
# Are We Frightened Because We Run Away? Some Evidence from Metacognitive Feelings

*Asher Koriat*

***Abstract***

*William James asked whether we run away because we are frightened or we are frightened because we run away. This issue is addressed here with regard to the relationship between metacognitive monitoring and metacognitive control. While discussions of metacognition generally assume that feelings of knowing drive controlled action, other discussions imply that such feelings are based on feedback from controlled action, and thus follow rather than precede behavior. Recent evidence is reported suggesting that when the investment of effort is goal driven, greater effort enhances metacognitive feelings, consistent with the "feelings-affect-behavior" hypothesis. When effort is data driven, however, metacognitive feelings decrease with increasing effort, suggesting that such feelings are based on feedback from behavior. Both types of causal effects can occur simultaneously.*

A long-lasting issue in theories of emotion concerns the cause-and-effect relation between subjective emotional feelings and bodily reactions. This issue is part of the general issue of the cause-and-effect relationship between subjective experience and behavior, which has attracted a heated philosophical debate. Within psychology, the dominant view has been that conscious awareness exerts a causal effect on controlled, voluntary action (Posner & Snyder, 1975; Schacter, 1989). This view has been reinforced by observations about the behavioral deficits of brain-damaged patients who suffer from different forms of loss of consciousness. With regard to emotional feelings, the layman's naive theory is that feelings drive behavior. William James (1884), however, challenged this view, proposing that subjective feelings rather than driving behavior are themselves caused by these behaviors. In his words:

> Common sense says, we lose our fortune, are sorry and weep; we meet a bear, are frightened and run; we are insulted by a rival, and angry and strike. The

> hypothesis here to be defended says that this order of sequence is incorrect and that the more rational statement is that we feel sorry because we cry, angry because we strike, afraid because we tremble. Without the bodily states following on the perception, the latter would be purely cognitive in form, pale, colourless, destitute of emotional warmth. We might then see the bear, and judge it best to run, receive the insult and deem it right to strike, but we could not actually^/ afraid or angry, (p. 190)

This quote assumes that bodily reactions are not simply "manifestations" or "expressions" of subjective feelings. Rather, subjective emotional feelings emerge as feedback from the bodily reactions. James' quote also antecedes the current distinction between experience-based and information-based judgments (Koriat & Levy-Sadot, 1999; Strack, 1992), as discussed below. We may then distinguish between two models of the cause-and-effect relation between emotional experience and behavior. In the first, emotional feelings are the *cause* of behavior: we run away because we are frightened. In the second, favored by William James, emotional feelings are the *effect*, they follow rather than precede behavior. In what follows I shall examine the issue raised by William James in the context of metacognition. The question to be addressed is whether metacognitive feelings drive controlled behavior or are themselves based on the feedback from such behavior. I shall examine evidence that has been seen to sup port each of these positions and will then discuss how the two positions may be combined within one conceptual framework. Although much of our discussion will concern noetic feelings (or "knowing feelings"; see Clore, 1992), I believe that the proposed conceptual framework applies to feelings in general.

## METACOGNITIVE MONITORING AND METACOGNITIVE CONTROL

The study of metacognition concerns the knowledge that people have about their cognition, the online monitoring of their learning and remembering processes and the strategic regulation of these processes in accordance with one's monitoring and with the constraints imposed by the task at hand (see Flavell, 1979; Koriat, 2005).

Metacognitive processes are ubiquitous in everyday life. When we read a text, we monitor our comprehension and when we feel that we do not understand the text, we read it again. Thus, the subjective monitoring of our comprehension seems to drive the decision whether to reread the text and how much attention to pay in reading it. Students preparing for an exam must also monitor the degree of mastery of the material online and decide whether they are ready for the exam or whether they should continue studying. They must



also decide how much time to allocate to each section based on their feelings of mastery and competence.

When we have a scheduled appointment, we often need to judge whether we have to write it in our calendar or take some other special precaution not to forget it. Sometimes we do not make a special effort to remember the appointment because we feel that we will remember it anyway, and consequently end up missing that appointment. Even when we do remember to perform a planned action, we have to remember that we already did it in order not to repeat the action once again. Deficiencies in output monitoring, as occur in old age, may result in a person taking a medicine more often than needed or in telling the same story again and again (Koriat, Ben-zur, & Sheffer, 1988).

Monitoring processes also take place during remembering. When we search our memory for a forgotten name, we often experience *& feeling of knowing* (FOK), and can even sense that the name is on the tip of the tongue and is about to emerge into consciousness. When the name does emerge into consciousness, we can generally feel that it is indeed the one for which we have been searching. Of course, when we have a feeling that we know the name, we will try harder to look for it than when we feel that we do not know it. However, feelings of knowing might sometimes deceive us (Koriat, 1998). Monitoring processes also occur in trying to report information from memory. A person on the witness stand, who is expected to tell the whole truth and nothing but the truth, must monitor the correctness of information that comes to mind before deciding whether to volunteer it or withhold it. Thus, subjective feelings of confidence might guide one's reporting behavior (Koriat & Goldsmith, 1996).

These examples illustrate the distinction between *monitoring* and *control* processes. Metacognitive monitoring refers to the subjective assessment of one's own cognitive processes and knowledge. For example, such assessments are reflected in the feelings of mastery, competence, or comprehension that we experience as we encode new material, in the feeling of knowing that we experience as we search our memory for an elusive name, and in the subjective confidence that we feel regarding the correctness of retrieved information. Metacognitive control, in turn, refers to the processes that regulate cognitive processes and behavior. Such processes include, for example, the choice of strategies for studying new material, the allocation of learning resources between these materials, the decision to continue searching for a solicited answer or quit, and the decision whether to volunteer that answer or not when the accuracy of the report is at stake.

