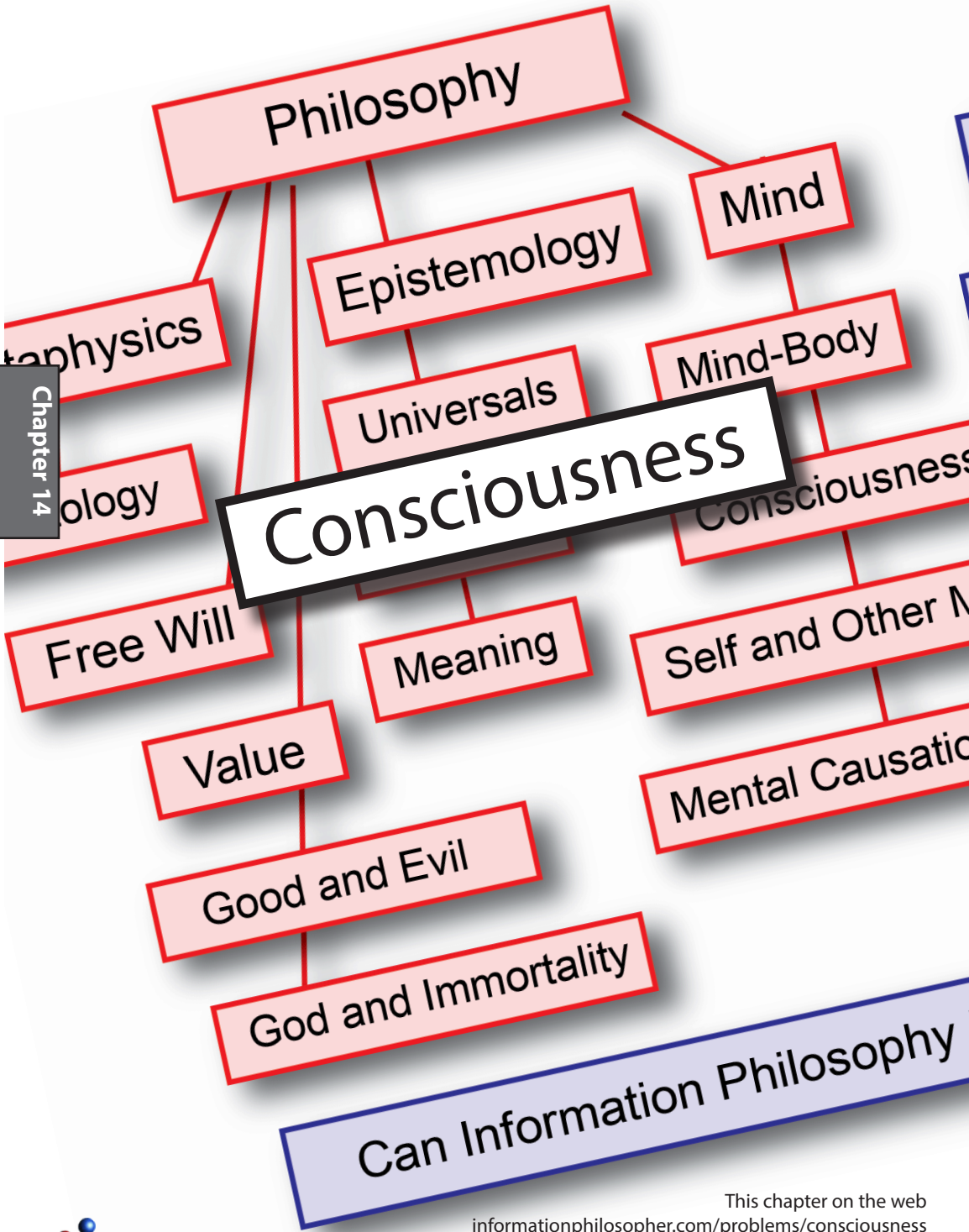

This chapter on the web
informationphilosopher.com/problems/consciousness

Consciousness

Consciousness can be defined in information terms as a property of an entity (usually a living thing but we can also include artificially conscious machines or computers) that interacts with the information (especially reacting to any changes in the information) in its environment and in itself.

