

Quick guide

Qualia

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What are qualia? Qualia — singular quale — is the philosophical term for the introspectively accessible, phenomenal aspects of our lives, the elemental feelings and sensations that are the building blocks of conscious experience. Qualia are at the very heart of the mind–body problem. How do the salty taste and crunchy texture of potato chips, the unmistakable smell of dogs after they have been in the rain, or the sensation of seeing red relate to the ever shifting patterns of electrical activity in the brain?

Why should you, as a biologist, care about qualia? The only way you know about the world, including your body, is by experiencing sensations or thoughts.

Do you need qualia? Not necessarily. Much of what goes on in the brain is not associated with qualia. Electrophysiological experiments prove that furious activity in legions of cortical neurons can fail to generate a conscious percept. In a reflex action, you will move your hand away from a hot burner before you consciously feel its heat. Many complex sensory-motor behaviors are similarly rapid and nonconscious. Anytime you drive a car, ride a bicycle, return a ball in tennis or climb a rock wall, your brain uses visual and other sensory cues to generate a very rapid, adaptive motor response. And much, if not most of this, bypasses consciousness. Francis Crick and I dubbed such automatic, highly trained sensory-motor systems ‘zombie agents’. The clumsy behavior of sleep-walkers or of patients with automatism that can occur during epileptic seizures might result from inactivation of the neural system(s) sufficient for consciousness.

Why is brain activity that triggers zombie behaviors insufficient for consciousness?

Experiments suggest that the neural activity underlying a quale must be sustained for at least several hundred milliseconds and is all-or-none. That is, on any given trial, conscious perception for any one attribute is not graded but either is experienced or not, reflecting the dynamics of the underlying neuronal coalitions. It has been argued that feedback from higher cortical regions to lower ones is critical for the genesis of a conscious percept.

How can qualia be studied in an empirical manner?

Psychologists have at their disposal many ways of hiding a stimulus from consciousness. These methods work best for vision. Lateral masking, binocular rivalry, flash suppression, change blindness or motion-induced blindness (Figure 1) are illusions in which something in plain view is not consciously perceived. In these cases, the unvoiced assumption of a straightforward relationship between a physical stimulus in the world and the associated quale in your head is violated. You may not see the stimulus, even though it is perfectly visible. Where in your brain, or that of a macaque monkey trained to push a button each time the stimulus becomes visible, are the neurons that are only active when the stimulus is consciously seen? Electrophysiological experiments show that individual neurons in the early stages of the visual pathway — the lateral geniculate nucleus (LGN) and the primary visual cortex (V1) — care little about the percept, firing in response to the physical presence of a particular stimulus: the exuberant spiking activity of tens of thousands or more of neurons in these regions does not appear to contribute to the subject’s percept. But neurons in the inferior temporal cortex, in monkeys, or the medial temporal lobe, in humans, fire only when the stimulus is actually consciously seen by the subject. When the image isn’t seen, the neurons are quiet. In this way, the footsteps of consciousness can be tracked throughout the brain.

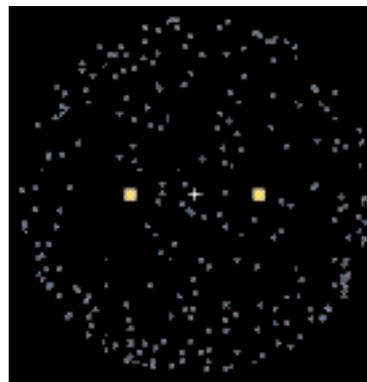


Figure 1. In motion-induced blindness, the swirling cloud of blue dots transiently suppresses the conscious percept of one or both bright, yellow squares. Modified from Bonnef et al. (2001). *Nature* 411, 798–801.

Is there any hope of moving from mere correlation to causation? Yes. This requires behavioral assays, tasks that in humans require conscious awareness and that can be extended to mice, flies or other genetic model organisms. Animals that pass such a battery of tests — akin to the Turing test for artificial intelligence — could be considered to be conscious to some degree. A crucial component of any such assay must be the storage of information for at least a few seconds. Certain forms of associative Pavlovian aversive conditioning appear quite promising. Conventional pharmacological intervention, combined with more targeted molecular protocols can then be devised to selectively, transiently, reversibly, and delicately inactivate populations of neurons that underlie these tasks. In this way, the neuronal correlates of consciousness can be discovered and characterized.

Where can I find out more?

Koch, C. (2004). *The Quest for Consciousness: A Neurobiological Approach*. Roberts and Publishers, CO (<http://www.questforconsciousness.com>)

Neural Correlates of Consciousness (2000). T. Metzinger, ed. (MIT Press: Cambridge).

The Association for the Scientific Study of Consciousness (<http://www.assoc.caltech.edu/>) puts on excellent annual meetings.

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