Chapter 9

Visual versus Verbal Metacognition: Are They Really Different?

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In the lead role of his film *That Obscure Object of Desire*, Luis Bunuel uses two different actresses, Carole Bouquet and Angela Molina, alternating between them depending on the mood of the scene. At times, one actress walks into a doorway and the other actress appears on the other side. It is quite possible to be absorbed in watching the entire film without ever noticing that two different people are playing the same character at different times. This finding is not unique. An entire research enterprise has developed surrounding the phenomenon known as "change blindness," where participants are not aware that their conversation partner has been switched with another person during a distraction (e.g., Rensink, O'Regan, and Clark, 1997; Simons and Levin, 1998). It seemed amazing to us that such bold substitutions of actors could occur without awareness, but it is perhaps equally important to ask whether one should be surprised that people fail to notice these changes. Do people typically assume that they would notice such major substitutions in the visual aspects of a display?

The answer to that question is yes; people do assume that they will notice major visual events such as a change in who portrays a character (Levin et al., 2000). In fact, our intuitions about our visual abilities are often incorrect. The military designed a new instrument panel for airplanes to be superimposed on the windshield of the plane, thus allowing the pilot to simultaneously view the area in front of the plane and the instruments of the control panel. The intuition was that placing the control panels on the windshield would improve efficiency and performance because pilots would not be required to move their head and eyes between controls at a lower level and the cockpit window. Tests in flight simulators demonstrated that this "head-up" control panel produced dramatically different performance than that anticipated by its creator (Haines, 1991). Attention to this control panel caused two out of eight pilots to proceed on paths that would have caused them to crash into planes directly in front of them during the landing process.

The examples of the film and aircraft simulator suggest that human perception is far from perfect and that our intuitions or metacognition about our visual processing are not always accurate. Despite a large body of research devoted to people's metacognition concerning factual knowledge (e.g., Metcalfe and Shimamura, 1994; Reder and Schunn, 1996; Yzerbyt, Lories, and Dardenne, 1998), there has been relatively little attention to the metacognitive processes associated with visual processing (for exceptions, see Busey et al., 2000; Chun and Jiang, 1998; Levin et al., 2000; Winer et al., 1996a; Winer et al., 1996b). The dramatic results from change blindness paradigms, such as failing to notice that one's conversation partner has changed identity mid conversation (Simons and Levin, 1998) underscores the need for more appreciation of the mechanisms involved.

Experiments in this area have found that participants are unable to predict their poor performance in change detection scenarios. The metacognitive errors seem to involve a systematic overestimation of human cognitive capacity in processing. Perhaps this overestimation is based on a lifetime of accurate (or seemingly accurate) perception of visual scenes, which results from the adaptive nature of metacognition, as addressed later in the chapter. Is visual metacognition as inaccurate as we have suggested above? If so, why? Can we understand visual metacognition by relating to previous research on metacognition that focused on semantic knowledge? In this chapter, we propose answers to all three questions.

What Is Metacognition?

Noting that the term *metacognition* seems to have different meanings for researchers in different subdisciplines of cognitive science, Reder (1996) asks whether these researchers have simply focused on different aspects of the same concept or whether there is actually a collection of different concepts that have all been labeled with the same term. "Metacognition" has been used to describe theory of mind, cognition about cognition, beliefs, monitoring of cognitive performance, and strategy selection. Although it has often been assumed within these areas that metacognitive functioning involves the conscious awareness of activities within the mind, we will present evidence that strategy selection and monitoring of cognitive performance are not always conscious. If this is so, it would seem that, to keep consciousness as a criterion, we would have to limit metacognition to a far narrower set of activities.

When we assume that metacognition is unconscious in some situations, we leave open the possibility that it may occur automatically, with no prompting from conscious systems. For the purposes of this chapter, we assume that metacognition refers to information about our cognitive state and that it is often associated with the control of behavior and the selection of control procedures to achieve a goal. We believe that such procedures, though sometimes conscious, are often automatic and part of a larger cognitive process (Cary and Reder, forthcoming; Reder and Schunn, 1996).

