conscious control. This mode of operation has been amply documented by social psychologists (see Bargh, 1997; Bargh, Chen, & Burrows, 1996). Clearly, the implicit/automatic mode of operation does not implicate metacognitive monitoring at all.

Where do noetic feelings belong, then? According to Koriat (1998b), noetic feelings occupy a unique role in mediating between the implicit/automatic mode of operation and the explicit/controlled mode of operation: They are implicit and unconscious as far as their antecedents are concerned, but explicit and controlled as far as their consequences are concerned. As argued throughout this chapter, noetic feelings (as distinct from noetic judgments) are the outcome of the implicit application of nonanalytic heuristics that rely on mnemonic cues. These heuristics may operate below full consciousness. However, once such heuristics give rise to conscious, noetic feelings, these feelings can serve to guide and motivate controlled behavior. For example, spurious priming of the terms of a question may unconsciously inflate the feeling of knowing associated with that question, The enhanced feeling of knowing, in turn, may result in spending more time trying to search for the answer before giving up (see Reder, 1987).

Using this general framework, we can now summarize the differences between the modes of operation involved when behavior is controlled by noetic feelings and when it is mediated by noetic judgments. These differences parallel those mentioned in our discussion of affective states between affect-based and information-based processes,

1. *Mediation.* The analytic process incorporating noetic judgments is a uniform process that operates in the explicit/controlled mode of operation throughout: Analytic, conscious considerations result in a noetic judgment, which can then affect choice and behavior in a "rational" manner, In contrast, when noetic feelings are implicated, these feelings serve to mediate between two qualitatively different processes, an implicit, nonanalytic process that operates below full awareness to shape subjective experience, and a controlled, largely con-

scious process that guides self-controlled behavior.

2. *Content.* A second difference is that the analytic determination of noetic judgments entails inspection of the content of domain-specific knowledge—theories, beliefs, and semantic and episodic memories. In contrast, in the nonanalytic process underlying noetic feelings, the content of the information does not enter into consideration (Koriat, 1993). Rather, the cues for feelings of knowing, judgments of learning, or subjective confidence lie in structural aspects of the information-processing system. This system, so to speak, engages in a self-reflective inspection of its own operation and uses the ensuing information as a basis for metacognitive judgments. This is precisely the process assumed to underlie the use of the availability heuristic for estimating frequencies (Tversky & Kahneman, 1973): People judge frequencies by the ease with which instances come to mind. Thus, all of the mnemonic cues mentioned as possible determinants of noetic feelings—cue familiarity, accessibility, and fluency—are indifferent to the content of the information.

3. Phenomenal quality. Finally, as stressed throughout this chapter, the phenomenal quality of monitoring processes differs when these processes entail an analytic inference and when they are based on a nonanalytic heuristic. Analytic inferences lead to a cognitive, intellectual judgment, whereas nonanalytic processes tend to lead to a feeling tone, an impression, or an intuition, without a clear awareness of the basis of this feeling. In this case, as Strack (1992) noted, the immediacy of the phenomenal experience seems to be transferred automatically to the judgment.

THE RELATION BETWEEN ANALYTIC AND NONANALYTIC PROCESSES IN METACOGNITIVE JUDGMENTS

Although in our discussion we have drawn a sharp distinction between the analytic and nonanalytic processes underlying metacognitive judgments, the two types of processes presumably operate together in determining metacognitive judgments (see Kelley & Jacoby, 1996a, 1996b). Thus analytic and nonanalytic processes may act in concert to influence behavior. Often, however, their combined effect is far from being additive. For example, Glucksberg and McCloskey (1981) found that participants could reach a "don't know" decision very quickly when presented with some questions (e.g., "Does Margaret Thatcher use an electric toothbrush?"). However, when they were informed beforehand that the answers to these questions were not known (e.g., "It is not known whether Margaret Thatcher uses an electric toothbrush"), this information actually slowed down "don't know" judgments, possibly because now the judgments tended to be based on retrieved information rather than on sheer subjective experience. Furthermore, it has been amply documented that awareness of the spurious source of subjective feelings may sometimes prevent their effects on judgments and behavior. For example, Jacoby and Whitehouse (1989) showed that an unaware presentation of a word just before its presentation for a recognition test misled participants into judging that word as "old." Supposedly, the increased processing fluency of the word (resulting from its prior presentation) was unconsciously misattributed to the word's presentation in the study phase. In contrast, a longer and aware presentation of the word prior to the recognition test yielded the opposite effect: It decreased the probability of judging the word as "old."

