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The Continuum of Consciousness

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Research in a wide variety of domains provides converging evidence for the psychological unconscious—percepts, memories, and other mental contents that influence experience, thought, and action outside of phenomenal awareness. Studies of preconscious processing indicate that two continua underlie conscious experience—one having to do with the quality of the stimulus event or its mental representation, and the other having to do with the cognitive resources brought to bear on the processing of that representation. However, evidence of subconscious processing violates these conclusions and suggests that something more is involved—perhaps a link between mental representations of events and of the self as the agent or experiencer of them.

Consciousness is the central issue for psychology and for the broader interdisciplinary effort known as cognitive science. Contemporary interest in consciousness (Bock & Marsh, 1993; Churchland, 1988; Dennett, 1991; Flanagan, 1992; Searle, 1992) is focused primarily on two rather different relations: between mind and body and between conscious and unconscious mental life. These are different problems, although they are related in some ways (for example, mind is often identified with consciousness, and many bodily processes are inaccessible to conscious awareness). My neuroscientific colleagues inform me that the mind–body problem has been solved, although there seems to be a residual dispute over just what the solution actually is. Accordingly, I want to focus on the second problem: understanding the nature of unconscious mental life, and the relations between unconscious mental structures and processes and conscious experience, thought, and action.

THE PSYCHOLOGICAL UNCONSCIOUS

I want to be clear at the outset that I am talking about unconscious *mental* life, or the *psychological* unconscious (Kihlstrom, 1990). For most of its history, scientific psychology has focused its attention on mental states that are represented in phenomenal awareness—on the percepts, memories, thoughts, beliefs, feelings, emotions, goals, and motives that we consciously experience while we do what we do. These conscious mental states comprise the far end of the continuum of consciousness, and while much remains to be learned, we already know quite a bit about them. What we do not know so much about is the other end: about whether, and to what degree, cognitions, emotions, and motives can influence behavior outside of conscious awareness.

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One reason for this situation is that for a long time, the psychological unconscious was a topic of what might be called cult interest. William James, despite his opposition in the *Principles* (James, 1890/1981) to the notion of unconscious thought, nevertheless was convinced by clinical phenomena of hysteria and multiple personality, experiments on hypnosis, and demonstrations of such ostensibly parapsychological phenomena as the planchette and spirit possession that complex mental activities could go on outside of phenomenal awareness (Taylor, 1983).[1] In order to account for the syndromes of hysteria, fugue, and multiple personality, Pierre Janet (1907) and Morton Prince (1906) introduced the concept of dissociation to our medical and scientific vocabulary. Sigmund Freud staked his entire career on the idea that our conscious mental life was determined by repressed ideas, affects, and impulses (Breuer & Freud, 1893–1895/1955; Freud, 1915/1957). More recently, we had the whole battle over perceptual defense (Bruner & Klein, 1960). Today, investigators of hypnosis often talk of divisions in consciousness and make friendly references to people like James, Janet, and Prince (Hilgard, 1977/1986; Kihlstrom, 1984, 1992). Others, who deal with victims of post-traumatic stress disorder, appear to be reviving Freud's concept of repression (Herman, 1992). But within mainstream psychology, until relatively recently, most of this kind of work was dismissed as esoteric, unreliable, difficult to study under controlled conditions, or otherwise beyond the pale.

IMPLICIT MEMORY AND IMPLICIT PERCEPTION

Everything changed about 20 years ago, as cognitive psychology turned into cognitive *neuro*psychology, and researchers began to see evidence of the psychological unconscious in the behavior of brain-damaged patients (for overviews, see Marcel & Bisiach, 1988; Milner & Rugg, 1992). Pride of place in this history goes to studies of the amnesic syndrome resulting from bilateral damage to the hippocampus and related structures in the medial temporal lobe or, alternatively, to the diencephalon and mammillary bodies. Such patients, as we all know, show a dense anterograde amnesia: after only a few moments of distraction, they cannot remember events that have occurred just recently. Thus, amnesia counts as a failure of episodic rather than semantic memory (Schacter & Tulving, 1982; Tulving, 1983). But as we all know, these patients also show the influence of the unremembered past on their current experience, thought, and action. For example, a patient who has recently seen the word *ASSASSIN* will be unable to recall or recognize the word shortly thereafter. But when asked to complete a fragment

[1] There is some confusion about James' views on unconscious mental life. In his arguments against the "mind-stuff" theory, James (1890/1981, pp. 166–177) offered objections to each of 10 alleged proofs of the existence of unconscious mental states and asserted that the idea of unconscious thought was a contradiction in terms. As the same time, however, James agreed that "we can neglect to attend to that which we nevertheless feel" (1890/1981, p. 201; also 455–458); and he concluded from his study of exceptional mental states such as hysteria that consciousness could be divided into several parallel streams, only one of which was accessible to phenomenal awareness at any moment. James referred to this as a state of "submerged consciousness" (e.g., 1890/1981, p. 203).

with a legal English word, he or she will be more successful with *A_A_I_*, which matches a previously studied word, than with *T_P_R_*, which does not. This effect, known generically as priming, shows that something about the past event has been retained in memory and actively influences current task performance.