Feeling of Knowing: An Illustration

Classically defined as the state of believing that a piece of information can be retrieved from memory even though it currently cannot be recalled, feeling of knowing (FOK) is a research paradigm that has led to much debate over the character of metacognition. People often experienced FOK as a tip-of-the-tongue phenomenon, when they are not able to retrieve an item from memory, but feel that they should be. Recent research has suggested that feeling of knowing includes a rapid, automatic process beginning prior to actual memory retrieval and determining the course of the retrieval process (Miner and Reder, 1994). According to this proposal, an FOK judgment often occurs within retrieval, but it becomes consciously available only when retrieval fails (as in the tip-of-the-tongue phenomenon) or when participants are asked to search for and report their judgment. When conceptualized as an automatic process in the procedure of memory retrieval, feeling of knowing can be tested by asking participants to make judgments about their ability to retrieve an item before they actually attempt retrieval. These judgments can then be compared to the participants' actual ability to retrieve and to characteristics of the question or problem itself. Despite evidence presented earlier that metacognition is often inaccurate, FOK ratings are highly related to performance on cued-recall tests, relearning rates, and feature identification. Participants are able to successfully predict correct recognition and recognition failure (Miner and Reder, 1994). Accuracy in this paradigm is well above chance, but not nearly perfect.

Several mechanisms have been proposed to account for the accuracy of feeling of knowing judgments. The trace access hypothesis suggests that, when a question is asked, there is an immediate partial retrieval of the answer, which enables participants to monitor some aspects of the target item and decide whether they will be able to fully retrieve the answer (e.g., Nelson, Gerler, and Narens, 1984). This hypothesis accounts for the ability of someone experiencing the tip-of-the-tongue phenomenon to recount the first letter or number of syllables of the desired word. The cue familiarity hypothesis suggests that FOK judgments are actually based on a feeling of familiarity with the question itself. Cues that are associated with the question or the context provide evidence as to the likelihood of retrieving the answer. This hypothesis predicts that as cue familiarity increases, so should the FOK judgment. For example, frequency of exposure to unfamiliar math problems was correlated with higher FOK judgments, even when only part of the problem was familiar (Reder and Ritter, 1992).

The evidence that feeling of knowing judgments represent a rapid preretrieval stage in memory leads one to ask what purpose FOK is fulfilling in retrieval processing. Research suggests that FOK judgments act as an automatic strategy selection device (Reder, 1988). The automatic determination whether a response can be retrieved allows one to quickly decide whether a memory search is a worthwhile expenditure of resources. If the item is judged to be unfamiliar and thus not retrievable, then one can quickly decide to look for the answer by using another strategy, such as calculating a math problem or researching a question (Reder, 1982, 1987; Reder and Ritter, 1992). This type of judgment could also be used to determine how long to continue a search before conceding that another strategy should be used. If the FOK judgment were strong, one would allow the search to continue for a longer period of time. Research shows that FOK judgment has a positive correlation with duration of search (Gruneberg, Monks, and Sykes, 1977; Nelson, Gerler, and Narens, 1984).

Strategy Selection Can Be Unconscious

A number of experiments have shown that participants can select and use strategies they are unaware of. For example, when experimental designs vary the base rates of the usefulness of various types of problem-solving strategies, participants' results indicate that they adapted their base rates of selecting among these strategies. Interestingly, although the data clearly suggest these adaptations, postexperimental interviews indicate that participants are often unaware of the manipulation of base rates. In an experiment where participants were required to judge the plausibility of statements based on a story they had read, they were unaware of the strategy they used or the likelihood that retrieval would be successful (despite strong adaptation). All participants believed they had used direct retrieval, even when that strategy was not possible (Reder, 1987).

Likewise, strategy selection in verification of math equations was shown to be sensitive to rates of success with the verification strategies. Thus, if many of the equations could be judged as false because they violated the parity rule (where the sum is even when the addends are both even or both odd), participants became more likely to test all equations for parity, although they claimed to be unaware that one strategy was more successful than another (Lemaire and Reder, 1999). On Lovett's "building sticks" task (Lovett and Anderson, 1996), where the probability of a successful "overshoot" versus "undershoot" strategy was varied, the results showed that, although the base rates of strategy success had an effect on strategy selection, participants did not accurately explain their behavior.