As suggested by the above examples, the assumption underlying most of the discussions of metacognition is that metacognitive monitoring drives metacognitive control. This assumption agrees with common sense, like the assumption that we run away because we are afraid. That is, subjective feelings are assumed to exert a causal effect on behavior. As we shall see below, however, some of

the current discussions in metacognition also imply a cause-and-effect relation in the opposite direction, from behavior to subjective metacognitive feelings. In what follows, I first review evidence that has been taken to support the view that monitoring affects control. This evidence comes from studies that have focused on the presumed adaptive *function* of noetic feelings. Although most of that evidence is correlational, some is based on experimental manipulations. I then turn to findings and discussions suggesting that metacognitive feelings in fact follow rather than precede controlled action. Support for this claim comes from studies that have focused on the *bases* of noetic feelings. Thus, I will discuss the distinction between noetic feelings and noetic judgments, and then, focusing on noetic feelings, I will examine theories and findings that would seem to imply that these feelings are actually based on feedback from controlled actions. Finally, I will discuss evidence pertinent to the possibility that both types of cause-and-effect relations exist, and examine the conditions for the occurrence of each of them. The conclusion from this analysis is that the models considered by William James are not mutually exclusive, but actually occur simultaneously or sequentially in the course of information processing and behavior.

## THE CAUSAL INFLUENCE OF SUBJECTIVE EXPERIENCE ON BEHAVIOR

The recent upsurge of interest in metacognition derives in part from the conviction that subjective experience is not a mere epiphenomenon, but actually influences and guides information processing and behavior (Koriat, 2000; Nelson, 1996). A commonly held assumption among most researchers of metacognition is that the effective monitoring of one's own knowledge has direct consequences for efficient learning and remembering (Koriat & Goldsmith, 1996; Metcalfe & Kornell, 2003; Nelson & Dunlosky, 1991). Therefore, emphasis has been placed on the need to educate intuitive feelings and alleviate illusions of competence (Bjork, 1999; Hogarth, 2001). Indeed, the growing interest in memory accuracy, memory distortion, and false memory has turned attention to the critical contribution of qualitative aspects of memory experience in assisting source monitoring and reality monitoring (see Kelley & Jacoby, 1998; Koriat, Goldsmith, & Pansky, 2000; Mitchell & Johnson, 2000). A similar emphasis on the role of subjective feelings in guiding judgments and behavior can also be seen in current research in social psychology (Bless & Forgas, 2000; Schwarz & Clore, 2003) and decision-making (Slovic et al., 2002).

The assumption underlying this growing body of research and theorizing is that subjective feelings exert a causal role on behavior. This assumption underlies a great many studies in metacognition that have attempted to demonstrate



some of the presumed effects of monitoring on control. What is the evidence for these effects? Studies of monitoring processes during learning have assumed a causal chain: monitoring—control—performance. Consider a little study by Thiede, Anderson, and Therriault (2003) on reading comprehension. They asked participants to generate keywords that captured the essence of several texts. Participants who wrote keywords after a delay exhibited better monitoring accuracy than those who wrote keywords immediately after reading. The superior monitoring of the delay participants resulted in a more effective regulation of study, which in turn produced greater overall test performance (reading comprehension). Thus, the assumption is that the output of monitoring serves to guide the regulation of control processes, which can then affect learning and performance.

Other researchers have also provided evidence suggesting that judgments of learning (JOLs) affect the choice of which items to restudy and how much time to allocate to each item. Indeed, when learners are allowed to control the allocation of study time to different items, they tend to invest more time in items that are judged to be difficult to learn than in those that are judged to be easier to learn (for a review, see Son & Metcalfe, 2000). Dunlosky and Hertzog (1998; see also Thiede & Dunlosky, 1999) proposed a discrepancy-reduction model according to which learners monitor online the increase in encoding strength that occurs as more time is spent studying an item, and cease study when a desired level of strength has been reached. This level is preset according to various motivational factors and according to various constraints. Thus, monitoring is assumed to drive study in the same way that fear may be said to drive running away until a desired feeling of safety has been achieved.

There are conditions, however, in which learners invest more study time in the easier items. This occurs, for example, when learners are presented with an easy goal (e.g., to be able to recall only 10 out of 60 items; see Thiede & Dunlosky, 1999), or when the overall amount of time available for study is severely limited (Son & Metcalfe, 2000). To account for these findings, Thiede and Dunlosky proposed a hierarchy of control levels with a superordinate level that determines whether to concentrate on the easier or on the more difficult items. Once a strategic decision has been reached, the online regulation of study time is then delegated to a subordinate level in which the allocation of study time is dictated by the online monitoring of degree of mastery.

Feeling-of-knowing (FOK) judgments made during recall attempts have been assumed also to affect the effort invested in trying to retrieve a solicited item from memory (e.g., Nelson & Narens, 1990). Consider a person who attempts to retrieve a name or a word from memory. Even when recall fails, he may still experience a feeling of knowing and may even have a tip-of-the-tongue (TOT) experience (see Schwartz, 2002). When FOK judgments are high, or when a person is in a TOT state, he is likely to search longer for a memory target

before giving up than when FOK is low (Barnes et al, 1999; Gruneberg, Monk, & Sykes, 1977; Schwartz, 2001). Once again, the assumption is that the feeling that one knows or does not know the answer to a question exerts a causal effect on behavior. Reder (1987), in fact, proposed that preliminary FOK judgments not only affect search time, but also influence the choice of strategy for answering a question. Importantly, when FOK judgments are misled by irrelevant factors they also misguide the choice of strategy.

In a similar manner subjective confidence judgments have been assumed to influence controlled behavior regardless of their accuracy. The more confident people are in the correctness of a certain statement, the more likely they are to commit themselves to it. For example, people are willing to stake money on the correctness of their answer when they are confident in it even when their confidence is entirely unwarranted (Fischhoff, Slovic, & Lichtenstein, 1977).

Koriat and Goldsmith (1994, 1996) proposed that an eyewitness who is sworn to tell the truth and nothing but the truth, must monitor the subjective likelihood that a memory response that comes to mind is correct. On the basis of his confidence in the correctness of a candidate response, he then decides whether to volunteer it or not. Thus, confidence is assumed to affect memory reporting. Indeed, the correlation between confidence and volunteering was found to be almost perfect, suggesting that people take for granted the validity of their subjective intuitive feelings. In fact, rememberers have been found to rely heavily on their subjective confidence even when it was not diagnostic of accuracy (Koriat & Goldsmith, 1996). Confidence judgments also influence the "grain size" of the memory report. When a person is not entirely certain about a piece of information that comes to mind, he might choose to report it at a coarse level rather than at a precise level, thus sacrificing informativeness (degree of precision) for accuracy (Goldsmith, Koriat, & Weinberg-Eliezer, 2002). To the extent that monitoring is accurate, allowing participants freedom to control their memory reporting enhances the accuracy of their reports.

