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REVIEW ARTICLE

The (Re)Discovery of the Unconscious: What We Have Learned from Neuroscience

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Abstract

While the unconscious mind is often viewed as the shadow of the "real" conscious mind, there is growing evidence that it is no less complex, intentional, or flexible than its conscious counterpart. Unconscious systems regulate a variety of cognitive processes which can influence behavior and emotions. Neuroscience has begun to investigate the neural correlates of these processes and their interactions with conscious processes. Although there are no specific brain structures or circuits dedicated to processing unconscious thought, all brain regions are involved in both conscious and unconscious thought. However, the relationship between the unconscious and consciousness remains unclear. It is uncertain whether these automatic and implicit activities can be conceptualized and organized in a self-unconscious mind that is similar to the self-conscious mind. Although perceptions, feelings, motivations, and some decision-making processes can occur outside of awareness, these implicit activities lack the ability and intensity to self-organize in a coherent and meaningful representation of reality.

Keywords

Unconscious, Neural mechanisms, Conscious, Unconscious mind

Introduction

It is commonly believed that Freud discovered the unconscious, but Henri Ellenberger's "The Discovery of the Unconscious" (1970) shows that theories of the unconscious pre-date Freud by at least a century. Today, fifty years later, it is important to re-evaluate the concept and nature of the unconscious in light of recent neuroscience research. Is there really an unconscious mind? If so, how can two unconscious minds coexist differently and be incompatible with each other, such as the Freudian and Ericksonian models? Moreover, what can the latest neuroscience research teach us about this fascinating subject?

Conscious vs. Unconscious mind

Many cognitive scientists still view the unconscious mind as a mere "shadow" of its conscious counterpart [1-3]. This raises the question of how well the mind can extract meaning from stimuli that are not consciously perceived.

In a consensus conference held by Loftus and Klinger [4], the question of whether the unconscious mind is "smart or dumb" was posed. As the unconscious mind was considered to be subliminal, the consensus was that the unconscious mind is rather "dumb" as it is only capable of highly routinized activities and perceives little without the aid of consciousness [4]. Numerous studies have shown that subliminal stimuli are relatively weak and of low intensity, so the mental processes they drive are necessarily minimal and irrelevant, suggesting that the powers of the unconscious mind are limited [4].

There is a high level of agreement regarding the characteristics of conscious thought processes. These processes are typically intentional, controllable, sequential, and can be accessed through awareness, meaning that they can be reported verbally [1].

By contrast, there is currently no clear consensus on the nature of the unconscious mind. Early psychodynamic theorists attempted to explain phenomena observed in clinical settings, while later cognitive scientists used computational models of the mind to describe empirical data. Recent research in imaging, psychophysics, and neuropsychology suggests

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that unconscious processes may take several hundred milliseconds before becoming consciously aware [5].

Advances in neuroscience are now enabling researchers to investigate the complexities of the unconscious mind in greater detail, and most cognitive neuroscientists believe that numerous complex cognitive processes and mental activities can occur outside of conscious awareness [6].

Unconscious mind vs. unconscious processes

Extensive data support the notion that a significant part of our mental activity, including thoughts, feelings, and motives, occurs outside conscious awareness [7]. Recent research has revealed that similar principles apply to cognition involving unconscious (implicit) affective and motivational processes, leading to the expansion of the Cognitive Unconscious to the Cognitive-Affective-Motivational Unconscious [8,9]. While there is robust evidence that lower-level processing, such as motor reflexes and sensory analysis, can occur outside of perceptual awareness (implicitly), there is still some debate regarding higher-level processing, such as semantic or inferential processing [10,11]. Kouider & Dehaene [12] suggest that for a stimulus to reach consciousness, it must have sufficient strength and receive top-down attention.

Subliminal perception: Subliminal perception occurs when stimuli are processed by our sensory systems but do not reach the threshold of consciousness, as they are presented below the limen of conscious perception. Subliminal priming can occur in various sensory modalities and with different stimuli (visual, verbal, auditory, etc.) and it is inferred when a stimulus is not perceived, yet it still influences actions, thoughts, feelings, learning, or memory.

Studies have shown that subliminal stimuli can still be highly processed and can even activate motor responses [13-15]. These studies suggest that subliminal words activate cognitive processes associated with their meanings, even though the effect is not consciously perceived. Therefore, it appears that some stimuli detected by our sensory organs do not reach the threshold of conscious awareness, yet they are still processed by our neural network and can influence higher-level cognitive processing and behavior.