Even low-level strategies can be affected implicitly by base rates of success. When participants are asked to respond to a target item in one of several locations while ignoring the distractor item that appeared in one of those same locations, their performance was affected by the frequency with which distractors appeared in specific locations (Reder and Weber, 1997). Over time, participants learned to prefer to examine certain locations and to ignore others, based on the probability of a target or distractor appearing in that location. When questioned at the end of the study about the distribution of distractors over the locations, however, they were unaware of any differential distribution. Chun and Jiang (1998) were able to affect the strategy used to detect a target by providing repeated contexts that predicted the location of the target. Whereas participants detected targets more quickly when the configuration of stimuli was repeated than when it was novel, they were at chance in discriminating repeated from novel configurations. Although we would hesitate to label these low-level tasks "metacognitive," they do provide evidence that search strategies can be affected implicitly.

Why Is Metacognition Sometimes Unconscious?

Thus, as we have shown, people are sometimes unaware of what causes them to select one strategy over another, and even of what strategy they may be using. We propose (see Reder and Schunn, 1996) that people are unlikely to be aware of the resulting strategy when the process requires rapid execution; that metacognition, in general, may be unconscious when the time course of processing is short; that cognitive monitoring, typically assumed to be a conscious process, may actually operate without much awareness; and that control of cognitive processing may be governed by implicit learning and memory.

There is a reason why metacognitive processes should be automatic and unconscious. When conscious control of metacognitive activity is not required, other cognitive resources are released and can be used in cognitive processing. Furthermore, metacognitive processes are less likely to interfere with regular cognitive processing if they are unconscious. For example, during a task that requires quick and accurate responses, the mind is able to monitor target location probabilities and adjust strategies without interfering in the rapid response to targets we are consciously aware of. Koriat (2000) has proposed that metacognitive feelings are an interface between automatic processing and consciously controlled processing and that experience-based metacognitive processing, which consists of a transition from low-level experience to high-level experience, may be implicit, whereas information-based metacognitive processing, involving analysis of higher-level experiences, is always explicit. Koriat allows for the possibility that these automatic cognitions can influence behavior and that "consciousness is not the sole gateway to action."

Other theorists have also supported the idea that metacognition may be unconscious under certain conditions. Defining *metacognition* as beliefs and opinions about our beliefs and opinions, Graham and Neisser (2000) maintain that, because our first level of beliefs and opinions (such as thoughts about "family and friends, Mahler's Fifth, and avocados") can be implicit, it is unreasonable to assume that our second level (our opinions about those earlier thoughts) must never be. Based on their work with a blindsight patient, Kentridge and Heywood (2000) make the argument that metacognition is not inherently conscious, that awareness might not always be necessary for changes in automatic processing to occur. Their patient could not see in certain regions of the visual field; this failure of an automatic process (vision) led to its replacement with another, unconscious strategy, outside the patient's awareness. The blindsight patient was able to orient his attention within the field of vision loss such that his reaction time to stimuli he could not consciously see was sped up by cues he could not consciously report.

When and Why Is Metacognition Inaccurate?

Using conscious processing in a task that is normally automatic can interfere with performance. For example, within the field of implicit learning, it has been established that strategy use is optimal when there is no conscious awareness of the strategy (Berry and Broadbent, 1984; Lewicki, Hill, and Bizot, 1988; Reber, 1989). When subjects are asked to consciously access and verbalize their experience in implicit learning tasks (e.g., Berry and Broadbent, 1984) or are otherwise given information that distorts an automatic process such as perception (Smith et al., 1976), their performance is significantly worse. In another example, verbalizing a description of a specialized stimulus (such as a face) produces a deficit in ability to recognize that face later on (Dodson, Johnson, and Schooler, 1997; Meissner and Brigham, 2001; Schooler and Engstler-Schooler, 1990; Westerman and Larsen, 1997). Some have proposed (Dodson et al., 1997; Westerman and Larsen, 1997) that this effect is due to a general shift in the processes involved in face recognition, rather than impairment for the stimulus face alone. Thus consciously analyzing and verbalizing an automatic process (such as storage of a face in memory) is detrimental to its outcome.

The difference in performance between novices and experts also provides evidence that conscious processing harms performance on automatic tasks. Research shows that expert golfers do not apply step-by-step attentional control to their putts (Beilock and Carr, 2001). This finding reflects an overall consensus that practice on a particular task will lead to its becoming automatic (Anderson, 1982; Logan, 1985, 1988; MacLeod and Dunbar, 1988; Regan, 1981). Expert golfers were found to putt more accurately when their attention was distracted ("distracted condition") than when they were told to pay step-by-step attention to their putting performance ("skill-focused condition"; Beilock et al., 2002). Expert soccer players were more successful when dribbling with their dominant foot in the distracted than in the skill-focused condition—and more successful when dribbling with their *non*dominant foot in the skill-focused than in the distracted condition. In contrast, novice soccer players performed better in the skill-focused condition when using either foot. These studies provide evidence that high-level skill execution is harmed when conscious attention is paid to the individual steps of an automatic process. Like golf and soccer skills in an expert, vision is an automatic process. We suspect that visual metacognition is often inaccurate because it is tested in a way that requires conscious access to unconscious automatic processes.