Credit for this discovery goes to Warrington and Weiskrantz (1968), but the significance of the observation was not entirely clear until many years later (Diamond & Rozin, 1984). Based on accumulating evidence of priming and similar effects, Schacter (1987; Graf & Schacter, 1985) and others (e.g., Roediger, 1990) began to draw a distinction between two expressions of memory, explicit and implicit (or, alternatively, memory with vs without awareness, direct vs indirect memory, or declarative vs nondeclarative memory; see Eich, 1984; Jacoby & Dallas, 1981; Johnson & Hasher, 1987; Richardson-Klavehn & Bjork, 1988; Squire & Cohen, 1984). Explicit memory refers to one's conscious recollection of the past, as manifested on tasks like recall and recognition. Implicit memory refers to any change in experience, thought, and action that is attributable to a past event: priming effects, savings in relearning, and proactive and retroactive interference are good examples.

Something like implicit memory can also be observed in domains other than episodic memory. Consider the syndrome of prosopagnosia, observed in patients who have suffered bilateral damage to the inferior portions of the occipital lobe. These individuals lose the ability to recognize faces of people who are objectively familiar to them. The deficit is more an agnosia than an amnesia, because the patients appear to lose conscious access to semantic knowledge about the identity of a face, rather than merely to episodic knowledge about whether it might have been encountered previously, and if so where and when. Prosopagnosic patients can describe these unknown faces accurately, and they often can recognize the people in question from other physical features, such as voice or gait; but they can no longer put names to faces (including their own). Nevertheless, prosopagnosic patients show differential physiological responses to familiar and unfamiliar faces and to correct vs incorrect names paired with familiar faces; further, concurrent presentation of familiar faces can influence the processing of words that are associated with these faces (for a review, see Young & De Haan, 1992). All of these effects show that memory for the face, and the connection between facial and verbal knowledge, has been preserved at some level, even if the patients cannot express this knowledge consciously. Similar effects have been documented in patients with other forms of visual agnosia (e.g., Humphreys, Troscianko, Riddoch, Boucart, Donnelly, & Harding, 1992), and they all count as evidence of implicit semantic knowledge.

By now, a great deal of evidence has accumulated in favor of the distinction between explicit and implicit memory, including evidence from subjects who are by no means brain-damaged (for recent reviews, see Squire, Knowlton, & Musen, 1993; Schacter, Chiu, & Ochsner, 1993). We now know that explicit and implicit memory are dissociable in at least three different senses: (1) There are patients, such as amnesics, who show implicit memory in the absence of explicit memory; (2) there are some variables that influence explicit but not implicit memory, others

that influence implicit but not explicit memory, and still others that influence both explicit and implicit memory but in opposite directions; and (3) explicit and implicit memory are stochastically independent, in that priming effects occur for items that cannot be recognized. All of this evidence indicates that memory for an event can be expressed in behavior, outside of phenomenal awareness.

Recently, my colleagues and I have extended the explicit–implicit distinction to the domain of perception. Whereas implicit memory refers to performance effects attributable to past events, we have been concerned with the analogous effects of an event in the current environment or in the very immediate past (Kihlstrom, Barnhardt, & Tataryn, 1992). Implicit perception is exemplified by studies of so-called "subliminal" perception, such as the classic experiment of Pierce and Jastrow (1884). In a series of studies of weight and brightness discrimination, these experimenters reduced the difference between standard and comparison stimuli until they were at zero confidence in judging which was the heavier or brighter. Yet, when forced to guess, their choices were significantly more accurate than chance. Apparently, then, some comparative stimulus information registered somewhere in the perceptual system and influenced the subject's experience, thought, and action. Pierce and Jastrow thought their evidence disproved the very existence of a sensory threshold or limen. That may be going too far, for reasons that will be discussed later in this paper. On the other hand, it is clear from other evidence that stimuli that are in no sense subliminal can have effects on behavior independent of conscious experience. For that reason, we have chosen to label the entire class of phenomena as implicit perception, paralleling the distinction made in the domain of memory.

Once again, some of the most dramatic evidence for implicit perception of *supra*liminal stimuli comes from brain-injured patients. Consider, for example, Weiskrantz's (1986) classic studies of blindsight in patients with damage to the striate cortex of the occipital lobe (for an update, see Cowey & Stoerig, 1992). Such patients report a lack of visual experience in some portion of the visual field: when a stimulus is presented to their scotoma, they say they see nothing at all. Yet when forced to make guesses about the properties of the object, their conjectures about its presence, location form, movement, velocity, orientation, and size are often more accurate than would be expected by chance alone.

Something similar sometimes occurs in visual neglect arising from lesions in the temporoparietal region of one hemisphere (usually the right) that do not affect primary sensory or motor cortices. These patients appear to neglect that portion of the contralateral sensory field (usually the left). Such a patient, asked to bisect a set of horizontal lines, may ignore the ones on the left side of the page; and for the remainder, the pencil strokes tend to be located about one-quarter of the way in from the right. It is as if the left half of the page, and the left half of each line, is not seen at all; but it is, at least in some instances. Marshall and Halligan (1988) showed a hemineglect patient two pictures of a house, one above the other. The pictures were identical in every respect, except that one had flames coming out of a window on the left side. The patient did not detect the difference, because after all the pictures had identical right sides; but when asked which she would prefer to live in, she consistently chose the one without the flames. This result

is not always obtained, but careful observation often yields evidence that something in the neglected area has been registered perceptually (Bisiach, 1992).