A recent study by Railo, et al. [16] found that participants were able to accurately discriminate the location of a visual stimulus they reported not seeing, albeit only slightly above chance level. Signal detection analyses revealed that while the participants categorized their percepts as “unconscious,” their capacity to discriminate the stimuli was on the same continuum as conscious vision. These findings suggest that subliminal perception is not a separate unconscious capacity, but rather based on similar processes as conscious vision.

Neuroimaging studies have also shown that subliminal priming evokes activation in several cortical areas [12]. However, cortical activation of subliminal stimuli is often weaker compared to supraliminal stimuli.

Affective (emotional)-motivational unconscious: Current evidence supports the idea of an affective (emotional)-motivational unconscious, based on the notion that mental activity is influenced by phylogenetically old emotion and motivation systems that shape early mental development [17-19].

Studies on the Emotional Unconscious provide compelling evidence that individuals can experience emotions without being aware of them and can act on these unconscious feelings [7,8,20].

Evidence suggests that emotional processing can be initiated and proceed without conscious awareness [17,21-25].

Research on brain lesion patients provides evidence that nonconscious stimuli can elicit emotional states. For instance, "affective blindsight" [26,27] is a phenomenon where patients with primary visual cortex lesions can have affective responses to emotional visual stimuli presented in their blind visual field without conscious awareness of the stimuli. Despite maintaining that they are blind, they have accurate behavioral responses to visual tracking and other select visual tasks, which are thought to be mediated by extrageniculostriate retinofugal pathways [26]. Thus, they can perceive visual stimuli in some way even though they are not conscious of doing so. These "unconscious emotion" effects are thought to be mediated by a subcortical visual pathway that includes the superior colliculus, pulvinar thalamus, and amygdala [28-30].

In accordance with this, blindsight patients show modulation of amygdala activity in response to the emotional meaning of stimuli they cannot see consciously [31-33].

In some cases, subliminally presented stimuli can lead to autonomic responses without the subject being aware of their emotional reaction. Two studies have shown that emotional states that are not consciously experienced can still influence behavior. Adolphs, et al. and Winkielman, et al. [34,35] found that subliminally presented happy or angry faces, which participants did not consciously perceive, could still affect their subsequent drinking behavior. Specifically, participants rated beverages as more pleasant and were willing to pay more for them after being subliminally presented with happy faces. Conversely, participants rated beverages as less pleasant and were willing to pay less for them after being subliminally presented with angry faces. These findings suggest that nonconscious stimuli can impact motivation, value judgment, and goal-directed behavior, even in the absence of conscious affective feelings.

The processing of unconscious emotions is predominantly done by a right hemisphere subcortical route that allows emotional stimuli to quickly reach the amygdala. The right hemisphere appears to store "non-removed unconscious memories," while conscious and unconscious emotions activate the right and left amygdala in opposite ways [36].

Unconscious motivational processes and decision-making: Motives can be activated unconsciously. Some experts believe that the majority of the motives that drive our behavior occur outside of our awareness (known as "unconscious will").

The "Theory of Unconscious Thought" (UTT) [37,38] proposes that conscious thought, due to its precision and rule-following nature, may lead to good choices in simple matters but result in worse choices for more complex matters due to its limited capacity. Unconscious thought, or "deliberation without attention," can handle higher capacity rules but is relatively imprecise, which can lead to lower quality choices. However, the quality of choices does not decrease with increasing complexity, so unconscious thought may lead to better choices under complex conditions since it can integrate vast amounts of information into its evaluation.

In four studies on consumer choice, in both laboratory and actual shopping settings, Dijksterhuis, et al. [38] confirmed that purchases of complex products were viewed more favorably when decisions were made without careful deliberation. Choices about simple products produced better and more favorable results after conscious deliberation.

These findings suggest that complex cognitive processes like decision-making occur at the unconscious level, and it may be better to think consciously about simple matters and unconsciously about complex ones [39].

However, the existence and generalizability of the UTT have been challenged by some researchers [40,41]. In the largest analysis to date, Nieuwenstein, et al. [41] found that previous reports of the UTT were confined to underpowered studies with relatively small sample sizes and that the "large-scale replication study yielded no evidence for the UTT."