We propose that metacognitive tasks are often inaccurate because they require conscious access to naturally fast, automatic processes and thus produce interference. The amount of interference from conscious analysis of processing may be modulated by factors such as the time course or other properties of the task. Cary and Reder (2002) have proposed that easier tasks are associated with less awareness of metacognitive processes. More difficult tasks may lead to greater awareness because of the greater number of errors or longer time course of execution. The nature of the cognitive processes used by a participant in a problem-solving task, whether reflective, deliberate, or routine (Carlson, 1997), may thus also determine the degree of metacognitive consciousness. For instance, protocol analysis relies on accessing cognitive processing throughout a much longer time course, which allows for greater awareness (Ericsson and Simon, 1998).

Are Perceptual and Conceptual Information Really Different?

Similarities exist between strategy selection and comparison processes. Decisions about when to retrieve versus calculate an answer to a math problem are analogous to decisions about whether to search a complex scene or rely on the information that calls for attention. If the scene appears familiar to us, or if we are not motivated by some external factor, we may not use our limited resources to carefully search the details of the scene. The information that is readily apparent, which draws our attention, is deemed sufficient. The same is true of answering math problems. If the problem seems familiar or the likely benefit from a correct answer seems slight, we may choose to retrieve an answer that may well be not accurate. The resources that would be used to carefully calculate the problem can then be applied elsewhere.

The phenomenon of change blindness is not unlike the cognitive illusion known as the "Moses illusion." Even when warned to be wary of distorted questions, participants answer, "Two," to the question "How many animals of each kind did Moses take on the ark?" (Erickson and Mattson, 1981). The correct answer would be "None," given that Noah, not Moses, was the figure associated with the ark. Participants are extremely bad at detecting these substitutions even when the critical word is capitalized, and it is confirmed that they know the correct answer. Researchers and laypersons alike are amazed at their inability to detect these distortions (Erickson and Mattson, 1981). This is similar to the inability of participants to detect a large change in the visual scene (such as a change in the identity of a conversation partner), although they expect that they would be able to detect such a change (Levin et al., 2000). Of course, this type of "trick question," like the Moses illusion, is not one that would be expected in everyday life. Thus it may be adaptive to avoid wasting resources searching for the identity of the person on the ark when we can simply assume that the question has been posed correctly. We will address this possibility at the end of the chapter.

Given that most research on metacognition has involved verbal and semantic tasks and stimuli, it would be ideal to find evidence to support the hypothesis that these conclusions generalize into the visual realm. Elsewhere, we have proposed that perceptual information is represented and processed analogously to conceptual information in memory (Reder, Donavos, and Erickson, 2002). As we argue in this chapter, the same basic processes operate on perceptual as on cognitive illusions, and the processes that operate on verbal and semantic information do so in an analogous fashion on perceptual information as well, such that metacognitive processes (both verbal and visual) can be assumed to proceed in the same way, using the same principles.

A number of theorists (e.g., Schacter, 1994) have postulated that conceptual information is somehow fundamentally different from perceptual information. For example, Roediger (1990) has proposed that explicit tests of memory, though susceptible to changes in conceptual or semantic elaboration, are not typically sensitive to changes in perceptual or surface features. Likewise, theorists (e.g., Gernsbacher, 1985) have proposed that semantic information has a special status in memory, such that it is less likely to be forgotten than the superficial features of verbal information, such as syntax and modality. These assertions are open to debate. For example, Anderson, Badiu, and Reder (2001) were able to account for a wide variety of the findings traditionally used to argue for different decay rates for semantic versus syntactic information, assuming decay rates do not differ for any one type of information. Likewise, Reder and colleagues (Diana, Peterson, and Reder, 2002; Diana and Reder, 2002; Reder et al., 2002) have argued from the findings of numerous studies that perceptual and conceptual information behave according to the same principles, such that the effects of manipulations on both types of information can be accounted for using the same type of memory representation and the same processing assumptions. In fact, recent research (Arndt and Reder, 2003) has shown that perceptual information does have an impact on recognition judgments when it is linked to semantic information.