In sum, much of the work on metacognitive control is predicated on the assumption that monitoring drives and guides information processing and behavior. This work, then, implies a causal influence of subjective experience on behavior. The assumption underlying that work is that control processes are goal driven; they capitalize on the general validity of noetic feeling to improve the effectiveness of learning and remembering.

We turn now to evidence that supports the "control affects monitoring" hypothesis. This evidence comes from studies that have focused on the question: how do we know that we know? The studies that have attempted to elucidate the *bases of the* metacognitive feelings underlying JOLs, FOK judgments, and subjective confidence seem to suggest that such feelings are based on the feedback from behavior, as William James suggested for emotional feelings.



## EXPERIENCE-BASED AND INFORMATION-BASED JUDGMENTS

In discussing the basis of metacognitive judgments, a distinction must be drawn between two types of processes leading to such judgments. Metacognitive judgments may be based either on information retrieved from memory, or may rely directly on sheer subjective feelings. This distinction follows the general distinction which is currently in vogue between two modes of thought underlying judgments, decisions, and behavior (see Chaiken & Trope, 1999; Epstein & Pacini, 1999; Kahneman, 2003; Strack, 1992). In the context of metacognition, information-based (or theory-based) judgments are based on a deliberate and explicit inferential process, in which the person consults his or her long-term memory for pertinent information, and uses that information as a basis for an analytic deduction. Experience-based (or affect-based) judgments, in contrast, are based on sheer subjective feelings. Koriat and Levy-Sadot (1999) used the term *noetic judgments* (or judgments of knowing) to designate information-based judgments, and *noetic feelings* (or feeling of knowing) to designate the subjective experience that underlies experience-based judgments. Consider, for example, the monitoring of one's knowledge during study. A person may judge that they are ready for the exam on the basis of an explicit inference: "I have read the chapter so many times, I am sure that I will succeed in the exam." However, they may also base their judgment on a sheer noetic feeling - an immediate sense of mastery and competence. Similarly, when learners are asked to make JOLs regarding the likelihood of recalling the studied items at test, they may base their judgments on inferences from beliefs or theories; for example, the belief that one has a bad memory, or that an item that was presented three times is likely to be better recalled than one that was presented only once. However, JOLs may also be based on a sheer feeling of competence (Koriat, 1997; Koriat et al., 2004). In that case, the person uses that feeling as a basis for recall predictions.

In like manner, when a person is required to recall the answer to a general-information question, he may provide a "feeling-of-knowing" judgment based on a deliberate, educated inference about the plausibility that the solicited answer will be subsequently recalled or recognized. Such a noetic judgment would be based on domain-specific memories and beliefs (see Nelson, Gerler, & Narens, 1984), and may sometimes take the form "I *ought* to know the answer," rather than "I feel that I know the answer."

In other cases, FOK judgments may be based on a sheer noetic feeling as occurs, for example, in the TOT state. Here the judgment that one knows the elusive word or name is based on a kind of gut feeling rather than on a deliberate, analytic inference based on retrieved beliefs and memories. The

feeling has the phenomenal quality of self-evidence (see Epstein & Pacini, 1999a and the person generally has little access to evidence that may question the validity of that feeling.

## THE BASIS OF NOETIC FEELINGS

Discussions of the basis of noetic feelings are relevant to the question whether such feelings precede controlled processes or actually follow them. Noetic feelings are immediately given and have the quality of direct perception. This phenomenal quality of noetic feelings has motivated trace-access theories (see Koriat, 1993; Schwartz, 1994), according to which such feelings are based on direct access to memory traces. For example, JOLs elicited during learning have been assumed to reflect the monitoring of the strength of the memory trace that is formed during learning (Cohen, Sandier, & Keglevich, 1991). Thus, in studying a list of words, a learner is assumed to detect directly the increase in encoding strength that occurs as more time is spent studying each word. In fact, he or she can then stop studying when a desired strength has been reached. This direct access model can also explain why JOLs are generally accurate. If JOLs monitor encoding strength, they should be accurate in predicting future recall because recall probability should also increase with increasing memory strength.

In a similar manner, FOK judgments have been assumed to be based on direct access to memory traces. Hart (1965), for example, proposed that FOK judgments are based on accessing a special memory-monitoring module that can directly inspect the information stored in memory to determine whether the solicited target is stored there. Thus, whenever a person is required to recall a target, the monitoring module is activated to make sure that the target is present in store before attempting to retrieve it. This model too can easily explain the accuracy of FOK judgments.

In contrast to the direct access models, recent discussions of the bases of noetic feelings subscribe to a cue-utilization view, according to which such feelings are also based on inferences from a variety of cues (e.g., Begg et al., 1989; Benjamin & Bjork, 1996; Koriat, 1993, 1997). However, the type of cues on which they rely, as well as the nature of the inferential process, differ from those underlying noetic judgments. Thus, noetic feelings are assumed to rely on internal, mnemonic cues that derive from the online processes involved in learning and remembering rather than on the content of beliefs and information retrieved from long-term memory. Indeed, evidence has accumulated suggesting that JOLs are based on the ease with which studied items are processed during encoding (Begg et al., 1989; Koriat, 1997; Matvey, Dunlosky, & Guttentag, 2001), or on the ease with which they are retrieved during study (Koriat & Ma'ayan, 2005; Nelson, Narens, & Dunlosky, 2004). Begg et al. (1989),



for example, reported results suggesting that the effects of several attributes of words (e.g., concreteness-abstractness) on JOLs are mediated by their effects on ease of processing. Matvey, Dunlosky, and Guttentag (2001) found that JOLs increased with increasing speed of generating the targets to the cues at study, and Hertzog et al. (2003) also found that JOLs increased with the success and speed of forming an interactive image between the cue and the target. More direct evidence regarding the effects of retrieval fluency on JOLs was reported by Benjamin, Bjork, and Schwartz (1998): the faster it took participants to retrieve an answer to a question, the higher was their estimate that they would be able to recall that answer at a later time, although in reality the opposite was the case. Koriat and Ma'ayan (2005) and Nelson, Narens, and Dunlosky (2004) observed that when learners were required to retrieve the target just before making JOLs, JOLs increased with the probability of recalling the target and decreased with the latency of retrieving it.