Over the last decade or so, we have seen a revival of interest in so-called subliminal perception (Bornstein & Pittman, 1992). Of special relevance here is the work of Merikle and his colleagues (Merikle & Reingold, 1992), who have distinguished between subjective and objective sensory thresholds. A subjective threshold is the point at which the individual can no longer consciously detect the presence of a stimulus, or (by extension) the difference between two stimuli. An objective threshold is the point at which the individual's forced-choice guesses about presence or difference fall to chance levels. Merikle and his colleagues have consistently obtained above-chance levels of performance on lexical decision tasks—that is, saying whether a stimulus was a word—at stimulus durations, intensities, and signal-noise ratios that are below subjective threshold—that is, when they are unaware of the stimulus in question. For their part, Greenwald and his colleagues (Greenwald, Klinger, & Liu, 1989; Greenwald, 1992) have found semantic priming effects at stimulus conditions that are very close to objective threshold.

Now, one could take all this simply as evidence for implicit memory: after all, the stimulus event happened sometimes in the past, and as James (1890/1981, pp. 188–189) acknowledged, all introspection is retrospection. But there is an important difference between implicit memory and implicit perception: in implicit memory, the events in question were consciously perceived at the time they occurred and subsequently were lost to conscious recollection. In implicit perception, the event was never consciously perceived at all: it is a *perception* that is implicit in task performance, not just a memory. In general, I prefer to reserve implicit memory for cases where the event in question was consciously perceived, but not consciously remembered.

Of course, because a memory trace is the record of perceptual processing received by an event, it follows that implicit percepts may leave traces in memory, although these memories may be amenable only to implicit expression. Consider, for example, the famous demonstration of subliminal mere exposure effects by Kunst-Wilson and Zajonc (1980). Repeated exposure to novel objects, including objects like irregular polygons that have no intrinsic meaning, leads to increases in people's preferences for these objects. When presented with an old object and a new one and asked to choose the one they like, subjects tend to pick the old one. Kunst-Wilson and Zajonc (1980) found that this mere exposure effect occurred even for items given tachistoscopically brief presentations; in fact, it may be *stronger* for unseen stimuli than for visible ones (Bornstein, 1989). The classical mere exposure effect qualifies as an implicit memory effect, because the stimulus is consciously perceived at the time of presentation, and the evaluation task is administered long (in psychologists' terms) after the stimulus has been presented. But the occurrence of the *subliminal* version shows that something of the stimulus must have been registered outside concurrent awareness; thus, first and foremost, subliminal mere exposure effects count as evidence of implicit perception.

EXTENSIONS TO OTHER DOMAINS

Implicit perception and implicit memory exemplify what I have called the *cognitive unconscious* (Kihlstrom, 1987). Paul Rozin (1976) originally introduced this term to our contemporary vocabulary, but he had in mind those hard-wired, inflexible cognitive structures that guide conditioning and learning—a portion of what we now call procedural knowledge (Anderson, 1976; Winograd, 1975).[2] While most discussions of the psychological unconscious are in terms of cognition, the notion can be expanded to encompass other domains of mental life. If one agrees with Kant (in the *Critique of Judgment*, 1790/1951; see also Cassirer, 1970; Kant, 1798/1978) that knowledge, feeling, and desire are fundamentally different, and one also agrees with the argument presented so far that unconscious cognitions can influence ongoing experience, thought, and action, then at some point the question must be raised whether there might be emotional and motivational states, as well as cognitive ones, that are dynamically active yet inaccessible to introspection and phenomenal awareness. I think that the answer must be "yes," at least in principle (Kihlstrom, Mulvaney, & Tobias, 1993; Tobias, Kihlstrom, & Schacter, 1992).

For example, the multiple-systems theory of emotion (Lang, 1968; Hugdahl, 1981) holds that every emotional response has three components—a subjective feeling state, an overt behavioral response, and a covert physiological correlate. Thus, an emotional state such as fear might be composed of the experience of anxiety, avoidance behavior, and heart-rate acceleration. The theory holds that these components are only imperfectly coupled, so that one can be dissociated from the other two—a condition known as desynchrony (Rachman & Hodgson, 1974). The multiple-systems theory of emotion is highly relevant to behavior therapists, who are concerned that extinction of only the behavioral response might leave the subjective and physiological components untouched, rendering the patient vulnerable to relapse. For present purposes, however, consider another possibility: that the subjective component might disappear while the behavioral and physiological ones remain intact. Thus, the person might lack the conscious experience of an emotional state, but still behave in a recognizably emotional manner. By analogy with perception and memory, this form of desynchrony would amount to a dissociation between two expressions of emotion:

[2] Procedural knowledge does seem to be unconscious in the strict sense that we have no access to the rules by which cognition proceeds— for example, the syntactic rules that govern the use of language or the perceptual principles that underlie constancies and illusions. Current research on unconscious procedural knowledge is exemplified by studies of implicit learning reported by Reber (1967, 1989), Lewicki (1986; Lewicki, Hill, & Czewska, 1992), and others, in which subjects appear to acquire rules and concepts that govern their behavior, without being able to articulate the rules and concepts themselves. Procedural knowledge is an important part of the psychological unconscious, because it guides the acquisition, transformation, and utilization of knowledge, feeling, and desire; but it is not the part that concerns me here in this paper. Rather, I am concerned with the mental representations on which these processes operate—with *declarative* knowledge. The argument is simply that there is a meaningful way to talk about behavior being determined by percepts, memories, and thoughts, and perhaps emotions and motives, which are not themselves accessible to phenomenal awareness. And that these nonconscious contents have the content of being mental in nature; they are not simply unconscious brain states.

explicit, reflecting the person's conscious experience of affect or mood, and implicit, reflecting behavioral or physiological changes that are attributable to an emotion.

