



## Mind and Body

Taking a bite of a Granny Smith apple releases a torrent of sensory experiences—a tart tang on the tongue, a savory smell in the nose, a crisp crunch at the ear, a firm feel in the hand, a chartreuse color at the eye. This bite also releases a torrent of neural activity in multiple areas of the brain. It is natural to ask: What is the relation between sensory experiences and neural activity? This question, in various forms, has perplexed philosophers for centuries. It now absorbs scientists in fields such as neuroscience, cognitive science, and computer science. All now agree that there are clear correlations between sensory experiences and neural activity. But, remarkably, there is no consensus on how to interpret these correlations: We have, as yet, no adequate theory of the relation between mind and body.

### Neural correlates of consciousness

There are many correlations between sensory experience and neural activity. In the case of vision, for instance, activity in the right hemisphere of the brain is correlated with visual experience in the left visual field, i.e., in the field of vision to the left of where one is directly looking. Similarly, activity in the left hemisphere of the brain is correlated with visual experience in the right visual field.

The two hemispheres are normally connected by a large band of neural fibers called the corpus callosum, allowing neural activity to flow back and forth between them. This band has been surgically cut in several patients to treat epilepsy. In an experiment

with such patients, one briefly shows a visual image of the phrase “KEY RING” so that KEY appears in the patient’s left visual field and RING appears in the right visual field. If the patient is asked to say out loud what they saw, they say “ring” and give no evidence of having seen the word “key.” If asked to draw with their left hand what they saw, they draw a picture of a key, and give no evidence of having seen the word “ring.”

This striking result is explained as follows. Speech is correlated with activity in the left hemisphere, whereas control of the left hand is correlated with activity in the right hemisphere. The left hemisphere was shown only the word “key,” and the right hemisphere only the word “ring.” The severed corpus callosum prevented neural activity from being shared between the two hemispheres. This failure to share neural activity is correlated with failure of the sensory experiences correlated with each hemisphere to be integrated into a single sensory experience. This experiment raises the fascinating question of how many selves, i.e., how many subjects of experience, comprise the patient with a severed corpus callosum. If there are two subjects of experience, were there also two before the corpus callosum was severed?

### Philosophical theories

Philosophical theories of the relation between mind and body come in three basic types: Physicalist, substance dualist, and idealist. There are many varieties of these basic types.

Physicalism asserts that only physical entities and properties exist. What counts as physical will no doubt evolve as the science of physics evolves. Among the entities and properties currently expected to count as physical are space-time, matter, energy, spin,

and charge. Some physicalist accounts of mind and body claim that physical systems, such as the brain, *cause* sensory experiences. Other physicalist accounts claim that sensory experiences *are identical to* brain states or processes. Still others claim that sensory experiences do not exist, and are therefore not caused by or identical to brain processes. Physicalism is the dominant philosophical theory today.

Substance dualism asserts that physical substances and mental substances both equally exist, and that neither can be reduced to the other. Sensory experiences are not identical to brain processes, nor do they depend on the brain for their existence. The relation between body and mind is like the relation between horse and rider. The French philosopher Rene Descartes famously espoused a version of substance dualism in which the mind interacted with the body at the pineal gland.

Idealism asserts that only consciousness and its contents exist. The physical world, including the brain, is among the sensory experiences that are the contents of consciousness. On this view, brain activity is caused by consciousness, and the brain itself exists only as sensory experiences created by consciousness. The British philosopher George Berkeley advocated a version of idealism, summarized by the dictum “*esse est percipi*” (to be is to be perceived).

### Scientific theories

Contemporary scientific theories of mind and body are almost exclusively physicalist. Most try to pinpoint processes of the brain that are responsible for causing the creation of specific sensory experiences, or for causing the general state of being conscious. Roger

Penrose and Stuart Hameroff proposed that quantum properties of special structures within neurons called microtubules are central to the transition from preconscious processing to conscious experience. Francis Crick and Christof Koch proposed that a brain structure called the claustrum is critical to generating consciousness, because of its global connectivity to other parts of the brain. Gerald Edelman and Giulio Tononi proposed that conscious experiences arise from certain patterns of neural activity that loop between the brain's cortex and a sub-cortical structure called the thalamus.

### Serious scientific work ahead

It is widely agreed that our current theories of the relation between brain activity and sensory experience are far from adequate. In each scientific theory an explanatory gap appears at the critical point where brain activity gives rise to conscious experience. This gap precludes each theory from making empirical predictions that one would expect from an adequate theory. For instance how, precisely, does a specific pattern of claustrum activation, or of quantum transitions in microtubules, or of looping activations between thalamus and cortex, give rise to, say, the specific sensory experience of the smell of garlic? How, precisely, must this specific pattern be altered in order to give rise to, say, the sensory experience of the taste of mint? Why, precisely, are these particular patterns required? Why are these patterns accompanied by any conscious experience at all? Why don't they simply go on unconsciously?

The scientific study of mind and body has progressed to the point where it is ready to face these tough questions. The answers that emerge will surely be intriguing.

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**See also:** Consciousness, Neuropsychology of perception, Visual perception

Further readings

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