Libet's classic studies [42,43] and Wegner's [44] theory suggest that "conscious will is an illusion" as brain activation can predict simple decisions well before a person becomes aware of their intent to take a specific course of action. Soon, et al. [45] used fMRI to demonstrate that unconscious brain activity in prefrontal and parietal cortices can predict decisions made by up to 7 seconds before the subject becomes consciously aware of their decision.

In addition, research has shown that distractions can facilitate creative problem-solving, demonstrating the importance of unconscious thought in creativity [46]. Furthermore, people have been found to perform better on feature-detection tasks when they trust their instincts [47]. These findings support the notion that unconscious processes play an important role in decision-making, problem-solving, and creativity.

Unconscious defense mechanisms

Psychodynamic theories emphasize the importance of unconscious dynamic processes, which are mental processes and contents that are defensively removed from consciousness due to conflicting attitudes. Recent empirical studies in healthy and patient populations have shed light on the neural basis of classical psychodynamic concepts such as repression, suppression, and dissociation.

Repression: Repression is a mechanism proposed by Freud [48] to explain how the conscious mind pulls thoughts into the unconscious to keep unwanted, anxiety-provoking, and painful memories, thoughts, desires, and impulses from entering consciousness. These "forgotten" thoughts, memories, and urges can still influence conscious thoughts and feelings and manifest as symptoms. Freud believed that mental illness arises when these unconscious forces, wishes, and motives are in conflict and influence behavior.

The neural mechanisms underlying repression remain unknown, but individuals with a repressive personality style have been found to exhibit smaller evoked potentials to subliminal stimuli and provide fewer verbal associations to them [49]. This suggests that people who require a longer time for neural activation to develop conscious experiences of stimuli may be prone to developing repression as a defense against unacceptable unconscious desires. For example, individuals with high intelligence may be prone to developing intellectualization as a defense mechanism.

Suppression: Suppression, as proposed by Freud in 1892-93, is a voluntary form of repression where unwanted information, such as thoughts or emotions, is consciously pushed out of awareness. It is more amenable to controlled experiments than repression. Memory suppression requires individuals to stop or override the retrieval process of unwanted memories, which impairs their later retention [50].

Studies have shown that controlling unwanted memories through suppression is associated with increased activation in the dorsolateral prefrontal cortex (PFC) and reduced activation in the hippocampus. The magnitude of forgetting is predicted by both PFC and right hippocampal activations. Therefore, individuals can actively suppress unwanted memories by recruiting the dorsolateral PFC, which is involved in executive control, to disengage hippocampal processing, which is essential for declarative memory formation and retrieval [50].

Dissociation: The DSM-5 (APA, 2013) defines dissociation as “a disruption, interruption, and/or discontinuity of the normal, subjective integration of behavior, memory, identity, consciousness, emotion, perception, body representation, and motor control”.

Functional neuroimaging and psychophysiological studies support the "corticolimbic disconnection hypothesis" proposed by Sierra, et al. [51], which suggests that depersonalization occurs via a fronto-limbic suppressive mechanism mediated by attention. This mechanism generates a state of subjective emotional numbing and disables the process by which perception and cognition become emotionally colored. The hypothesis suggests that hyperactivity of the right PFC, particularly the right dorsolateral PFC, increases alertness, while left PFC activation inhibits the amygdala and other limbic structures, resulting in chronic hypoemotionality in DPD [51,52].

Dissociative Identity Disorder (DID) challenges the notion of a unitary self-consciousness and is characterized by identity fragmentation rather than proliferation. DID is typically associated with a history of severe childhood trauma [53] and involves the presence of two or more distinct dissociative identity states characterized by different emotional responses, cognitions, moods, and perceived self-images. These responses recurrently and alternately take control of one’s behavior and consciousness.

Recent neurobiological studies lend support to the diagnosis of DID and provide insights into the neural underpinnings of dissociation. Vermetten, et al. [54] conducted the first controlled structural MRI study of DID and found that patients with DID had significantly smaller hippocampal and amygdalar volumes (19.2% and 31.6% respectively) compared to healthy controls. It is possible that individuals with a small hippocampus and/or amygdala due to genetic factors may be at a higher risk for DID. Another hypothesis, the orbitofrontal hypothesis of DID [55], suggests that dysfunctional interaction between the anterior and posterior brain regions may contribute to the neurophysiology of dissociation. Sar, et al. [56,57] found that DID patients had decreased perfusion in the orbitofrontal cortex bilaterally, while having increased perfusion in the median and superior frontal and occipital regions bilaterally, as well as in the left lateral temporal region.

