

Cognition, unconscious processes

John F. Kihlstrom

1. The Psychological Unconscious

The *psychological unconscious* refers to mental structures and processes that influence a person's ongoing experience, thought, and action outside of conscious awareness (Kihlstrom, 1987). In the 19th century, the concept was exemplified by Helmholtz's idea that conscious perception is based on unconscious inferences; by Pierce and Jastrow's demonstration of the registration of subliminal stimuli; by the notions of co-conscious and subconscious thought developed by Janet and James on the basis of their observations of hysteria and hypnosis; and of course by Freud's assertion that conscious mental life is determined by unconscious conflict surrounding primitive sexual and aggressive impulses.

Interest in both conscious and unconscious mental life fell off markedly during the heyday of behaviorism but was revived with the cognitive revolution in psychology. The early multistore models of human information processing, by implicitly identifying consciousness with attention and primary (short-term, working) memory, left only a rather restricted place for unconscious mental processes. According to the "wastebasket" view, the unconscious consisted of unattended percepts and unrehearsed memories that were subsequently lost through decay and displacement. According to a more substantial view, the unconscious was identified with preattentive perceptual processes involved in feature detection and pattern recognition, and with latent memory traces stored in secondary (long-term) memory. In either case, the implication was that nonconscious mental structures make no contact with the "higher" mental processes, and thus cannot directly influence conscious experience, thought, and action.

2. Automaticity

More recently, it has been popular to distinguish between *automatic* and *controlled* mental processes (Shiffrin and Schneider, 1984). Automatic processes are inevitably engaged by the appearance of specific environmental stimuli, regardless of the person's conscious intentions. Once evoked, they proceed inevitably to their conclusion. Some processes are innately automatic, whereas others become automatized after extensive practice, or routinization. In either case, execution of an automatic process consumes no attentional resources; nor does it interfere with other ongoing cognitive processes, or leave any trace of itself in memory. Although automaticity was originally confined to relatively low-level perceptual processes, experiments on social cognition and behavior indicate that highly complex cognitive activities can go on outside of conscious awareness as well (Bargh and Chartrand, 1999). Automatized processes form the person's repertoire of *procedural knowledge* (Anderson, 1992). Controlled processes are executed consciously and deliberately. By contrast, automatic processes appear to be unconscious in the strict sense of being inaccessible to introspection under any circumstances and knowable only by inference.

3. Implicit memory

Although procedural knowledge may be unconscious, declarative knowledge is generally held to be accessible to conscious awareness. However, it is now clear that mental states need not be represented in phenomenal awareness in order to influence ongoing experience, thought, and action. Recent work on memory functions in both amnesic patients and intact subjects motivates a distinction between *explicit memory*, which involves the conscious recollection of a previous episode, and *implicit memory*, in which there is a change in experience, thought, or action that is attributable to a past episode, even if the event is not consciously remembered (Schacter, 1987). For example, amnesic patients who studied *assassin* in a word list will be unable to recall or recognize that word subsequently, but when they are asked to complete the fragment *_ss_ss_n* with an English word will be more likely to do so than if they had not studied the word at all. This effect, where one task facilitates another one, is known as *priming*. In addition to patients with lesions of the hippocampus and the medial temporal lobes, spared priming has also been observed in the amnesias associated with electroconvulsive therapy (Dorfman et al, 1995), conscious sedation (Cork et al, 1996), and hypnosis (Kihlstrom, 1997).

The dissociation between priming and recall or recognition can also be observed in normal, neurologically intact subjects. For example, recall and recognition are affected by the "level" at which items are processed at the time of encoding, but priming effects on perceptual identification are not (Jacoby and Dallas, 1981). Similarly, subjects can show savings in relearning a list of words that they cannot recall or recognize (Nelson, 1978). Because priming effects can occur in the absence of conscious recollection (in amnesic patients), or independent of factors known to influence conscious recollection (in normal subjects), they constitute unconscious expressions of memory for the past.