"Similarly, it has been observed that a bad mood resulting from bad weather reduces participants' judgments of their happiness and satisfaction with their life as a whole. However, participants tend to correct for the effects of a bad mood when their attention is drawn to the rainy weather in an opening remark (Schwarz & Clore, 1983; see also Murphy & Zajonc, 1993; Murphy, Monahan, & Zajonc, 1995).

In fact, the rich social-psychological literature on assimilation and contrast effects (e.g., Higgins, Bargh, & Lombardi, 1985; Higgins, Rholes, & Jones, 1977; Lombardi, Higgins, & Bargh, 1987; Martin, Seta, & Crelia, 1990; Strack, Erber, & Wicklund, 1982; Strack & Hannover, 1996; Strack, Schwarz, Bless, Kubler, & Wanke, 1993) offers a good demonstration of how awareness of an irrelevant activation of a certain concept enables analytic processes to correct (and even overcorrect) for the biased effects of

nonanalytic processes on judgment. For example, Strack et al. (1993) had participants judge the likability of a target character whose behavior was ambiguous. They were found to give relatively high likability ratings when primed with positive adjectives in a previous, seemingly irrelevant task, and relatively low ratings when primed with negative adjectives (assimilation effect). However, when participants were reminded of the priming task, the opposite pattern emerged (contrast effect). (For other demonstrations of the operation of effortful and automatic processes in opposition, see also Jacoby, Kelley, Brown, &c Jasechko, 1989; Jacoby, Kelley & McErlee, Chapter 19, this volume; Kelley &; Jacoby, 1996a; Trope, 1986; Trope & Gaunt, Chapter 8, this volume.)

We believe that in a similar manner, analytic processes can circumvent the effects of nonanalytic processes on metacognitive judgments. Thus, under those conditions in which irrelevant episodic events inflate metacognitive judgments by enhancing fluent processing, the explicit recollection of these irrelevant events should prevent the effects of processing fluency on metacognitive judgments (see Kelley & Jacoby, 1996a, 1996b).

AFFECTIVE FEELINGS REVISITED

Our analysis of the role of metacognitive judgments in terms of the distinction between an explicit/controlled mode, an implicit/automade mode, and a crossover mode of operation may have implications beyond the realm of metacognitive judgments. We illustrate some of these implications with regard to the analysis of affective feelings.

In discussions of affective responses, there has been a debate concerning the possibility of nonconscious affect. Whereas some believe that emotions are by definition conscious, subjectively experienced states of awareness (e.g., Clore, 1994; LeDoux, 1994), others argue for the possibility that emotions may be apparent in behavior and physiology with no experiential component (e.g., Lang, 1988). For example, Zajonc (1980, 1994) and Epstein and Pacini (Chapter 23, this volume) argued that behavior can sometimes be mediated by gross, diffuse affective reactions of which the person is not aware (see, e.g., Murphy et al., 1995). In fact, a similar proposal has been recently voiced in the area of metacognition: Reder and Schunn (1996) have argued that metacognitive monitoring and control processes, such as those involved in the feeling of knowing, also operate automatically and without awareness.

However, as detailed above, the position advocated in Koriat (1998b) and adopted in the present chapter suggests that stimuli that have a positive or negative valence may affect approach-avoidance behavior directly and automatically, without the mediation of consciousness or subjective experience. Such automatic effects are like those discussed by Bargh (1997) and need not invoke the notion of nonconscious affect. These effects are part of the implicit/automatic mode of operation, in which unconscious processes find their way automatically into behavior. A similar argument may be raised with regard to some of the observations cited by Reder and Schunn (1996): Various events may implicitly affect strategies of information processing, without any mediation of conscious metacognitive monitoring and control.

However, in the same way that unconscious processes can influence behavior directly and automatically, they may also influence and shape affective feelings. For example,-a person may feel cheerful or depressed without knowing why, or may experience a disgust toward a particular food with no particular explanation (see Rozin, Millman, & Nemeroff, 1986; Spielman, Pratto, &: Bargh, 1988). In such a case we are not talking about unconscious affect, because the feeling itself, like the feeling of knowing, is clearly conscious. The important point to stress, however, is that once unconscious influences give rise to a subjective feeling state, that state can now guide and direct behavior in a controlled, conscious manner. Thus, like noetic feelings, affective feelings may serve a crossover function, mediating between implicit and explicit modes of operation.