Early research by Reder and colleagues (see Reder, 1987) demonstrated that subjects can be made to feel they know the answer to a general knowledge question when terms from the question are primed. Perceptual features of an arithmetic problem can likewise influence one's assessment of whether the answer is known. Reder and Ritter (1992) found that unstudied math problems whose operands had frequently been presented in the same problem, but with a different operator, were likely to get a fast "Know it!" response, whereas studied math problems whose operands had merely been transposed ("B*A" instead of "A*B") were judged as unfamiliar. Although, in the former case, the answer was not known, whereas, in the latter, it was, participants' first impressions were influenced by the perceptual features of the problem.

These results can be interpreted in terms of a source of activation confusion (SAC) model (e.g., Reder and Schunn, 1996; Schunn et al., 1997). SAC models represent perceptual and conceptual information in a unified long-term memory network. If a word encoded at study is presented in a relatively unusual font, the representation for the font information is associated with the encoding episode in the same way that the semantic and orthographic information are. If the same font is used to present the word at test, both the word node and the font node will provide sources of activation to send to the episode node, thereby further raising its activation level and increasing the chances of passing threshold

for a recollection response (Reder et al., 2000, Reder, Donavos, and Erickson, 2002). An implication of the SAC theory is that no information is privileged. The only reason certain types of information seem less likely to be forgotten is that conceptual information is more easily elaborated and thus more easily reconstructed. Perceptual information, on the other hand, is more difficult to elaborate and therefore subject to interference from outside information (Anderson and Reder, 1979).

It is worth noting that in Reder, Donavos, and Erickson, 2002, perceptual cues, even those not relevant to the judgment task, were shown to influence the accuracy of a recognition judgment. Lists of words were presented, with some words being shown in unique salient fonts, and others in the same salient font. Participants were significantly more likely to recognize a previously presented word when they saw it in the same font at test as at study. Although the finding that a matching font from study to test aids recognition was not new (see, for example, Graf and Ryan, 1990), Reder and colleagues' varying the number of words that shared a salient font was. With this manipulation, they found that the number of other words presented in the same font at study modulated the effectiveness of re-presenting a word in the same font at test as at study. Or, as Arndt and Reder (2003) have suggested, a font becomes less distinctive and thereby a less effective retrieval cue if shared with many other words. Further, Reder, Donavos, and Erickson, 2002, contradicts the thesis that perceptual information is only influential in implicit memory tasks (see McDermott and Roediger, 1994; Richardson-Klavehn and Bjork, 1988). It also supports the proposal that perceptual and conceptual information are processed in the same way within memory, which it explains in terms of the same memory principles that Reder and colleagues used to explain verbal learning effects such as word frequency.

Source of activation confusion models theorize that any memory trace, whether semantic or perceptual, is subject to the same laws of memory and follows the same principles of decay, strengthening, and elaboration. Modeling efforts have lent support to the thesis that decay processes are the same for both perceptual and semantic information. SAC models generally maintain the same parameters when the equations are used to explain and predict results from various experiments. Cary and Reder (2001) modeled the experiments in Reder, Donavos, and Erickson, 2002, with a simulation that used the same parameter values for the representations of perceptual and semantic information (e.g., for spread of activation, decay, and strengthening). Thus SAC models, can account (qualitatively and quantitatively) for perceptual matching effects within a unified representational system of memory, using the same mechanisms and parameter values for perceptual and conceptual information.

On the other hand, the perceptual representation system (PRS; Tulving and Schachter, 1990), which is believed to have properties qualitatively different from those of semantic memory, predicts that perceptual information has a special area in memory, one separate from the area for semantic and conceptual information—

a predication disputed by the modeling efforts of Cary and Reder. PRS also predicts that the most important variable in memory experiments is that the same processing is required at testing as at encoding. PRS predicts that the distinctiveness of various perceptual features will not have an effect on the degree to which perceptual match affects memory. Clearly, the findings of Reder, Donavos, and Erickson provide a strong challenge to this theory.