At present, there is not a large body of methodologically sound documentation for the dissociation between explicit and implicit emotion. One relevant line of research has revived the psychodynamic concept of repression, but without all the baggage of Freudian psychosexual theory (Singer, 1990). In a classic study, Weinberger, Schwartz, and Davidson (1979) identified a group of individuals who showed low scores on a measure of anxiety, but high scores on a measure of social desirability. These individuals, called repressors, generally denied distress, but when presented with threatening words and phrases showed physiological responses that were similar to those of their nondefensive counterparts. On the assumption that repressors would report that the phrases did not bother them, this finding has the character of a dissociation between explicit and implicit emotion. Of course, better evidence for the dissociation between explicit and implicit emotion would be provided by an experiment in which subjects were asked to consciously evaluate the stimuli at the same time as their physiological responses to them were recorded. Such an experiment has not yet been performed, at least to my knowledge, so for the present the experimental evidence must remain somewhat ambiguous.

While evidence for a dissociation between explicit and implicit emotion is rather sparse at the moment, there is good evidence that emotional changes can serve as expressions of implicit perception and memory (for reviews, see Kihlstrom et al., 1993; Tobias et al., 1992). That is, the person can be aware of an emotional state without being aware of the percepts or memories that gave rise to it. The study by Kunst-Wilson and Zajonc (1980) on subliminal mere exposure effects has this character to it. So does work on subliminal affective conditioning (Greenwald, 1992; Niedenthal, 1992), in which the affective valence of a preconscious prime influences response to a consciously presented target (e.g., Niedenthal, 1992). And there is also evidence that amnesic patients can acquire affective responses through experiences that they cannot remember (e.g., Johnson, Kim, & Risse, 1985). While these studies do not reveal dissociations between explicit and implicit emotion, they do provide further support for the explicit/implicit distinction in perception and memory.

THE CONDITIONS LIMITING AWARENESS

It seems quite clear, in these cases and many others like them, that some stimulus information has registered despite the subject's inability to consciously perceive the object in question and that some trace information has been retained, despite the individual's ability to consciously remember the event. There are some disputes about details, and some very real questions about limits on these effects, to which I will turn later. But first I want to try to understand what conditions produce limitations on our awareness of percepts and memories. These conditions seem to come in two types: one has to do with the condition of the perceptual stimulus or memory trace and the other with the condition of the subject who processes this information.

The first set of conditions reflects a continuum of stimulus degradation. To make a long story short, we consciously perceive something when it is presented in the fovea (or wherever) for a relatively long period of time, at a relatively high signal-to-noise ratio, in the absence of metacontrast or masking. But as these conditions are eliminated, conscious awareness is correspondingly reduced. Thus, a stimulus lasting 50 ms followed by a pattern mask is not consciously seen, yet it may be enough to support implicit perception, as indicated by priming effects on lexical decision-making (Forster, 1987). There comes a point, however, where the stimulus is so degraded—so brief, so weak, so noisy, so thoroughly masked—that there is no longer any evidence of processing at all. This is what Merikle means by an objective threshold (Merikle & Reingold, 1992). So Pierce and Jastrow (1884) were probably wrong, and there is a limen after all; is just a lot lower than we once might have thought.

Something similar can be said about a memory trace. For example, immediately after presentation of an item (such as an unfamiliar telephone number or the name of a stranger), that item is easily accessible to free recall. But let just a couple of moments go by, especially if these are moments filled with distraction, and the item is no longer retrievable without benefit of various sorts of prompts and cues. It is as if the memory trace has decayed (although we know that the actual situation is more complicated than mere decay; Crowder, 1976). The contrasting outcomes of free recall and recognition underscore the distinction between availability and accessibility, which is essentially a difference in consciousness: a memory that is not consciously remembered under one set of retrieval cues may well be consciously remembered under another set. At some point, however, the item cannot be retrieved through cued recall or recognition either. Nevertheless, as Nelson (1978) showed in a classic study, subjects can demonstrate savings in relearning paired associates which they can than neither recall nor recognize. These savings effects are expressions of implicit memory.

The second type of condition reflects a continuum of cognitive resources applied to information-processing. This is most clearly demonstrated by the neuropsychological cases of implicit perception and memory. Apparently certain brain structures, such as the striate cortex or the hippocampus, somehow serve conscious perception and memory. Damage to these areas, or perhaps to connections to them, produces a loss of awareness in perception and memory. Of course, one does not have to be brain-damaged to lose resources. As attention and effort decrease, the prospects for conscious perception and memory correspondingly diminish. Nevertheless, something of the event can be registered, and something retained. Consider, for example, a dichotic listening experiment in which subjects shadow a list of homophones, such as *PEACE–PIECE* or *HAIR–HARE,* while disambiguating cues (e.g., *WAR* or *TORTOISE*) are presented over the unattended channel. Memory for the unattended items is very poor, suggesting that they were never consciously perceived, but these items nevertheless influence the subject's later performance when asked to spell or define homophones presented earlier (Eich, 1984).