In addition, affective feelings may result from an explicit analysis of information. For example, a person who does not like fish may feel some repulsion toward a salad offered in a buffet when he or she learns (or suspects) that it contains tuna fish. On the basis of that information, the person may consciously and deliberately choose to avoid that salad. This

kind of avoidance behavior may emanate directly from the pertinent information, or may be mediated by the affective reactions that ensue from that information.

It is important to stress that even when affective reactions are information-based, people may still rely on their immediate feelings in guiding their behavior, rather than on the information on which these feelings are based. This may occur, for example, under time constraints or competing task demands that make it difficult to retrieve or reassess the pertinent information (see Clore, Schwarz, &C Conway, 1994; Schwarz, 1990; Strack, 1992). Of course, when the informational basis of affective reactions is not available to consciousness, people have no choice but to base their judgment and behavior on the affective feelings.

Extending our analysis of noetic processes to affective processes, we can make the following two propositions: First, the phenomenal quality of a feeling state should be different when the person is aware of the source of the feeling and when he or she is not (see Murphy et al., 1995). This proposal was in fact advanced by Freud (1917/1963) in his discussion of free-floating anxiety. For example, when a feeling of disgust associated with a particular salad is based on the knowledge that the salad contains tuna fish, this should differ from disgust associated with the same salad but based on an unexplained gut sensation. As noted earlier, the distinction between the qualities of explained and unexplained affective states parallels the distinction between types of noetic states—for example, the distinction between "knowing" and "just knowing" (Block, 1995), or between recollection-based and familiarity-based processes (e.g., Jacoby & Brooks, 1984).

Second, our review of the work on noetic feelings indicates that these feelings can be contaminated by a variety of factors of which a person is not aware. Possibly the same is true of affective feelings (Spielman et al., 1988). When this occurs, the person's feelings may be judged to be "inappropriate" or "invalid" (Schwarz & Clore, 1996). What is important to stress is that people act on the basis of their gut feelings, whether or not these feeling are "founded," "justified," or "adequate." A person who feels disgust toward some food will tend to avoid it, whether the feeling of disgust indeed reflects some undesirable property of the food or reflects some irrelevant property, such as the circumstances in which that food has been previously encountered (see Rozin et al., 1986). A similar pattern has been found with regard to metacognitive judgments: When people decide whether to report an answer to a question, they base their decision heavily on their confidence in the answer, and they do so even when their confidence judgments are not diagnostic of the accuracy of their answer (see Koriat & Goldsmith, 1996). Thus, the importance of both noetic and affective feelings is that they play a critical role in governing behavior, regardless of their basis or of the extent to which they are "accurate" or "appropriate."

In sum, in this chapter we have outlined a conceptual framework that emerges from the study of metacognitive judgments, and have also shown how it can be extended to the analysis of emotional feelings and behavior. Our distinction between analytic and nonanalytic processes and between experience-based and information-based reactions accords well with current views in cognitive and social psychology that distinguish between two different modes of information processing. In the present analysis, however, we have stressed the distinction between two processes: one that is explicit and controlled throughout, and one that entails a transition from an implicit/automatic mode of operation to a mode of operation that is more explicit and controlled. The important feature of the latter, crossover process lies in the unique role played by subjective feelings, noetic or affective, in mediating between unconscious influences and conscious, controlled behavior.

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REFERENCES

Bargh, J. A. (1997). The automaticity of everyday life. In R. S. Wyer, Jr. (Ed.), *Advances in social cognition* (Vol. 10, pp. 1-61). Mahwah, NJ: Erlbaum. Bargh, J. A., Chen, M., & Burrows, L. (1996). Automaticity of social behavior: Direct effects of trait construct and stereotype activation on action. *Journal of Personality and Social Psychology, 71,* 230-244. Barnes, A. E., Nelson, T. O., Dunlosky, J., Mazzoni, G., 8c Narens, L. (1998). An integrative system of metamemory components involved in retrieval. In D. Gopher &C A. Koriat (Eds.), *Cognitive regulation of performance: Interaction of theory and application* (pp. 287-313). Cambridge, MA: MIT Press. Begg, L, Duft, S., Lalonde, P., Melnick, R., & Sanvito, J. (1989). Memory predictions are based on ease of processing, *journal of Memory and Language, 2S,* 610-632.