In a similar manner, when recall of a solicited target fails, FOK judgments have been shown to rely on the familiarity of the cue that is used to probe memory (Metcalfe, Schwartz, & Joaquim, 1993; Reder & Ritter, 1992; Reder & Schunn, 1996), on the amount of partial information retrieved about the target, and on the ease with which that information comes to mind (Koriat, 1993, 1995). Importantly, according to Koriat's (1993) accessibility model, both correct and incorrect partial clues about the target contribute to the enhancement of FOK judgments.

Confidence judgments in the correctness of one's retrieved information have also been claimed to rely on the ease with which that information is retrieved. Indeed, several researchers have documented an inverse relationship between confidence judgments and the latency of selecting an answer from among distractors or the latency of recalling an item from memory (e.g., Costermans, Lories, & Ansay, 1992; Nelson & Narens, 1990; Robinson, Johnson, & Herndon, 1997). Kelley and Lindsay (1993), who used priming to speed up the emergence of an answer, found confidence judgments to increase accordingly. This was true for both correct and incorrect answers. However, it is generally the case that correct answers are associated with shorter latencies than incorrect answers, so that latency of responding is generally a valid cue for the correctness of the answer.

In sum, like noetic judgments, noetic feelings also have been assumed to be based on an inference. However, an important difference between noetic feelings and noetic judgments is that the latter require consulting the content of beliefs and knowledge stored in long-term memory, a process that generally takes time and effort. The former, in contrast, are based on the quality of information processing in the here and now. Such cues as encoding fluency, familiarity, amount of partial information accessed, and the ease with which information comes to mind, convey information about the quality of information processing,

and can be detected online, with little effort, because they are the by-products of the normal processes of learning and remembering.

To illustrate this difference, consider the study of Koriat et al. (2004). That study was based on the assumption that if JOLs monitor the online processing of the items during study, they should be indifferent to the expected time of testing, because the processing fluency of an item will be the same whether testing is expected after a week or immediately after study. Indeed, when participants made JOLs for tests that were expected immediately after study, a day after study, or a week after study, JOLs were entirely indifferent to the expected retention interval, although actual recall exhibited a typical forgetting function. The result was such that JOLs matched actual recall very closely for immediate testing, whereas for a week's delay, participants predicted over 50 percent recall whereas actual recall was less than 20 percent.

The inference underlying noetic feelings is also assumed to differ in quality from the type of inference underlying noetic judgments. As indicated earlier, noetic judgments entail deliberate, analytic deductions that rely on beliefs and memories. In contrast, noetic feelings are mediated by the implicit application of nonanalytic heuristics (see Jacoby & Brooks, 1984; Koriat & Levy-Sadot, 1999). These heuristics operate below full consciousness to influence and shape subjective experience itself. Once a noetic feeling has been formed, it can then serve as the immediate basis for metacognitive judgments.

Indeed, the work of Jacoby, Kelley, and their associates on the fluency heuristic (see Kelley & Jacoby, 1998), as well as that of Whittlesea (2002, 2004), provided ample evidence for the claim that subjective experience can be shaped by unconscious inferential processes. Thus, fluent processing of a stimulus, when it is enhanced by advance priming, may be attributed to the past, resulting in the feeling of familiarity (Jacoby & Dallas, 1981; Jacoby, Kelley, & Dywan, 1989). Fluent processing may also be attributed to characteristics of the stimulus, resulting in such perceptual experiences as enhanced brightness or clarity (for a review, see Kelley & Rhodes, 2002).

## THE CAUSAL INFLUENCE OF BEHAVIOR ON SUBJECTIVE EXPERIENCE

Examination of the mnemonic cues that have been assumed to shape noetic feelings indicates that they all reside in the feedback from control processes, implying that monitoring *follows* control rather than vice versa. Consider, as an example, Koriat's accessibility model of FOK. This model departs from the classical, trace-access model proposed by Hart (1965). As noted earlier, Hart's model assumes that monitoring precedes and guides control (see also Barnes et al., 1999): when a person is asked to recall a memory target, he or



she first consults the monitoring mechanism in order to ascertain that the target is indeed available in memory before attempting to retrieve it. The advantage of such a monitoring mechanism, according to Hart, is that it can save the time and effort looking for a target that is not in store.

Koriat's accessibility model, in contrast, actually places control ahead of monitoring. According to that model, it is by attempting to search for a solicited target that one can judge whether the target is "there" and worth continuing to search for. The cues for FOK are assumed to reside in the products of the retrieval process itself. Whenever we search our memory for a name or a word, many clues often come to mind, including fragments of the target, semantic attributes, episodic information, and a variety of activations emanating from other sources. Although such clues may not be articulate enough to support an analytic inference, they can still act in concert to produce the subjective feeling that the target is "there." Indeed, FOK judgments have been found to increase with the amount of partial information retrieved about the target and with the ease with which that information is retrieved (Koriat, 1993, 1995). Such cues, of course, are not available prior to attempted retrieval.

Because monitoring follows retrieval, if retrieval goes wrong, so will monitoring. Thus, retrieval may be fooled by a variety of clues deriving from many sources, such as neighboring targets, priming, misleading postevent information, and so on. In that case monitoring too will go wrong. Indeed, because of the nonanalytic nature of the accessibility heuristic, both correct and wrong partial information have been found to enhance FOK judgments. Wrong partial clues can readily lead to faulty intuitions and unwarranted positive FOK (Koriat, 1994).