Similarly, we consciously remember an event when we have performed elaborative and organizational processing at the time of encoding (Kihlstrom & Barn-

hardt, 1993). But again, as we eliminate this activity, conscious accessibility is similarly reduced. Thus, an item that has been inspected for its orthographic properties, but not for its semantic properties, is unlikely to be remembered on a free recall test of explicit memory. But it may very well influence performance on a priming test of implicit memory (Jacoby & Dallas, 1981). In fact, one of the tests of implicit memory is its independence from cognitive activity at the time of encoding: explicit memory varies as a function of depth of processing, while implicit memory generally does not.

These two continua—of degraded representations on the one hand, and of degraded cognitive processes on the other—are intended to focus our attention on two different conditions under which preconscious processing occurs: those that pertain to properties of the situation and those that pertain to attributes of the person. But of course, these conditions are not entirely independent. Brain damage, divided attention, and shallow processing may very well result in degraded perceptual representations even of very rich stimuli; and degraded representations may be difficult to process elaboratively, even under the best of conditions, and thus be especially vulnerable to the effects of decay and interference. Taken together, these two continua illustrate what I think of as the conventional wisdom about the relations between conscious and unconscious mental life: that in order to be conscious, percepts and memories must engage a relatively large share of the organism's cognitive resources. If the relevant brain structures are intact, the stimulus is robust, and the person pays attention, then the event is consciously perceived or remembered. If one or more of these conditions fails to obtain, conscious access is lost, although some degree of preconscious processing may remain possible. I do not think this conventional view is correct—consciousness is more interesting than this—but the statement provides a useful summary of what we know so far.

THE LIMITS OF PRECONSCIOUS PROCESSING

Are there any limits to preconscious processing? Paralleling the two continua just described, there are two approaches to this question: one emphasizing situational circumstances and the other organismic conditions. To take up the latter question first: just how unconscious can one be before the capacity for preconscious processing is lost? For example, what happens when a surgical patient is under general anesthesia? This question has been raised literally since the time general anesthetics were induced. While some physicians (and patients!) worry that the patient might be fully conscious on the operating table, recent documentation of implicit perception and memory has reformulated the question in the following way: even though adequately anesthetized patients are unconscious, is it possible for surgical events to register in the cognitive system anyway and somehow influence postoperative experience, thought, and action? The answer appears to be *yes*, at least in some circumstances (for reviews, see Kihlstrom, 1993b; Kihlstrom & Schacter, 1990).

Consider an experiment performed with my colleagues Randall Cork and Daniel Schacter (Kihlstrom, Schacter, Cork, Hurt, & Behr, 1990). A group of patients

received elective surgery with a mixture of isoflurane and oxygen as the anesthetic agent. During the operation, they heard a tape presenting a list of 15 paired-associates of the form *BREAD–KNIFE*. In the recovery room, and again 48 h later, they were presented with the cue terms; on one test they were asked to produce the associated response, while on another they were asked to report the first word that came to mind. Cued recall was at chance levels, but free association showed a significant priming effect. Other people have gotten this kind of effect too, but not everybody has been successful. And we ourselves failed to confirm the effect when we switched from isoflurane and oxygen to sufentanil and nitrous oxide as the anesthetic agent (Cork, Kihlstrom, & Schacter, 1992). But the fact that we get these effects at all, even sometimes, indicates that the possibilities for preconscious processing go pretty deep.

Just how deep do they go? A rather extreme test is presented by coma—or at least by the persistent vegetative state (PVS; Jennett & Plum, 1972), in which a brain-injured, comatose patient lies in an eyes-open state with intaçt sleep stages but no apparent awareness of the environment. The general consensus among neurologists is that PVS reflects preserved brainstem function and nothing more, so that these patients lack the capacity to experience pain and other mental states. Nevertheless, the possibility of information-processing during PVS is sometimes held out to the families of such patients, and in fact there is an ongoing Congressional investigation to see if this is anything more than a scam on the part of for-profit rehabilitation institutes. Unfortunately, all there is at the moment is anecdotal evidence that some PVS patients, sometimes, appear to show psychophysiological responses to stimuli that are known to be meaningful to them. Unfortunately, we know little about the reliability of these responses, whether they predict such things as subsequent recovery or whether recovered patients show any memory, explicit or implicit, of stimulation they received while comatose (for a review, see Turkstra, 1993).