Benjamin, A. S., & Bjork, R. A. (1996). Retrieval fluency as a metacognitive index. In L. M. Reder (Ed.), *Implicit memory and metacognition* (pp. 309-338). Hillsdale, NJ: Erlbaum.

Benjamin, A. S., Bjork, R. A., *&C* Schwartz, B. L. (1998). The mismeasure of memory: When retrieval fluency is misleading. *Journal of Experimental Psychology: General, 127,* 55-68.

Bjork, R. A. (1998). Assessing our own competence: Heuristics and illusions. In D. Gopher iv A. Koriat (Eds.), *Cognitive regulation of performance: Interaction of theory and application* (pp. 435-459). Cambridge, MA: MIT Press.

Block, N. (1995). On a confusion about a function of consciousness. *Behavioral and Brain Sciences, 18,* 227-287.

Brandimonte, M., & Ellis, J. (1996). *Prospective' memory*. Mahwah, NJ: Erlbaum.

Brown, N. R., & Siegler, R. S. (1993). Metrics and mappings: A framework for understanding real-world quantitative estimation. *Psychological Review, 100,* 511-534.

Brown, R., &: McNeill, D. (1966). The "tip of the tongue" phenomenon. *Journal of Verbal Learning and Verbal Behavior, 5,* 325-337.

Busey, T. A., Tunnicliff, J. L., Loftus, G. R., &: Loftus, E. F.(1995, November). *Predicting picture memory performance: Not all confidence judgments are equal.* Paper presented at the 36th Annual Meeting of the Psychonomic Society, Los Angeles.

Carroll, M., Nelson, T. O., & Kirwan, A. (1997). Trade-off of semantic relatedness and degree of overlearning: Differential effects on metamemory and on long-term retention. *Acta Psychologica, 95,* 239-253.

Chandler, C. C. (1994). Studying related pictures can reduce accuracy, but increase confidence, in a modified recognition test. *Memory & Cognition, 22,* 273-280.

Clore, G. L. (1992). Cognitive phenomenology: Feelings and the construction of judgment. In L. L. Martin & A. Tesser (Eds.), *The construction of social judgments* (pp. 133-164). Hillsdale, NJ: Erlbaum.

Clore, G. L. (1994). Why emotions are never unconscious. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: fundamental questions* (pp. 285-290). New York: Oxford University Press.

Clore, G. L., Schwarz, N., & Conway, M. (1994). Affective causes and consequences of social information processing. In R. S. Wyer, Jr., & T. K. Srull (Eds.), *Handbook of social cognition* (2nd ed., Vol. 1, pp. 323-418). Hillsdale, NJ: Erlbaum.

Cohen, R. L., Sandier, S. P., & Keglevich, L. (1991). The failure of memory monitoring in a free recall task. *Canadian Journal of Psychology, 45,* 523-538. Costermans, J., Lories, G., & Ansay, C. (1992). Confidence level and feeling of knowing in question answering: The weight of inferential processes. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18,* 142-150.

Dunlosky, J., & Nelson, T. O. (1992). Importance of the kind of cue for judgments of learning (JOLs) and the delayed-JOL effect. *Memory Cr Cognition, 20,* 373-380.

Dunlosky, J., & Nelson, T. O. (1994). Does the sensitivity of judgments of learning (JOLs) to the effects of various study activities depend on when the JOLs occur? *Journal of Memory and Language, 33,* 545-565. Epstein, S. (1994). Integration of the cognitive and psychodynamic unconscious. *American Psychologist,* 49, 709-724.

Epstein, S., Lipson, A., Holstein, C., &: Huh, E. (1992). Irrational reactions to negative outcomes: Evidence for two conceptual systems. *Journal of Personality and Social Psychology,* 62, 328-339.

Fischhoff, B., Slovic, P., £*t* Lichtenstein, S. (1977). Knowing with certainty: The appropriateness of extreme confidence. *Journal of Experimental Psychology: Human Perception and Performance, 3,* 552-564.