Consider next the claim that confidence judgments in an answer are based in part on the latency of recalling or selecting that answer or that solution: the more effort and the longer the deliberation needed to reach an answer the lower will be the confidence in that answer (e.g., Barnes et al., 1999; Costermans, Lories, & Ansay, 1992; Kelley & Lindsay, 1993; Nelson & Narens, 1990; Robinson, Johnson, & Herndon, 1997). This claim implies that confidence judgments are based on the feedback from controlled action: When faced with a problem, the person spends as much time and effort as is needed to reach a solution. Once a solution has been produced, confidence is based on a retrospective review of the process that has led to the solution, particularly the amount of effort invested. Thus, again the assumption is that monitoring follows control and is based on the feedback from control processes.

In the same way, the idea that JOLs during learning are based on encoding fluency or retrieval fluency also implies that it is by attempting to commit an item to memory or by attempting to retrieve it that one can appreciate the likelihood of recalling that item in the future. Presumably, the mnemonic cues gained from the learning process help to shape a feeling of competence, and that feeling can then be used as a basis for recall predictions.

In conclusion, examination of the mnemonic cues that have been assumed to shape noetic feelings suggest that these cues reside in the feedback from the control processes engaged in learning and remembering. Reviewing the work on the bases of metacognitive feelings, Koriat and Levy-Sadot (1999) concluded that the cues for noetic feelings lie in structural aspects of the information-processing system. It is as if the cognitive system inspects its own functioning as it attempts to carry out its information-processing chores, and uses the product of that inspection as a basis for metacognitive feelings.

An important implication of this view is that metacognitive judgments are not based on specialized modules that are dedicated to monitoring. Rather, monitoring occurs as a by-product of the normal processes of learning and remembering. People carry out their routine cognitive processes designed to achieve certain goals, and cues stemming from these processes (fluency of processing, effort, ease of access, etc.) are used to shape noetic feelings. Thus, the process underlying noetic feelings can be said to be parasitic on the normal processes of learning and remembering (Koriat, 1993). This idea seems to agree with the spirit of William James' position: fear is simply a by-product of running away from danger.

## THE RECIPROCAL EFFECTS BETWEEN SUBJECTIVE EXPERIENCE AND BEHAVIOR

To summarize the foregoing discussion, the work in metacognition reveals ambivalence regarding the cause-and-effect relation between monitoring and control or, more generally, between subjective experience and behavior. When researchers focus on the presumed *adaptive function* of noetic feelings, they tend to endorse the view that monitoring affects control (Nelson & Leonesio, 1988). In contrast, when they focus on the *bases* of noetic feelings, their theorizing would seem to imply that noetic feelings are actually based on the feedback from controlled operations, and thus follow rather than precede behavior.

How can these two meta-dieoretical positions be reconciled? A recent study by Koriat, Ma'ayan and Nussinson (2006) attempted to do just that. First, they attempted to specify the conditions under which monitoring can be said to affect control and those in which monitoring would seem to rely on the feedback from control operations; and second, they attempted to examine how the two types of cause-and-effect relations may be combined in the course of information processing and behavior.

The logic underlying Koriat et al.'s investigation can be illustrated with regard to emotional behavior. Consider the question addressed by William James: do we run away because we are frightened or are we frightened because we run away? Because the feeling of fear and the action of running away generally



go hand in hand, one way to distinguish cause from effect is to consider the strength of each of the two variables. If it is the feeling of fear that causes one to run away from danger, then the faster one runs away, the less fear one should experience after running. In contrast, if it is running away that produces a feeling of fear, then the faster one runs away the *more* fear one should experience. Thus, the correlation between the speed of running away and the intensity of fear experienced afterwards cari disclose the cause-and-effect relation between emotional feelings and behavior.

Applying this logic to metacognition, Koriat et al. (2006) considered the relationship between the amount of effort invested in a task (control) and the noetic feelings experienced after performing that task (monitoring). If monitoring drives control, noetic feelings should *increase* with the effort invested in the task. Thus, for example, the more time and effort invested in studying a certain material, the stronger should be the feeling of competence experienced after study. In contrast, if monitoring is based on the feedback from control operations, then noetic feelings should *decrease* with the effort invested in the task. For example, JOLs following study should decrease with increased study time and effort.

Koriat et al. (2006) proposed that a positive relationship between control effort and noetic feelings should be obtained when the regulation of control effort is *goal driven*, that is, when that regulation is used as a strategic tool for improving performance and achieving certain objectives. For example, a student may place a premium on a particular exam, strategically investing more effort in studying for that exam than he or she would do otherwise. In that case, the added effort would be expected to instill a *stronger* sense of competence. Similarly, when different incentives are awarded to the remembering of different items in a list (e.g., Castel et al., 2002; Dunlosky & Thiede, 1998), we should expect the high-incentive items to draw more study time and in parallel to result in higher JOLs following study.

In contrast, when the regulation of control effort is *data driven*, dictated by die nature of the task itself, we should expect a negative correlation between control effort and noetic feelings. In that case, effortless, fluent processing would serve as a mnemonic cue that instills a sense of competence. Thus, a student who spends more time studying a particular segment of the material because that segment is intrinsically more difficult than others, would be expected to feel *less* confident about the future recall of that segment, in comparison with other segments.

This conceptual framework received support in a number of experiments involving the self-paced study of a list of paired associates. Participants were allowed to control the amount of time spent on each item, and before moving to the next item they made JOLs on a 0-100 percent scale, reflecting the likelihood that they would be able to recall the target word in response to the cue word at test. Consistent with previous findings, participants spent more time studying the more difficult items than the easier items. The standard

explanation of this finding is that the differential allocation of study time reflects a strategic attempt to compensate for the greater difficulty of the more difficult items. Thus, according to the discrepancy-reduction model (e.g., Dunlosky & Hertzog, 1998), in self-paced learning learners continuously monitor the online increase in encoding strength that occurs as more time is spent studying an item, and cease study when a desired level of strength has been reached. In this model, the allocation of study time is used as a strategic tool to achieve certain goals, and is guided by the online monitoring of degree of mastery.

The discrepancy-reduction model, however, encounters serious difficulties. Not only was the greater investment of study time found to be useless in terms of enhancing the recall of the difficult items, but participants continued to assign lower JOLs to the difficult items. Thus, when participants studied the same list of paired associates under self-paced conditions, they continued to invest more study time in the more difficult items even in the fourth presentation, and in parallel continued to admit that the difficult items were less likely to be recalled. Why do learners stick to a maladaptive strategy if they are aware of its futility?

