THE POSSIBILITY OF EMPIRICAL TEST OF HYPOTHESES ABOUT CONSCIOUSNESS

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The possibility of empirical test is discussed with respect to three issues: (1) What is the ontological relationship between consciousness and the brain/physical world? (2) What physical characteristics are associated with the mind/brain interface? (3) Can consciousness act on the brain independently of any brain process?

Running Title: Empirical Test of Hypotheses About Consciousness

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Recent models of consciousness have made a variety of hypotheses about the relationship of conscious experience to physical laws (Burns 1990, 1991). I discuss three issues which are addressed by many models and ask whether it is possible for hypotheses about these issues to be subject to empirical test. The term *consciousness* is used here to refer to the aggregate of all aspects of conscious experience, including those describable in terms of an information content, such as thoughts and sensory perceptions, and those which are not, such as awareness itself.

1. What is the ontological relationship between consciousness and the brain/physical world?

Physicalism holds that all aspects of consciousness can be explained in terms of physical laws, and other hypotheses (*dualism, monistic idealism, implicate order,* etc.) claim that not all aspects of consciousness can be explained in this way.

The varieties of physicalism hypothesized in current literature are *reductionism* and *emergent physicalism*. Reductionism holds that all aspects of conscious experience can be explained in terms of physical laws. Emergent physicalism is similar to reductionism but holds that some aspects of consciousness (e.g., awareness) are new properties of matter which emerge only in certain physical conditions (e.g., complexity) and therefore cannot be traced to the laws describing ordinary matter.

Physical law ultimately is based on various symmetries and their associated conservation principles. Physicist Saul-Paul Sirag, who has developed a unified field theory describing these basic principles, has pointed out that the mathematical space which describes these principles intersects another mathematical space which might represent the basic principles underlying consciousness (Sirag 1993a, 1993b). Because these principles are different from those of the physical world, he refers to his model as dualistic.

Models of monistic idealism (Goswami 1989, 1993) and the implicate order (Bohm 1982) propose that matter and individual mind arise out of consciousness, which is more fundamental than either of these. (These models differ in their hypotheses about the nature of the mind-brain interface.)

The hypothesis of reductionism is testable in that, if the brain is thoroughly understood and all aspects of consciousness can be traced back to underlying physical mechanisms in the brain, reductionism would then be demonstrated. However, there is no way to differentiate experimentally between the hypotheses of emergent physicalism, dualism, monistic idealism and the like, because each one states that some aspect of consciousness cannot be traced back to known physical laws.

2. What physical characteristics are associated with the mind/brain interface?

A variety of proposals have been made concerning the physical nature of the brain-mind interface (Burns 1990, 1993). (In physicalism, the interface is considered to be the cause of all attributes of consciousness. Non-physicalist theories claim that the interface simply provides the means by which independently existing qualities of consciousness can be associated with the brain.)

Contemporary proposals about the interface include the following: Gregory Bateson (1979) and E. Roy John (1976) have each proposed that consciousness is associated with aggregations of matter, such as neurons in the brain, that are linked in sufficiently complex ways. (This postulate is frequently also made by researchers in artificial intelligence who are interested in consciousness.)

Goswami (1989, 1993), Penrose (1989), Stapp (1993), and Walker (1975) have each proposed that consciousness is associated with quantum mechanical processes in the brain.

Mathematician E. C. Zeeman (1976, 1977) has pointed out that sensory experience is probably associated with synchronous electrochemical oscillations in the brain, and this association has recently been confirmed by experimental work (Freeman 1991; Skarda and Freeman 1987). Crick and Koch (1990; Crick 1994) have suggested that the mind-brain interface is associated with various neural processes, including synchronous oscillations.

Synaptic transmission and much other activity of neurons is dependent upon the action of microtubules within the cell. Hameroff (1987) has pointed out that loss of consciousness is associated with loss of ability of microtubule proteins to change conformation, and has proposed that the interface is associated with these conformational changes.

The central problem in evaluating any interface hypothesis is knowing which entities are conscious and which are not. It is reasonable to assume that all humans who exhibit ordinary behavior are conscious. This criterion contains gray areas: During a petit mal seizure a person may continue actions previously initiated (and continue to play the piano, for instance), but not be conscious (Penfield 1975). Even so, if it appears that consciousness is present whenever the human brain manifests a particular physical condition, but never present when it is lacking, it is reasonable to suppose that this condition is associated with the mind-brain interface.

It is when we wish to know the complete set of conditions necessary to human consciousness, or whether non-human entities are conscious, that a problem arises. Suppose, for instance, Hameroff's proposal proves correct, that the mind-brain interface is associated with the ability of microtubule proteins to make changes in their conformation. Microtubules exist within all eukaryotic cells. Is a single cell conscious? Or are additional conditions, always present in human brains, necessary to consciousness, such as complexity?

We can only investigate the nature of the mind-brain interface in non-human entities if we know which of these are conscious. It is sometimes suggested that if a non-human entity can reproduce human behavior, it must be conscious (the Turing test). But this argument leads to an absurd conclusion: holographic images of humans perfectly replicate human behavior; therefore such images must be conscious.

We have no present way to determine whether non-human entities are conscious. Therefore, we have no way to empirically investigate the full nature of the interface.

3. <u>Can consciousness act on the brain independently of any brain process?</u>

All known processes of the physical world are either deterministic or exhibit quantum randomness. For that reason, it is sometimes suggested that free will does not exist, and that our experience of it is an illusion (Dennett 1984).

Nevertheless, a number of models of consciousness have postulated that free will can act to select between alternative brain programs, with this action being independent of any physical process (Burns 1991). Several researchers have shown that such action would contradict the second law of thermodynamics (Burns 1991). Therefore, a model which made such a postulate could not be reductionist. However, it could be based on emergent physicalism or any of the other ontologies.

If we thoroughly understood the workings of the brain, it might be possible to show that some brain action could not be traced back to previous physical conditions. Or alternatively, it might be shown that all brain action can be so traced. Until such understanding of the brain is attained - perhaps some centuries hence - it will not be possible to demonstrate empirically whether free will does or does not occur.

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