Freud, S. (1963). *A general introduction to psychoanalysis* (J. Riviere, Trans.). New York: Liveright. (Original work published 1917)

Gardines, J. M., Craik, F. I. M., & Bleasdale, F. A. (1973). Retrieval difficulty and subsequent recall. *Memory* c[v] *Cognition, 1,* 213-216.

Gardiner, J. M., & Java, R. I. (1993). Recognizing and remembering. In A. F. Collins, S. E. Gathercole, M. A. Conway, & P. E. Morris (Eds.), *Theories of memory* (pp. 163-188). Hove, England: Erlbaum.

Garry, M., Manning, C. G., Loftus, E. E, & Sherman, S. J. (1996). Imagination inflation: Imagining a childhood event inflates confidence that it occurred. *Psychonomic Bulletin and Review, 3,* 208-214.

Gigerenzer, G., Hoffrage, U., & Kleinbolting, H. (1991). Probabilistic mental models: A Brunswikian theory of confidence. *Psychological Review, 98,* 506-528. Glucksberg, S., & McCloskey, M. (1981). Decisions about ignorance. *Journal of Experimental Psychology: Human Learning and Memory, 7,* 311-325.

Gregory, W. L., Burroughs, W. J., & Ainslie, F. M. (1985). Self-relevant scenarios as an indirect means of attitude change. *Personality and Social Psychology Bulletin, 11,* 435-444.

Gregory, W. L., Cialdini, R. B., & Carpenter, K. M. (1982). Self-relevant scenarios as mediators of likelihood estimates and compliance: Does imagining make it so? *Journal of Personality and Social Psychology, 43,* 89-99. Gruneberg, M. M., &: Monks, J. (1974). "Feeling of

knowing" and cued recall. *Acta Psychologica, 38, 257-265.*

Hart, J. T. (1965). Memory and the feeling-of-knowing experience. *Journal of Educational Psychology, 56,* 208-216.

Hart, J. T. (1967a). Memory and the memory-monitoring process, *journal of Verbal Learning and Verbal Behavior,* 6, 685-691.

Hart, J. T. (1967b). Second-try recall, recognition and the memory-monitoring process, *journal of Educational Psychology, 58,* 193-197.

Hastie, R., Landsman, R., &: Loftus, E. F. (1978). Eyewitness testimony: The dangers of guessing. *Jurimetrics Journal, 19,* 1-8.

Higgins, E. T., Bargh, J. A., &: Lombardi, W. (1985). The nature of priming effects on categorization. *Journal of Experimental Psychology: Human Learning and Memory, 11,* 59-69.

Higgins, E. T., Rholes, W. S., & Jones, C. R. (1977). Category accessibility and impression formation. *Journal of Experimental Social Psychology, 13,* 141-154.

Jacoby, L. L. (1991). A process dissociation framework: Separating automatic from intentional uses of memory, *journal of Memory and Language, 30,* 513-541.

Jacoby, L. L., & Brooks, L. R. (1984). Nonanalytic cognition: Memory, perception and concept learning. In G. Bower (Ed.), *The psychology of learning and motivation: Adi'anccs in research and theory* (Vol. 18, pp. 1-47). Orlando, Florida: Academic Press.

Jacoby, L. L., &: Kelley, C. M. (1987). Unconscious influences of memory for a prior event. *Personality and Social Psychology Bulletin, 13,* 314-336.

Jacoby, L. L., Kelley, C. M., Brown, J., £: Jasechko, J. (1989). Becoming famous overnight: Limits on the ability to avoid unconscious influences of the past. *Journal of Personality and Social Psychology, 56,* 326-338.

Jacoby, L. L., Lindsay, S. D., & Toth, J. P. (1992). Unconscious influences revealed: Attention, awareness, and control. *American Psychologist, 47,* 802-809.

Jacoby, L. L., *&c* Whitehouse, K. (1989). An illusion of memory: False recognition influenced by unconscious perception. *Journal of Experimental Psychology: General, 118,* 126-135. James, W. (1890). *The principles of psychology* (Vol. 1).
New York: Holt.

Kelley, C. M., & Jacoby, L. L. (1996a). Adult egocentrism: Subjective experience versus analytic bases for |udgment. *Journal of Memory and Language, 35,* 157-175.