There is considerably greater information about cognition during sleep, which has been systematically investigated since World War I (Bootzin, Kihlstrom, & Schacter, 1990; Ellman & Antrobus, 1991). The received wisdom, expressed in a classic paper by Simon and Emmons (1954), was that sleep learning is possible to the extent that subjects stay awake. But that conclusion referred to conscious recollection—or, at least, it did not distinguish between explicit and implicit expressions of memory. Mostly based on theoretical considerations, Eich (1990) suggested that implicit memory might be preserved in sleep, but there was no formal test of this hypothesis until the recent report by Wood and his colleagues (Wood, Bootzin, Kihlstrom, & Schacter, 1992). In their first test, sleeping subjects were presented with an audiotape recording of paired-associates consisting of a homophone plus a disambiguating cue, such as *TORTOISE–HARE*. In the second test, the tape presented another set of paired associates consisting of a category label followed by an instance of that category, such as *METAL–GOLD*. For some subjects, the items were presented in Stage REM, while for others they were presented in Stage 2 sleep. A control group heard the same lists while reclining with their eyes closed. Two minutes after list presentation, the subjects received a variety of memory tests. As expected, tests of free recall and recogni-

tion yielded no explicit memory for the items; however, tests of free association and category instantiation showed no evidence of *implicit* memory, either.

How can we reconcile the positive evidence of implicit memory following general anesthesia with the negative evidence of implicit memory following sleep? By any standard, there must be greater levels of cortical activity in sleeping subjects (especially in Stage REM) than in anesthetized patients. The key here, I think, is to be found in an important procedural difference: Wood et al. (1992) monitored their subjects closely during sleep and turned off the tape whenever they showed alpha activity or other EEG signs of cortical arousal. Unfortunately, Kihlstrom et al. (1990) we were not able to do this during surgical anesthesia, due to physical constraints imposed in the operating room. Even with very careful monitoring, anesthetic depth varies naturally over the course of surgery, and it is possible that the patients occasionally achieved levels of cortical arousal high enough to support some processing of information from the external environment (although it is important to note that all the patients were adequately anesthetized, according to standard clinical criteria, throughout their surgeries; and to remember that no patient showed explicit memory for the procedure). This possibility was denied the to sleeping subjects. Different results might have been obtained if Kihlstrom et al. (1990) had turned the tape off whenever their surgical patients showed even the slightest signs of cortical arousal or if Wood et al. (1992) had played their tape while their subjects slept normally.

HOW DEEP IS PRECONSCIOUS PROCESSING?

To take up the question situational limits on preconscious processing, it should be understood that the degree of information processing found in anesthesia by Kihlstrom et al. (1990) experiment was quite limited. Technically, it was an instance of repetition priming, because all of the information presented at the time of test was also presented at the time of encoding. Even though the cue and target were associatively related to each other, therefore, it is not necessarily the case that the meanings of the words were processed or that the semantic relations between them formed the basis for the priming effect. The entire effect could have been mediated by what Schacter (1990a; Tulving & Schacter, 1990) has called a perceptual representation system — a memory store that preserves information about the structure of a stimulus but not any of its semantic features. Even if repetition priming is possible in anesthesia (or sleep, for that matter), it will remain to be demonstrated that more complex semantic processing can take place in such states of extremely low cortical arousal. Put another way: just because repetition priming may be possible in anesthesia, it does not follow that other forms of priming, which are mediated by semantic representations, are also possible—or that they are possible under all conditions.

Consider, for example, the vagaries of implicit memory in amnesic patients and normal subjects. It is fairly easy to get priming for lists composed of familiar words, but what about for unfamiliar material? In an extensive series of studies, Schacter, Graf, and their colleagues (Graf & Schacter, 1985; for reviews, see Schacter, 1987; Schacter et al., 1993) developed a paradigm in which subjects

studied paired associates consisting of unrelated words (e.g., *WINDOW–REASON*); priming was tested by asking subjects to complete a stem (*REA___*) that was presented in the context of either the original cue (*WINDOW*) or a new one (*OFFICER*). Context-specific priming was observed on the word-stem completion task, indicating that new associations can be formed between previously unassociated words and expressed implicitly, but this occurs only when subjects are able to engage in elaborate and organizational processing at the time of encoding or when subjects are aware of the connection between the items presented on the priming test and those presented during the study phase. Similarly, amnesic patients are able to show context-specific priming, but only those who are mildly or moderately impaired. So amnesic patients show some evidence of implicit memory, but they do not show implicit memory for everything or in every circumstance.

The question of processing limits pervades the literature on implicit perception. Recall that Marcel (1983a) revived research in this area with evidence of masked semantic priming: primes such as *DOCTOR* primed lexical decisions about targets such as *NURSE*. Other investigators have also obtained semantic priming effects, but it has to be said that the magnitude of these effects varies markedly with stimulus conditions. Again, the distinction between objective and subjective thresholds is highly relevant (Merikle & Reingold, 1992). As stimulus conditions become progressively more degraded, subjective awareness of the stimulus initially disappears, but discriminative response to the stimulus remains above chance levels: this is the subjective threshold. Later, discrimination itself falls to chance levels: this is the objective threshold. The available literature, summarized by Greenwald (1992), indicates that semantic processing of subliminal stimuli is most likely at stimulus levels that are close to the subjective threshold; as stimulus levels move toward the objective threshold, semantic priming becomes less likely.