Charcot [58] believed that the neurological symptoms of "hysteria," now known as "dissociative (conversion) disorder," and the transient effects of hypnosis involved similar brain mechanisms. Recent cognitive neuroscience studies support this idea by demonstrating that the brain processes involved in hysteria symptoms are similar to those seen in hypnotic phenomena [59]. Moreover, there is evidence that hypnotizability is linked to developing dissociative symptoms, particularly in sensorimotor function, and that suggestions in highly hypnotizable people can replicate dissociative symptoms [59]. It is worth noting that dissociative "symptoms," whether simulated through hypnosis or diagnosed clinically, are associated with increased PFC activation, indicating that interference by the prefrontal/executive system in voluntary and automatic cognitive processes is a shared neural feature of dissociation and hypnosis [5].

Neural correlates of conscious vs. unconscious processes

The intricate interplay between conscious and unconscious processes is a topic that continues to baffle our comprehension of the human mind.

Existing evidence suggests that complex cognitive processes can occur without consciousness. The unconscious brain is both purposeful and independent and can selectively access and activate implicit goals and motives. Nonetheless, the precise role of unconscious emotions and evaluations in shaping the neural networks that give rise to conscious perception remains unclear. Studies indicate that subliminal stimuli can elicit neural activity at a relatively high level of complexity sufficient to evoke an appropriate behavioral response [1,5]. However, this neural activity is insufficient to give rise to conscious experience. Therefore, what is the missing link in this chain of events?

Conscious perception is not solely dependent on the activation of specific brain regions. Rather, it seems to be related to the coordinated dynamic states of the cortical network and the transient synchronization of widely distributed neural assemblies. This idea is supported by various studies, including Dehaene, et al., Deahane, Engel, et al., Engel and Singer, Lamme, Melloni, et al., Singer and Thompson, et al. [13,60-66].

There is a debate among researchers regarding the nature of consciousness. Some argue that consciousness arises from a quantitative increase in holistic brain functioning, meaning that the more neuronal activity there is, the more consciousness there is [67]. Others propose that consciousness is a qualitatively different property of the brain, arising from qualitative differences in neuronal activity. However, it is possible that both quantitative and qualitative neural firing properties are necessary for conscious experience to arise, as different functional states of the same substrate [68].

Unconscious processes may reflect the neural network in its modular state, which consists of relatively isolated loops of action and reaction [68], or the local coordination of neural activity and propagation along sensory processing pathways [13]. Conscious processes, on the other hand, may involve global coordination of widely distributed neural activity by long-distance synchronization [13,68]. Unconscious activity may be mediated by a rapid, feed forward netwave of activity that can trigger neurons and behaviour, but this is not

sufficient to establish a robust coalition for the 500 ms or longer necessary for conscious awareness [67].

Conclusion

The mysteries of the Conscious and Unconscious Mind remain unsolved, leaving many questions unanswered. It is unclear if the Unconscious Mind exists as a "shadow" of the Conscious Mind or as a counter-part or an anti-consciousness in its own right. Additionally, the organizational level of the Unconscious Mind and its relationship to the Conscious Mind are not fully understood. However, recent research has shown that Unconscious processes are capable of complex information processing, emotion regulation, goal pursuit, and cognitive control [6].

There is still much to learn about how conscious and unconscious drives suddenly become unconscious (e.g., repression), or unconscious drives suddenly become conscious (e.g., Freudian slips), or how or when hidden urges can be overridden by force of will [5,69]. To better understand the neural basis of consciousness, researchers must consider the complex dynamics that occur between conscious and unconscious thought and the underlying neural mechanisms [13,60,70,71]. Consciousness is believed to be generated by a quantitative increase in the holistic functioning of the brain [72], but a combination of both qualitative and quantitative neural activation may be required for conscious experience [60,73].

It is not yet clear if we can organize implicit and automatic activities in a Self-Unconscious Mind in the same way as the Self-Conscious Mind. While some researchers perceive the Unconscious Mind as the "shadow" of the Conscious Mind [1], recent studies suggest that the Unconscious lacks the capacity and intensity of implicit activities to self-organize into a meaningful and coherent representation of reality, possibly through a mechanism of bottom-up neural networks [60].

As we move away from the myth of the Freudian and Ericksonian Unconscious, modern cognitive psychology and neuroscience are helping us to better understand the essence and dynamics of cognitive activities outside of awareness. This (re) - discovery of the unconscious could pave the way for a new science of consciousness.

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