Kelley, C. M., &: Jacoby, L. L. (1996b). Memory attributions: Remembering, knowing, and feeling of knowing. In L. M. Reder (Ed.), *Implicit memory and metacognition* (pp. 287-307). Hillsdale, NJ: Erlbaum.

Kelley, C. M., & Lindsay, D. S. (1993). Remembering mistaken for knowing: Ease of retrieval as a basis for confidence in answers to general knowledge questions. *Journal of Memory and Language, 32,* 124.

Keren, G. (1991). Calibration and probability judgments: Conceptual and methodological issues. *Acta Psychologica, 77,* 217-273.

Koriat, A. (1993). How do we know that we know? The accessibility model of the feeling of knowing. *Psychological Review, 100,* 609-639.

Koriat, A. (1994). Memory's knowledge of its own knowledge: The accessibility account of the feeling of knowing. In J. Metcalfe & P. Shimamura (Eds.), *Metacognition: Knowing about knowing* (pp. 115-135). Cambridge, MA: MIT Press.

Koriat, A. (1995). Dissociating knowing and the feeling of knowing: Further evidence for the accessibility model. *Journal of Experimental Psychology: General,* 124,311-333.

Koriat, A. (1997). Monitoring one's own knowledge during study: A cue-utilization approach to judgments of learning. *Journal of Experimental Psychology: General, 126,* 349-370.

Koriat, A. (1998a). Illusions of knowing: The link between knowledge and metaknowledge. In V. Y. Yzerbyt, G. Lories, & B. Dardenne (Eds.), *Metacognition: Cognitive and social dimensions* (pp. 16-34). London, England: Sage.

Koriat, A. (1998b). Metamemory: The feeling of knowing and its vagaries. In M. Sabourin, F. I. M. Craik, *&C* M. Robert (Eds.), *Advances in Psychological Science: Biological and cognitive aspects* (Vol. 2, pp. 461-479). Hove, England: Psychology Press.

Koriat, A., Edry, E., & de Marcas, G. (1998). *What do we know about what we cannot remember: Accessing the semantic attributes of words that cannot be recalled.* Manuscript in preparation.

Koriat, A., &; Goldsmith, M. (1994). Memory in naturalistic and laboratory contexts: Distinguishing the accuracy-oriented and quantity-oriented approaches to memory assessment. *Journal of Experimental Psychology: General, 123,* 297-315.

Koriat, A., &: Goldsmith, M. (1996). Monitoring and control processes in the strategic regulation of memory accuracy. *Psychological Review, 103,* 490-517.

Koriat, A.,' *&i* Goldsmith, M. (1998). The role of metacognitive processes in the regulation of memory accuracy. In G. Mazzoni &: T. Nelson (Eds.), *Metacognition and cognitive ncitropsychology: Monitoring and control processes* (pp. 97-118). Mahvvah, NJ: Erlbaum.

Koriat, A., Lichtenstein, S., &: Fischhoff, B. (1980). Reasons for confidence. *Journal of Experimental Psychology: Human Learning and Memory, 6,* 107-118.

Koriat, A., *&C* Lieblich, I. (1977). A study of memory pointers. *Acta Psychologica, 41,* 151-164. Knnsky, R., &: Nelson, T. O. (1985). The feeling of knowing for different types of retrieval failure. *Acta Psychologica, 58,* 141-158.

Lang,' P. J. (1988). What are the data of emotion? In V. Hamilton, G. Bower, & N. Frijda (Eds.), *Cognitive science perspectives on emotion and motivation* (pp. 173-194). Amsterdam: Martinus Nijhoff.

LeDoux, J. E. (1994). Emotional processing but not emotions can occur unconsciously. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 291-292). New York: Oxford University Press.

Lombardi, W. J., Higgins, E. T, & Bargh, J. A. (1987). The role of consciousness in priming effects on categorization: Assimilation versus contrast as a function of awareness of a priming task. *Personality and Social Psychology Bulletin, 13,* 411-429.

Lovelace, E. A. (1984). Metamemory: Monitoring future recallability during study. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10, 756-766.*

Martin, L. L., Seta, J. J., &: Crelia, R. (1990). Assimila-

tion and contrast as a function of people's willingness and ability to expend effort in forming an impression. *Journal of Personality and Social Psychology,* 59, 27-37.