Koriat et al. (2005) proposed that in self-paced learning, the differential allocation of study time does not reflect a premeditated policy to invest more study effort in difficult items with the intention either to compensate for their *a priori* difficulty or to achieve a predetermined level of mastery. Rather, the allocation of study time is generally *data driven:* learners spend as much time as is required for a particular item. The amount of time and effort invested in attempting to commit the item to memory is then used as a cue for JOLs under the heuristic that the more time invested in studying an item the less likely it is to be later recalled. Therefore, monitoring can be said to *follow* control rather than precede it. It is by investing a greater amount and effort studying an item that a learner "knows" that the item will be difficult to recall.

If study effort is data driven then a *negative* correlation should be expected between study time and JOLs. Indeed, in several experiments (Koriat et al., 2005) JOLs were found to *decrease* with the amount of study time invested in each item. This negative correlation is analogous to the idea that the faster one runs away from a bear the more fear one should feel. In parallel to the effects of study time on JOLs, recall was also found to *decrease* with study time, supporting the validity of the memorizing effort heuristic. These results are consistent with the idea that monitoring *follows* control or, more generally, that subjective experience is based on the feedback from controlled behavior.

In contrast to the negative correlation between study time and JOLs, a positive correlation is expected when study time is *goal driven.* In fact, students know that their success in a forthcoming exam should increase with the amount of time spent preparing for it. To examine the relationship between JOLs and study time when study time is goal driven, Koriat et al. (2005) manipulated the incentive associated with the recall of different items in the list. Participants



were presented with the same learning task as before except that they were instructed that they would win 1 point for recalling some of the items and 3 points for recalling the other items. The incentive associated with each item $_{w}$as announced just prior to its presentation. This differential manipulation of incentive resulted in a *positive* correlation between JOLs and study time. Participants spent more time studying the high-incentive items (5.22 s per item) than the low-incentive items (4.33 s) and, in parallel, assigned higher JOLs to the high-incentive items (61.4 percent) than to the low-incentive items (56.6 percent). This positive correlation is the postulated signature of goal-driven metacognitive regulation: die greater the effort invested, the stronger the ensuing feeling of competence. This is analogous to idea that the faster one runs away the more secure one should feel.

However, the presence of a positive correlation between study time and JOLs did not preclude the occurrence of a negative correlation for each level of incentive. Thus, when the results were analyzed separately for the low-incentive and high-incentive items, JOLs were found to *decrease* with study time. The correlation between study time and JOLs averaged —.45 for the low-incentive items, and —.56 for the high-incentive items, suggesting that the allocation of study time between same-incentive items was data driven.

These results suggest that the two models considered by William James with respect to the cause-and-effect relation between emotional feelings and emotional behavior are not mutually exclusive. In fact, as just noted, evidence for both models was found within the same situation. Whereas the effects of goal-driven regulation are consistent with the feeling-affects-behavior model, the data-driven regulation is consistent with the behavior-affects-feeling model.

The above results suggest that the two models can coexist within the same situation. However, they can also occur sequentially. For example, even if an emotional feeling occurs as feedback from an emotional behavior (behavior-affects-feeling), it can be expected, in turn, to exert its own effects on subsequent behaviors (feeling-affects-behavior). This possibility is suggested by Schachter and Singer's (1962) work. They showed that the arousal produced by injected epinephrine could be experienced either as anger or happiness depending on the person's attributions. Thus, in agreement with the James-Lange theory, emotional feelings are assumed to emerge in response to bodily changes. However, once an emotional feeling has been produced, that feeling can then cause specific actions (see also Carver & Scheier, 1990).

In a similar manner, we may imagine a sequence of events such that monitoring drives control, and feedback from control operations then produces monitoring output, which in turn drives control, and so on. Evidence for such sequencing is provided by Koriat and Levy-Sadot (2001), who suggested that two heuristics, cue familiarity and accessibility, exert their influence on FOK

in a cascaded manner: at an early stage of searching for a memory target FOK judgments are primarily determined by the familiarity of the cue that probes memory. When cue familiarity is high, it can drive the search for the target, and then the accessibility of pertinent clues about the target may contribute further to FOK judgments. Indeed, the effects of accessibility on FOK judgments were found to be stronger when cue familiarity was high than when it was low. This pattern suggests that the familiarity of the cue, perhaps resulting from greater processing fluency, can motivate memory search (i.e. monitoring affects control), and the feedback from that search can then affect later FOK judgments (i.e., control affects monitoring).

## CONCLUDING REMARKS

The recent advances in metacognition provide opportunities for scratching the surface of some old standing meta-theoretical issues regarding the role of subjective experience in behavior. One such issue concerns the function of subjective experience (see Koriat, 2000). Another issue touched upon in this chapter concerns the cause-and-effect relation between subjective experience and behavior. The research and theorizing in metacognition discloses ambivalence regarding this issue. This ambivalence, however, may actually suggest that the two options considered by William James in the quote at the beginning of this chapter are not mutually exclusive. We propose that some of the dynamics discussed with regard to noetic feelings also hold true for other types of feelings. To the extent that our running away from a bear is entirely data driven, dictated by the speed (or size) of the bear, then the faster we run away, the more fear we should experience, as would be predicted by William James' model. However, if we make a goal-driven effort that goes beyond that called for by the stimulus situation, then the extra effort invested in running away should contribute towards reducing our feeling of fear.

### AUTHOR NOTES

The preparation of this chapter was supported by the Israel Science Foundation (grant No. 928/00) and by a grant from the German Federal Ministry of Education and Research (BMBF) within the framework of German-Israeli Project Cooperation (DIP). I am grateful to Hilit Ma'ayan and Ravit Nussinson (Levy-Sadot) who made significant contributions to the ideas presented in this chapter. Correspondence concerning this chapter should be addressed to Asher Koriat, Department of Psychology, University of Haifa, Haifa, Israel. Email: akoriat@research.haifa.ac.il.



### REFERENCES

Barnes, A. E., Nelson, T. O., Dunlosky, J., Mazzoni, G., & Narens, L. (1999). An integrative system of metamemory components involved in retrieval. In D. Gopher & A Koriat (Eds.), *Attention and performance XVII - Cognitive regulation of performance: Interaction of theory and application* (pp. 287-313). Cambridge, MA: MIT Press.