Moreover, Greenwald (1992) has persuasively argued for another limitation on subliminal semantic processing: subjects may be able to extract meaning from a single word, but they appear to be unable to extract meaning from a phrase made up of two words. Greenwald's experiments are especially interesting, because of the great care he has taken to present stimuli at or near the objective threshold, thus obviating Eriksen's (1960) devastating criticisms of the early subliminal perception literature (Greenwald et al., 1989). In their studies, masked presentation of a negative word like *ENEMY* primes judgments of the connotative meaning of an affectively congruent word like *TORTURE*. But under the same conditions, a positive phrase like *ENEMY LOSES* does not appear to prime judgments of an affectively congruent word like *VACATION*. Apparently, stimulus presentation near the objective threshold does not afford the cognitive system the opportunity to process the meaning of a two-word phrase.

A finding like this spells trouble for advocates of subliminal advertising (Moore, 1982, 1988). If preconscious processing has trouble extracting the meanings of single words presented close to objective threshold, it is not at all clear that the mental apparatus can make sense of a whole phrase such as *BUY YOUR NEXT REFRIGERATOR AT SEARS*. Similar difficulties are posed by the advocates of subliminal selfhelp tapes, which contain therapeutic messages (of course, the

self-help tapes have other problems, like the apparent fact that some of them do not contain any detectable messages at all (Merikle, 1988) or that they are no more effective than placebos (Greenwald, Spangenberg, Pratkanis, & Eskenazi, 1991).

The problem is exemplified by the rather large research tradition on what is known as subliminal symbiotic stimulation. In a remarkable series of experiments, Silverman, Weinberger, and others (Silverman, 1976; Silverman & Weinberger, 1985; Weinberger & Harday, 1990; Weinberger & Silverman, 1990) have shown that the repeated subliminal presentation of the sentence *MOMMY AND I ARE ONE* has generally salutary effects on emotion and behavior. Silverman's explanation of this effect is that the subliminal perception of this stimulus makes more or less direct contact with primitive unconscious desires for the comforting, protective, nurturing mother of early childhood—a situation that results in all sorts of salutary effects. Weinberger (1992) has proposed that the actual mediator of this effect is the positive affect brought about by perception of the subliminal symbiotic stimulation—which, if true, would demystify the phenomenon by bringing it in line with the work on subliminal mere exposure effects discussed earlier. But first we have the problem of Greenwald's (1992) two-word challenge: if preconscious processing cannot analyze the meanings of fairly straightforward two-word phrases like *ENEMY LOSES*, why should it be able to understand a fairly obscure sentence like *MOMMY AND I ARE ONE*?

SUBCONSCIOUS PROCESSING

So far, all of the evidence on the psychological unconscious has come from studies of what might be called *preconscious processing*—that is, the effects on experience, thought, and action of percepts and memories that are in some sense too weak to be represented in phenomenal awareness. I use the term preconscious to indicate that if circumstances were different—if the stimulus were stronger or longer or unmasked, if the trace were more elaborate, the retention interval shorter, or the retrieval environment richer—these mental contents *could* be brought into awareness. They are potentially conscious—in contrast to the procedural knowledge involved in language, perception, and learning which is apparently unconscious in principle, and cannot be brought into phenomenal awareness in any circumstances. The idea of a continuum of consciousness is closely tied to the distinction between preconscious and conscious mental representations.

But just as subliminal perception does not exhaust the category of implicit percepts (because there are some instances of implicit perception where the stimulus is in no sense subliminal), preconscious percepts, memories, and the like do not exhaust the category of nonconscious mental states. Of special relevance here is work on hypnosis as a means of altering conscious awareness (Hilgard, 1977/1986; Kihlstrom, 1984). Hypnosis is a social interaction in which one person offers suggestions to another for imaginative experiences involving alterations in perception, memory, and voluntary control. Many of these suggestions involve negative alterations of awareness: that is, the hypnotic subject is unable to gain conscious access to percepts, memories, or other mental contents of which they would ordinarily be aware.

Consider the phenomenon of hypnotic analgesia, in which the person is unaware of ordinarily painful stimuli, such as ischemic muscle pain or cold-pressor pain (for a review, see Hilgard & Hilgard, 1975/1983). In ordinary circumstances pain quickly becomes intolerable in these situations; but when hypnotizable subjects receive suggestions for analgesia, pain mounts more slowly and remains tolerable for a much longer period of time, and some subjects appear to be completely oblivious to the pain. Here the stimulus is not in any sense subliminal—in fact, quite the contrary!—and the subject's cognitive resources are not sapped by self-distraction or other pain-control strategies (Miller & Bowers, 1986, 1993). Yet the pain is not consciously perceived. We know that the pain has registered, because we can record related psychophysiological changes such as heart-rate acceleration; and under certain conditions we can recover veridical pain reports from these same subjects—that is, reports that parallel those given by subjects who have not received hypnotic suggestions. Yet it is not represented in the subject's phenomenal awareness.