4. Implicit perception

Implicit memory is conceptually related to subliminal perception, or the processing of stimuli that are so degraded by low intensity, short duration, distracting context, or masking stimulus that they cannot be consciously perceived. Although claims of subliminal perception aroused considerable controversy for almost 100 years, it has now been demonstrated convincingly that events in the current stimulus environment that are not consciously detected and attended may nonetheless be processed for meaning, at least to some extent ([Draine and Greenwald, 1998](#)). For example, masked presentation of the word *enemy* makes it easier to judge that the semantically related word *war* is affectively negative. Apparently, subliminal perception occurs in the "space" between a *subjective threshold*, where subjects' confidence in their perception falls to zero, and an *objective threshold* where discriminative response to a stimulus falls to chance levels ([Cheesman and Merikle, 1985](#)). Because truly subliminal perception is limited to relatively simple "automatic" analyses ([Greenwald, 1992](#)), claims for the power of subliminal advertising or therapy are probably exaggerated ([Moore, 1992](#)).

Unconscious perception can also be observed when the stimuli are in no sense subliminal. For example, in *blindsight*, patients with damage to the striate cortex of the occipital lobe can make above-chance judgments of the visual properties of stimuli that they cannot see ([Weiskrantz 1995](#)). Something similar can be observed in patients with hemianopia who show *visual neglect* ([Schweinberger and Stief, 2001](#)) or extinction ([Vuilleumier and Rafal, 2000](#)). In *prosopagnosia*, patients with damage to the mesial portions of the temporal and occipital lobes of the cerebral cortex can no longer recognize familiar faces, but they may display differential behavioral and psychophysiological responses to old and new faces ([Bauer, 1984](#)). Processing outside of awareness can also be demonstrated in psychiatric patients with conversion disorder who are functionally blind or deaf ([Bryant and McConkey, 1989](#)), and in blindness and deafness suggested by hypnosis ([Bryant and McConkey 1989](#)). By analogy with implicit memory, implicit perception is said to occur when a person's experience, thought, or action is affected by an event in the *current* environment, in the absence of, or independent of conscious perception. Implicit memory for events occurring during general anesthesia, when the person is unconscious, constitutes evidence of implicit perception as well ([Ghoneim and Block, 1997](#)). Implicit perception, including but going beyond strictly subliminal perception, is unconscious perception.

5. Implicit thought and language

Unconscious priming effects in memory and perception provide a paradigm for revealing unconscious processing in other cognitive domains. For example, subjects can guess which of two closely similar word or picture puzzles is soluble, even though they are not aware of what the solution is ([Bowers et al, 1990](#)). These experimental outcomes provide evidence for *implicit* thought, when the solution to a problem, or some other mental content which is neither a percept (i.e., a representation of a current event) nor an episodic memory (i.e., a representation of a past event), affects task performance, even though the person is not aware of the thought itself. There may also be evidence for unconscious processing in language. For example, prior presentation of words can give rise to priming effects even in alexic patients who cannot read whole words but must decode them letter by letter ([Schacter et al, 1990](#)). Furthermore, normal subjects show priming of entries in the mental lexicon even when the primes are presented subliminally ([Forster et al, 1990](#)). Word priming may indicate that the mental lexicon is intact in patients who do not have conscious, deliberate access to it. Implicit thought is particularly interesting, because it may form the basis of the "intuition" stage in problem solving. By the same token, "incubation" effects may reflect the process by which implicit thoughts become explicit, and thus accessible to conscious awareness ("insight") and reflection on the part of the problem-solver.

6. Implicit learning

Long before implicit memory received its name, implicit learning was described as the acquisition of knowledge through experience, without awareness of the knowledge thus acquired—or, in some cases, even of the acquisition process ([Reber, 1967](#)). For example, subjects who memorize meaningless letter strings produced by an artificial grammar (such as *PVPXVPS* or *PTTTVPS*) are subsequently able to distinguish new grammatical strings (e.g., *PTTTTVPS*) from those that are not grammatical (e.g., *PTVPXVSP*), without being able to describe the grammar itself. Similarly, subjects can learn to predict the behavior of a system without being able to articulate the equation that describes the relation between inputs and outputs ([Dienes and Perner, 1999](#)). Claims for implicit learning are controversial, because performance might be mediated by conscious access to partial knowledge of the relevant function. Nevertheless, it has been suggested that unconscious learning is a phylogenetically primitive capacity that humans share with a broad spectrum of other animals.