Begg, I., Duft, S., Lalonde, P., Melnick, R., & Sanvito, J. (1989). Memory predictions are based on ease of processing. *Journal of Memory and Language, 28,* 610-632.

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

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

Bjork, R. A. (1999). Assessing our own competence: Heuristics and illusions. In D. Gopher & A. Koriat (Eds.), *Attention and performance XVII- Cognitive regulation of performance: Interaction of theory and application* (pp. 435-459). Cambridge, MA: MIT Press.

Bless, H. & Forgas, J. P. (Eds.) (2000). *The message within: The role of subjective experience in social cognition and behavior*. Philadelphia: Psychology Press.

Carver, C. S. & Scheier, M. F. (1990). Origins and functions of positive and negative affect: A control-process view. *Psychological Review, 97,* 19-35.

Castel, A. D., Benjamin, A. S., Craik, F. I. M., & Watkins, M. J. (2002). The effects of aging on selectivity and control in short-term recall. *Memory & Cognition, 30,* 1078—1085.

Chaiken, S. & Trope, Y. (Eds.) (1999). *Dual-process theories in social psychology:* New York: Guilford Press.

Clore, G. L. (1992). Cognitive phenomenology: Feelings and the construction of judgment. In A. Tesser & L. L. Martin (Eds.), 77K *construction of social judgments* (pp. 133-163). 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. & Hertzog, C. (1998). Training programs to improve learning in later adulthood: Helping older adults educate themselves. In D. J. Hacker (Ed.), *Metacognition in educational theory and practice* (pp. 249-275). Mahwah, NJ: Erlbaum.

Dunlosky, J. & Thiede, K. W. (1998). What makes people study more? An evaluation of factors that affect self-paced study. *Acta Psychologica, 98,* 37-56.

Epstein, S. & Pacini, R. (1999). Some basic issues regarding dual-process theories from the perspective of cognitive-experiential self-theory. In S. Chaiken & Y. Trope (Eds.), *Dual-process theories in social psychology* (pp. 462-482). New York: Guilford Press.

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

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34,* 906—911.

Goldsmith, M., Koriat, A., & Weinberg-Eliezer, A. (2002). The strategic regulation of grain size in memory reporting. *Journal of Experimental Psychology: General, 131,* 73-95

Gruneberg, M. M., Monks, J., & Sykes, R. N. (1977). Some methodological problems with feelings of knowing studies. *Acta Psychologica, 41,* 365-371.

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

Hertzog, C., Dunlosky, J., Robinson, A. E., & Kidder, D. P. (2003). Encoding fluency is a cue used for judgments about learning. *Journal of Experimental Psychology: Learning Memory, and Cognition, 29,* 22—34.

Hogarth, R. M. (2001). *Educating intuition*. Chicago: University of Chicago Press.

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

Jacoby, L. L. & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General, 110,* 306-340.

Jacoby, L. L., Kelley, C. M., & Dywan, J. (1989). Memory attributions. In H. L. Roediger III & F. I. M. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tulving* (pp. 391-422). Hillsdale, NJ: Erlbaum. James, W. (1884). What is an emotion? *Mind, 9,* 188-205.

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist, 58,* 697-720. Kelley, C. M. &Jacoby, L. L. (1998). Subjective reports and process dissociation: Fluency, knowing, and feeling. *Acta Psychologica, 98,* 127-140.

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,* 1-24.

Kelley, C. M. & Rhodes, M. G. (2002). Making sense and nonsense of experience: 1 Attributions in memory and judgment. In B. H. Ross (Ed.), *Psychology of learning and motivation: Advances in theory and research* (Vol. 41, pp. 293-320). New York: Academic Press.

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 & A. 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. (1998). Metamemory: The feeling of knowing and its vagaries. In M. Sabourin, I F. I. M. Craik, & M. Robert (Eds.), *Advances in psychological science* (Vol. 2, pp. 461-469). Hove, UK: Psychology Press.

Koriat, A. (2000). The feeling of knowing: Some metatheoretical implications for consciousness and control. *Consciousness and Cognition, 9,* 149-171.



Koriat, A. (2005). Metacognition and consciousness. In P. D. Zelazo, M. Moscovitch, & E Thompson (Eds.), *Cambridge handbook of consciousness.* New York: Cambridge University Press.

Koriat, A., Ben-zur, H., & Sheffer, D. (1988). Telling the same story twice: Output monitoring and age. *Journal of Memory and Language, 27,* 23-39.

Koriat, A., Bjork, R. A., Sheffer, L., & Bar, S. K. (2004). Predicting one's own forgetting: The role of experience-based and theory-based processes. *Journal of Experimental Psychology: General, 133,* 643-656.

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., Goldsmith, M., & Pansky, A. (2000). Toward a psychology of memory accuracy. *Annual Review of Psychology, 51,* 481-537.

Koriat, A. & Levy-Sadot, R. (1999). Processes underlying metacognitive judgments: Information-based and experience-based monitoring of one's own knowledge. In S. Chaiken & Y. Trope (Eds.), *Dual process theories in social psychology* (pp. 483-502). New York: Guilford Press.

Koriat, A. & Levy-Sadot, R. (2001). The combined contributions of the cue-familiarity and accessibility heuristics to feelings of knowing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 27,* 34—53.

Koriat, A. & Ma'ayan, H. (2005). The effects of encoding fluency and retrieval fluency on judgments of learning. *Journal of Memory and Language, 52,* 478-492.

Koriat, A., Ma'ayan, H., & Nussinson, R. (2006). The intricate relationships between monitoring and control in metacognition: Lessons for the cause-and-effect relation between subjective experience and behavior. *Journal of Experimental Psychology: General,* in press.

Matvey, G., Dunlosky, J., & Guttentag, R. (2001). Fluency of retrieval at study affects judgments of learning (JOLs): An analytic or nonanalytic basis for JOLs? *Memory & Cognition, 29,* 222-233.