Later research (Diana and Reder, 2002; Diana, Peterson, and Reder, forthcoming) showed that not only does perceptual information influence participants to be more likely to recognize a word they have seen before; it also leads them to believe they have seen a stimulus that is novel. In other words, perceptual features of the verbal stimuli influence the likelihood that participants will spuriously recognize that stimulus. This result is especially interesting because it provides evidence that familiar perceptual features, as well as semantic features, can produce false memories. The Deese, Roediger, and McDermott paradigm (see Roediger and McDermott, 1995) shows that when words from a given semantic category are presented, participants are more likely to falsely believe that they have seen another word from that semantic category than one from a separate category, a result that supports the thesis that false memories can result from perceptual influences alone.

Our ongoing studies are investigating the degree to which the same effects can be found within the domain of face recognition memory as within that of perceptual and conceptual information memory. Our preliminary findings (Diana and Reder, 2002) suggest that irrelevant perceptual information also influences one's ability to recognize a face, that there is no need to propose a separate explanation for facial memory representations over verbal memory representations. Source of activation confusion models can make predictions about both visual/facial and verbal memory phenomena simply by assuming that the two types of information are governed by the same principles.

Metacognitive Processes Are Adaptive

Research on metacognition in laboratory tasks has led to the belief that our metacognitions are frequently inaccurate. While the evidence appears to support this belief, it is important to keep in mind that laboratory tasks may create artificial situations that subvert the adaptive character of metacognition. Human cognition is set up to deal with the real world and to conserve resources whenever possible. One major area of resource expenditure is careful and detailed attention to an entire scene, document, or conversation. Visual metacognition is important because it would be impossible to process all of the visual information in a complex scene. People require heuristics to figure out what aspects of a scene or display should receive attention. This is may help to explain change blindness—there are simply not enough resources to continually process all aspects of a scene.

What heuristics do we use to decide whether to direct attention to something? We learn the regularities in the display or scene and we focus our attention on those aspects we have not yet learned are best to ignore (i.e., because they are unchanging or irrelevant). That people learn to anticipate where to look and what to ignore has been demonstrated in low-level attentional tasks (e.g., Chun and Jiang, 1998; Reder, Weber, Shang, and Vanyukov, 2003) and higher-level tasks such as air traffic control or solving algebra equations (e.g., Lee and Anderson, 2001).

This is why change blindness strikes us as so bizarre. In real life, things such as the identity of our conversational partner do not change unexpectedly. When a person we do not know presents us with a task in an experiment, we do not bother to encode the facial features of that person because they are not relevant to the task at hand and because we certainly do not expect the identity of the person to change "before our eyes." Because of the specialization of our system, we are unlikely to miss a change when it is feasible and important, thus we are unlikely to realize that we have missed a change at some later point. We think that we see everything because we have grown to expect stability in certain areas and similar configurations within scenes of the same type. Based on our previous life's experience, we believe that our visual perception is accurate. Thus, when our metacognitions are accessed in answer to the question, "Would you be likely to detect a change in this scene?" we respond based on our experience.

Even if humans had the cognitive capacity to encode all the information in a visual scene, the overwhelming amount of information would take such great lengths of time to process that the human processor would freeze in confusion. The trade-off of occasional mistakes in unlikely situations is preferable to the overload of storing and attempting to use a huge amount of unnecessary information. Processes become routine over time, as the needless steps and processing are weeded out. The predictability of the world allows us to learn and to increase our efficiency, a principle that may be true of all metacognition, both visual and verbal, and one even more necessary in visual metacognition than in semantic metacognition. Visual input is much richer than semantic input and requires a much greater degree of filtering, although, of course, this assumption may also be an illusion. The voice of the speaker, the intonation, the problem of invariance in phonemes, or the font of the typeset are all extra information in semantic processing. We usually take these sources of information for granted and ignore them in our overall processing. Metacognition is the key to deciding where resources should be expended and what information is important.

Conclusions

Metacognition can be explained as part of an integrated cognitive system and does not need to be proposed as a separate one. The role of metacognition in general cognition is to provide a feedback loop by which strategy selection (e.g., memory search versus reasoning an answer; statistical learning) can be accomplished.

Some metacognition can and does occur implicitly when time or resources are constrained. These implicit processes are less likely to cause interference in the task at hand. The inaccuracies commonly found in metacognition may result from attempts to access a system that is normally implicit and automatic. Because we propose that there is no separate system for perceptual versus conceptual information in general cognition, we also believe that the same system exists for perceptual and conceptual metacognitions Therefore, visual metacognition results from the same mechanisms and obeys the same properties as metacognition in general.

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