We see something similar in the phenomenon of posthypnotic amnesia, in which subjects are unable to remember the events and experiences that transpired while they were hypnotized (for reviews, see Kihlstrom, 1985; Kihlstrom & Barnhardt, 1993). This amnesia is not a result of impoverished encoding: it is quite easy to obtain amnesia for wordlists that have been intentionally memorized to a strict criterion of learning; moreover, the material can be recovered when the amnesia suggestion is canceled by a prearranged cue. So, this amnesia is unambiguously a retrieval effect—one of the few examples around. As we might expect, material covered by posthypnotic amnesia continues to exert priming effects on posthypnotic task performance, but these priming effects are also different from what we usually observe in implicit memory. Thus, in an early study from my laboratory, we were able to observe priming effects on a free-association task (Kihlstrom, 1980, Experiment 1). Having memorized the word *BUTTER*, subjects were more likely to produce *BUTTER* in response to *BREAD*, compared to subjects who had not memorized the word. But this is genuine associative priming, because the cues were not part of the study list. Thus, the priming cannot reflect the mere preservation of some perceptual representation of stimulus input; rather, the priming is mediated by semantic associations formed at the time of encoding. Now, there are other examples of semantic priming around, but most of these are not independent of explicit memory. Here associative priming is independent of explicit memory, because it occurs regardless of whether the subject remembers the item from the study list or indeed regardless of whether the subject remembers the study episode at all.

Was there any way in which the amnesic subjects differed from control subjects who were not amnesic? In most respects no, but in one very important respect, yes. In a conceptual replication, subjects were taught four instances of each of four conceptual categories (Kihlstrom, 1980, Experiment 2). Later, following a free recall test, they were asked to generate instances of these same categories and controls. Amnesic subjects showed priming effects that were identical in magnitude to those of nonamnesic controls, even though they could not remember the items they had learned. But the nonamnesic subjects showed significant clus-

tering of list items, and thus faster retrieval of targets, while the amnesic subjects did not. In other words, the nonamnesic subjects were able to strategically capitalize on their explicit memory for the study list and its conceptual organization; the amnesic subjects, by contrast, were left to the vicissitudes of associative memory.

The point of all of this is that the psychological unconscious is not limited to the effects of degraded, poorly processed percepts and memories, mental contents that hardly qualify as percepts and memories at all. The percepts and memories that are affected by hypnotic suggestion, however, surely do qualify as percepts and memories, fully formed mental contents. They are contents that *should* be conscious, but are not conscious. Following William James, Pierre Janet, Morton Prince, and others, I label these classes of mental representations as *subconscious*. They have all the properties of conscious mental states except for one little detail: they are not conscious.

Evidence of subconscious processing is important because it violates the principle of a continuum of consciousness. The percepts affected by hypnotic analgesia, anesthesia, and negative hallucinations are all supraliminal, while the memories affected by posthypnotic amnesia are all deeply processed and available for memory. If suggestions were not offered to the hypnotized subject, they would be perceived and remembered clearly and easily. Similarly, hypnotized subject are in no sense brain-damaged and are otherwise in possession of their normal information-processing resources. If they were not hypnotized, they would perceive and remember clearly and easily. It seems evident that something else must be involved in becoming consciously aware of something. Elsewhere (Kihlstrom, 1993a), I have followed Claparede (1911/1951) in suggesting that the critical factor in conscious awareness is the mental representation of the self as the agent or experiencer of the event in question. If mental representations of events make contact with a mental representation of self active in working memory, they become part of our phenomenal awareness; if not, we are not aware of them, although these events may still influence experience, thought, and action implicitly, outside of awareness.

IS THE UNCONSCIOUS SMARTER THAN YOU ARE?

All of this psychological research (and much, much more) fails to inform us about the mind–body problem, but it does tell us something important about the nature of consciousness viewed in strictly psychological terms and the relations between conscious and unconscious mental life. We now understand, as we did not understand 30 years ago that consciousness is not to be identified with the capacity for discriminative response, because discriminative behavior can occur without any subjective awareness of the thing to which we respond.

The psychological unconscious is not to be identified with Freud's notion of primitive instincts seething up out of the id, and the defense mechanisms unconsciously arrayed by the ego to repress and thwart them. The unconscious is kinder and gentler than that. It can include some mental contents that are rather banal and others that are quite pleasant.

Nonconscious mental contents are not merely latent, waiting to be attended to or retrieved and brought into consciousness where they can do some work. The psychological unconscious is truly dynamic in that unconscious mental contents can influence the person's ongoing, and conscious, experience, thought, and action.

The extent of this influence depends on the manner in which the contents in question have been rendered unconscious. By and large, the effects of preconscious percepts and memories are severely limited: we simply do not get as much out of them as we do their conscious counterparts. Subconscious percepts and memories can have a more profound influence, but even here there are limits: conscious awareness is a logical precondition for conscious control, and we cannot make strategic use of either preconscious or subconscious percepts and memories. A recent newspaper article was entitled "Your Unconscious Mind May Be Smarter Than You" (Goleman, 1992). No: even in the case of subconscious mental life, your unconscious is stupider than you are. The scope of preconscious and subconscious processing simply cannot match that of conscious processing. Notions to the contrary seem not to reflect the available evidence, but rather certain romantic notions about an omniscient unconscious derived from either psychoanalytic theory or humanistic psychology (Kihlstrom, 1993c).

Finally, it should be clear that consciousness is not simply a matter of paying attention, consuming some critical mass of mental resources, or engaging a sufficient amount of cortical workspace. There needs to be something else. Whether that "something else" is a connection between one brain module serving some mental function and another one serving as a conscious awareness system, as some cognitive neuropsychologists have suggested (Moscovitch, 1992; Schacter, 1990b), or a connection between mental representations of experience and an activated mental representation of the self, as I have suggested, or something else, is a problem for research and theory in the future.

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