Mazzoni, G., & Cornoldi, C. (1993). Strategies in study time allocation: Why is study time sometimes not effective? *Journal of Experimental Psychology: General, 122,* 47-60.

Mazzoni, G., & Nelson, T. O. (1995). Judgments of learning are affected by the kind of encoding in ways that cannot be attributed to the level of recall. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21,* 1263-1274.

McClelland, A. G. R., & Bolger, F. (1994). The calibration of subjective probabilities: Theories and models 1980-1994. In G. Wright & P. Ayton (Eds.), *Subjective probability* (pp. 453-482). Chichester, England: Wiley.

Metcalfe, J. (1993). Novelty monitoring, metacognition and control in a composite holographic associative recall model: Implications for Korsakoff amnesia. *Psychological Review, 100,* 322.

Metcalfe, J. (1996). Metacognitive processes. In E. L. Bjork & R. A. Bjork (Eds.), *Memory* (pp. 381-407). San Diego, CA: Academic Press.

Metcalfe, J., Schwartz, B. L., & Joaquim, S. G. (1993). The cue-familiarity heuristic in metacognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19,* 851-861.

Metcalfe,]., & Shimamura, A. P. (1994). *Metacognition: Knowing about knowing.* Cambridge, MA: MIT Press.

Morris, C. C. (1990). Retrieval processes underlying confidence in comprehension judgments. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16,* 223-232.

Murphy, S. T, Monahan, J. L., & Zajonc, R. B. (1995). Additivity of nonconscious affect: Combined effects of priming and exposure. *Journal of Personality and Social Psychology, 69,* 589-602.

Murphy, S. T, & Zajonc, R. B. (1993). Affect, cognition, and awareness: Affective priming with subliminal and optimal stimulus. *Journal of Personality and Social Psychology, 64,* 723-739.

Narens, L., Jameson, K. A., & Lee, V. A. (1994). Subthreshold priming and memory monitoring. In J. Metcalfe 8c P. Shimamura (Eds.), *Metacognition: Knowing about knowing* (pp. 71-92). Cambridge, MA: MIT Press.

Nelson, T. O. (1996). Consciousness and metacognition. *American Psychologist, 51,* 102-116.

Nelson, T. O., Gerler, D., & Narens, L. (1984). Accuracy of feeling-of-knowing judgment for predicting perceptual identification and relearning. *Journal of Experimental Psychology: General, 113,* 282-300.

Nelson, T. O., & Leonesio, R. J. (1988). Allocation of self-paced study time and the "labor-in-vain effect." *Journal of Experimental Psychology: Learning, Memory, and Cognition, 14,* 676-686.

Nelson, T. O., & Narens, L. (1990). Metamemory: A theoretical framework and new findings. In G. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 26, pp. 125-123). San Diego, CA: Academic Press.

Reder, L. M. (1987). Strategy selection in question answering. *Cognitive Psychology, 19,* 90-138.

Reder, L. M. (1988). Strategic control of retrieval strategies. In G. Bower (Ed.), *The psychology of learning and motivation* (Vol. 22, pp. 227-259). San Diego, CA: Academic Press.

Reder, L. M. (Ed.). (1996). *Implicit memory and metacognition.* Hillsdale, NJ: Erlbaum.

Reder, L. M., & Ritter, F. E. (1992). What determines initial feeling of knowing? Familiarity with question terms, not with the answer. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 18,* 435-451.

Reder, L. M., & Schunn, C. D. (1996). Metacognition does not imply awareness: Strategy choice is governed by implicit learning and memory. In L. M. Reder (Ed.), *Implicit memory and metacognition* (pp. 45-78). Hillsdale, NJ: Erlbaum.

Rozin, P., Millman, L., & Nemeroff, C. (1986). Operation of the laws of sympathetic magic in disgust and other domains. *Journal of Personality and Social Psychology, 50,* 703-712.

Ryan, R. H., & Geiselman, R. E. (1991). Effects of biased information on the relationship between eyewitness confidence and accuracy. *Bulletin of the Psychonomic Society, 29, 79.*

Schunn, C. D., Reder, L. M., Nhouyvanisvong, A., Richards, D. R., 8c Stroffolino, P. J. (1997). To calculate or not to calculate: A source activation confusion (SAC) model of problem-familiarity's role in strategy selection. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23,* 329.