Metcalfe, J. & Kornell, N. (2003). The dynamics of learning and allocation of study time to a region of proximal learning. *Journal of Experimental Psychology: General, 132,* 530-542.

Metcalfe, J., Schwartz, B. L., & Joaquim, S. G. (1993). The cue-familiarity heuristic in metacognition. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19,* 851-864.

Mitchell, K. J. & Johnson, M. K. (2000). Source monitoring: Attributing mental experiences. In F. I. M. Craik & E. Tulving (Eds.), *The Oxford handbook of memory* (pp. 179-195). Oxford: Oxford University Press.

Nelson, T. O. (1996). Gamma is a measure of the accuracy of predicting performance on one item relative to another item, not of the absolute performance on an individual item. *Applied Cognitive Psychology, 10,* 257-260.

Nelson, T. O. & Dunlosky, J. (1991). When people's judgments of learning (JOLs) are extremely accurate at predicting subsequent recall: The "delayed-JOL effect." *Psychological Science, 2,* 267-270.

Nelson, T. O., Gerler, D., & Narens, L. (1984). Accuracy of feeling of knowing judgments 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. 123-125). San Diego: Academic Press.

Nelson, T. O., Narens, L., & Dunlosky, J. (2004). A revised methodology for research on metamemory: Pre-judgmcnt recall and monitoring (PRAM). *Psychological Methods, 9,* 53-69.

Posner, M. I. & Snyder, C. R. R. (1975). Attention and cognitive control. In R. L. Solso (Ed.), *Information processing and cognition: The Loyola symposium* (pp. 55-85). Hillsdale, NJ: Erlbaum.

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

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—77). Mahwah, NJ: Erlbaum.

Robinson, M. D., Johnson, J. T., & Herndon, F. (1997). Reaction time and assessments of cognitive effort as predictors of eyewitness memory accuracy and confidence. *Journal of Applied Psychology, 82,* 416-425.

Schachter, S. & Singer, J. (1962). Cognitive, social, and physiological determinants of emotional state. *Psychological Review, 69,* 379-399.

Schacter, D. L. (1989). On the relations between memory and consciousness: Dissociable interactions and conscious experience. In H. L. Roediger & F. I. M. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tubing* (pp. 355-389). Hillsdale, NJ: Erlbaum.

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

Schwartz, B. L. (2001). The relation of tip-of-the-tongue states and retrieval time. *Memory & Cognition, 29,* 117-126. Schwartz, B. L. (2002). *Tip-of-the-tongue states: Phenomenology, mechanism, and lexical retrieval.* Mahwah, NJ: Erlbaum.

Schwarz, N. & Clore, G. L. (2003). Mood as information: 20 years later. *Psychological Inquiry, 14,* 296-303.

Slovic, P., Finucane, M., Peters, E., & MacGregor, D. G. (2002). The affect heuristic. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: Tlie psychology of intuitive judgment* (pp. 397-420). New York: Cambridge University Press.

Son, L. K. & Metcalfe, J. (2000). Metacognitive and control strategies in study-time allocation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26,* 204-221.



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

Thiede, K. W., Anderson, M. C. M., & Therriault, D. (2003). Accuracy of metacognitive monitoring affects learning *of texts. Journal of Educational Psychology, 95,* 66-73.

Thiede, K. W. & Dunlosky, J. (1999). Toward a general model of self-regulated study: An analysis of selection of items for study and sell-paced study time. *Journal of Experimental Psychology: Learning, Memoiy, and Cognition, 25,* 1024-1037.

Whittlesea, B. W. A. (2002). Two routes to remembering (and another to remembering not). *Journal of Experimental Psychology: General, 131,* 325-348.

Whittlesea, B. W. A. (2004). The perception of integrality: Remembering through the validation of expectation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30,* 891-908.

**New Perspectives in Cognitive Psychology**

New Perspectives in Cognitive Psychology is a series of works that explore the latest research, current issues, and hot topics in cognitive psychology. With a balance of research, applications, and theoretical interpretations, each book will educate and ignite research and ideas on important topics.

*Memory and Emotion: Interdisciplinary Perspectives*
Edited by Bob Uttl, Nobuo Ohta, and Amy L. Siegenthaler

*Involuntary Memory: New Perspectives in Memory Research*
Edited by John Mace

# MEMORY AND EMOTION

## INTERDISCIPLINARY PERSPECTIVES

**EDITED BY Bob Uttl, IMobuo Ohta, and Amy L. Siegenthaler**

Blackwell Publishing

BLACKWELL PUBLISHING
350 Main Street, Maiden, MA 02148-5020, USA 9600
Garsington Road, Oxford OX4 2DO_, UK 550
Swanston Street, Carlton, Victoria 3053, Australia



First published 2006 by Blackwell Publishing Ltd
1 2006

*Library of Congress Cataloging-in-Publication Data*

Memory and emotion : interdisciplinary perspectives / edited by Bob Uttl, Nobuo Ohta, and Amy L. Siegenthaler.
p. cm. — (New perspectives in cognitive psychology)
Includes bibliographical references and indexes. ISBN-13: 978-1-4051-3981-6 (hardcover : alk. paper) ISBN-10: 1-4051-3981-1 (hardcover : alk. paper) ISBN-13: 978-1-4051-3982-3 (pbk. : alk. paper)
ISBN-10: 1-4051-3982-X (pbk. : alk. paper) 1. Memory. 2. Emotions. 3. Memory—Physiological aspects. 4. Emotions—Physiological aspects. 5. Psychology, Pathological. I. Uttl, Bob. II. Ohta, Nobuo. III. Siegenthaler, Amy L. IV. Series.

BF371.M4478 2006
153.1'2-dc22

2005032608

A catalogue record for this tide is available **from the British Library.**
Set in 10/12.5pt Baskerville by Graphicraft Limited, Hong Kong
Printed and bound in Singapore by COS Printers Pte Ltd

The publisher's policy is to use permanent paper from mills that operate a sustainable forestry policy, and which has been manufactured from pulp processed using acid-free and elementary chlorine-free practices. Furthermore, the publisher ensures that the text paper and cover board used have met acceptable environmental accreditation standards.

For further information on
Blackwell Publishing, visit our website:
www.blackwellpublishing.com

# CONTENTS