7. Beyond implicit cognition

Implicit perception, memory, learning, thought, and language processing constitute the cognitive unconscious, and raise questions of whether emotional and motivational states might be unconscious as well. Support for a concept of implicit emotion is provided by evidence of *desynchrony*, a form of dissociation in which subjects show behavioral or physiological signs of emotion, even though they are unaware of any changes in feeling state (Rachman and Hodgson, 1974). It has also been suggested that *implicit motivation*, assessed through the appearance of motive-related imagery in stories and other productions, can be dissociated from explicit motivation assessed through self-reports through personality questionnaires (McClelland et al, 1989). Recently, priming paradigms have been employed by social psychologists to assess implicit attitudes, stereotypes, and self-concepts that may diverge radically from those that people consciously acknowledge and express (Greenwald et al, 2002). Although the idea of unconscious emotional and motivational states seems somewhat reminiscent of Freudian psychoanalysis, modern research on unconscious mental life owes nothing to Freud and provides no support for psychoanalytic theory.

8. Neural correlates of consciousness

Research on unconscious mental life—cognition, emotion, and motivation—offers a new perspective on the neural correlates of consciousness (NCC), by showing that "the unity of consciousness is illusory" (Hilgard, 1973). The brain structures and functions specifically responsible for conscious experience will not be discovered simply by comparing the normal state of alert, attentive wakefulness to sleep, anesthesia, or coma. This is because people who are awake, alert, and attentive can process some information automatically and unconsciously. For this and other reasons, they can be unaware of implicit percepts, memories, and thoughts that nonetheless affect their ongoing experience, thought, and action. Neurological patients who show explicit-implicit dissociations in one domain or another take us one step further, but they also add complications. For example, studies of organic amnesia suggest that the hippocampus and related structures in the medial temporal lobe are responsible for conscious recollection, but the striate cortex and related structures are responsible for conscious vision. Thus, it may be that there are different brain systems responsible for consciousness in different domains. Alternatively, perhaps conscious recollection, vision, and the like are mediated by a specialized brain module that can be selectively disconnected from modules responsible for memory, vision, and so on (Schacter, 1990).

The search for the NCC is further complicated by the fact that dissociations between explicit and implicit cognition can be found in neurologically intact individuals. Perhaps brain-imaging technologies such as positron-emission tomography (PET) and magnetic resonance imaging (MRI) will be helpful in this case. However, the wide variety of such dissociations observed makes it seem unlikely that we will be able to identify any single brain system that is responsible for conscious mental life. The point is not that the search for the NCC will be fruitless but rather to define the problem of the NCC more broadly. The problem is not simply to discover the neural correlates of consciousness, defined as waking, alert, attentiveness, but also to discover the neural correlates of both conscious and unconscious processing in persons who are already awake, alert, and attentive.

At the psychological level of analysis, all aspects of unconscious mental life appear to have in common a disruption of the connection between experience and the self—what Claparede called "*moi-ite*" or "me-ness" (Claparede, 1911, 1951). All conscious mental states involve the first-person pronoun: "I remember *assassin*" or "I see *enemy*." By contrast, all implicit expressions of perception, memory, and thought lack this core of self-reference: "The word whose fragment is *_ss_ss_n* is assassin" or "The concept *war* is unpleasant." Therefore, it seems that consciousness requires that a link be forged between an activated mental representation of an event and an activated mental representation of oneself as the agent or patient, or stimulus or experiencer of that event. If this analysis is correct, then the search for the NCC should focus on the neural representation of the self and the neural systems responsible for self-reference.

9. Author notes

The point of view represented in this article is based on research supported in part by NIMH Grant MH-35856.

10. See Also

[Anesthesia, effects on cognitive functions](#)

[Cognition](#)

[Consciousness: neural basis of conscious experience](#)

[Learning and memory, neural mechanisms](#)

[Psychoanalysis \[Classic paper\]](#)

[Psychoanalysis and neurobiology](#)

Author's website:

<http://socrates.berkeley.edu/~kihlstrm>

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