Schwartz, B. L. (1994). Sources of information in metamemory: Judgments of learning and feeling of knowing. *Psychonomic Bulletin and Review, 1,* 357-375.

Schwartz, B. L., & Metcalfe, J. (1992). Cue familiarity but not target retrievability enhances feeling-of-knowing judgment. *Journal of Experimental Psychology: Learning, Memory, and Cognition, IS,* 1074-1083.

Schwarz^ N. (1990). Feelings as information: Informational and motivational functions of affective states. In E. T. Higgins & R. M. Sorrentino (Eds.), *Handbook of motivation and cognition: Foundations of social behavior* (Vol. 2, pp. 528-561). New York: Guilford Press.

Schwarz, N., & Clore, G. L. (1983). Mood, misattribution, and judgments of well-being: Informative and directive functions of affective states. *Journal of Personality and Social Psychology, 45,* 513-523.

Schwarz, N., & Clore, G. L. (1996). Feelings of phenomenal experiences. In E. T. Higgins 5c A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp. 433-465). New York: Guilford Press.

Shaw, J. S., Ill (1996). Increases in eyewitness confidence resulting from postevent questioning. *Journal of Experimental Psychology: Applied, 2,* 126-146.

Shaw, R. J., & Craik, F. I. M. (1989). Age differences in predictions and performance on a cued recall task. *Psychology and Aging, 4,* 133-135.

Sherman, S. J., Cialdini, R. B., Schwartzman, D. E, & Reynolds, K. D. (1985). Imagining can heighten or lower the perceived likelihood of contracting a disease: The mediating effect of ease of imagery. *Personality and Social Psychology Bulletin, 11,* 118-127.

Sloman, S. (1996). The empirical case for two systems of reasoning. *Psychological Bulletin, 119,* 322.

Spielman, L. A., Pratto, F., & Bargh, J. (1988). Automatic affect: Are one's moods, attitudes, evaluations, and

emotions out of control? *American Behavioral Scientist, 31,* 296-311.

Strack, F. (1992). The different routes to social judgments: Experimental versus informational strategies. In I. I. Martin *8c* A. Tesser (Eds.), *The construction of social judgments* (pp. 249-275). Hillsdale, NJ: Erlbaum.

Strack, R, Erber, R., & Wicklund, R. (1982). Effects of salience and time pressure on ratings of social causality. *Journal of Experimental Social Psychology, 18,* 581-594.

Strack, E, & Hannover, B. (1996). Awareness of influence as a precondition for implementing correctional goals. In P. Gollwitzer & J. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behavior* (pp. 579-596). New York: Guilford Press.

Strack, R, Schwarz, N., Bless, H., Kubler, A., & Wanke, M. (1993). Awareness of the influence as a determinant of assimilation versus contrast. *European journal of Social Psychology, 23,* 53—62.

Turtle, J., & Yuille, J. C. (1994). Lost but not forgotten details: Repeated eyewitness recall leads to reminiscence but not hypermnesia. *Journal of Applied Psychology, 79,* 260-271.

Trope, Y. (1986). Identification and inferential processes in dispositional attribution. *Psychological Review, 93* 239-257.

Tversky, A., *&C* Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology, 4,* 207-232.

Wells, G. L, Ferguson, T. J., & Lindsay, R. C. L. (1981). The tractability of eyewitness confidence and its implications for triers of fact. *Journal of Applied Psychology, 66,* 688-696.

Whittlesea, B. W. A., Jacoby, L. L., &c Girard, K. (1990). Illusions of immediate memory: Evidence of an attributional basis of feelings of familiarity and perceptual quality. *Journal of Memory and Language, 19,* 716-732.

Wright, G., & Ayton, P. (Eds.). (1994). *Subjective probability.* Chichester, England: Wiley.

Zajonc, R. B. (1980). Feeling and thinking-. Preferences need no inferences. *American Psychologist, 35,* 151-175.

Zajonc, R. B. (1994). Evidence for nonconscious emotions. In P. Ekman & R. J. Davidson (Eds.), *The nature of emotion: Fundamental questions* (pp. 293-297). New York: Oxford University Press.

Zechmeister, E. B., & Shaughnessy, J. J. (1980). When you know that you know and when you think that you know but you don't. *Bulletin of the Psychonomic Society, 15,* 41-44.