We can define this as *information consciousness*.

Thus an animal in a deep sleep is not conscious because it ignores changes in its environment. And robots may be conscious in our sense. Artificial intelligence normally has artificial consciousness in our sense. Even the lowliest control system using negative feedback (a thermostat, for example) is in a minimal sense conscious of (aware of, exchanging information about) changes in its environment.

This definition of consciousness fits with our model of the mind as an experience recorder and reproducer (ERR).[1] The ERR model stands in contrast to the popular cognitive science or "computational" model of a mind as a digital computer or connectionist neural network modeled with logic gates. No algorithms or stored programs are needed for the ERR model, although we do see mind as software in the brain hardware.

Our consciousness model assumes that neurons that get wired together during an organism's experiences, in multiple sensory and limbic systems, are such that later firing of even a part of those wired neurons (caused by a new experience that resembles an original experience in one or more ways) can stimulate firing of all or part of the original complex.

If the neural correlate of consciousness is neurons firing, firing them again can *reproduce* consciousness of the past.

Whereas Donald Hebb famously argued that "neurons that fire together wire together," our experience recorder and reproducer (ERR) model assumes that "neurons that *have been wired together* will fire together."

1 See appendix E for details.

The Binding Problem

Neuroscientists are investigating how diverse signals from multiple pathways can be unified in the brain. The ERR offers a very simple and specific insight into this "binding" problem. We also hope to shed some light on the question of philosophical "meaning"[2] of any given information structure, beyond the obvious relevance (survival value) for the organism of remembering past experiences.

There is a great deal of controversy about whether most living things have some form of consciousness. Defining consciousness as interactions, with exchanges of meaningful information, especially exchanges that involve coding and decoding and translations between symbolic systems, may allow applications to biological subsystems like organs and organelles.

A higher-level conscious being is constantly recording information about its perceptions of the external world, and most importantly for ERR, it is simultaneously recording its feelings. Sensory data such as sights, sounds, smells, tastes, and tactile sensations are recorded in a sequence along with pleasure and pain states, fear and comfort levels, etc.

All these experiential and emotional data are recorded in association with one another. This means that when the experiences are reproduced (played back in a temporal sequence), the accompanying emotions are once again felt, in synchronization.

The capability of reproducing experiences is critical to learning from past experiences, so as to make them guides for action in future experiences. We see the ERR model as the *minimal mind model* that provides for such learning by living organisms.

The ERR model does not need a single "central processor unit" (CPU) or even several "parallel processors." It does not use computer-like "data retrieval," based on the "address" of the data, to reproduce past experiences. All that is required is that past experiences "play back" (are reproduced) whenever they are stimulated by present experiences that resemble the past experiences in one or more ways. When the organism repeats past experiences by acting them out, they can become "habitual" behaviors, "subconscious" information structures.

2 See chapter 11.

It is critical that the original emotions also play back, along with any variations in current emotions that are experienced on playback. ERR might then become an explanatory basis for conditioning experiments, classical Pavlovian and operant conditioning, and in general a model for associative learning.

Bernard Baars's Global Workspace Theory uses the metaphor of a "Theater of Consciousness," in which there is an audience of purposeful agents calling for the attention of the executive on stage.[3]

In the ERR model, vast numbers of past experiences clamor for the attention of the central executive at all times, whenever anything in current experience has some resemblance.

If we define "current experience" as all afferent perceptions plus the current contents of consciousness itself, we get a dynamic self-referential system with plenty of opportunities for negative and positive feedback.

William James's description of a "stream of consciousness" together with a "blooming, buzzing confusion" of the unconscious appear to describe the ERR model very well.

In the "blackboard" model of Allan Newell and Herbert Simon, concepts written on the blackboard call up similar concepts by association from deep memory structures. The ERR model supports this view, and explains the mechanism by which concepts (past experiences) are retrieved and come to the blackboard.

In Daniel Dennett's consciousness model, the mind is made up of innumerable functional homunculi, each with its own goals and purposes. His mind architecture is an amalgam of ideas like Marvin Minsky's *Society of Mind*, Baars' Global Workspace, and the Simon-Newell "Blackboard."

Dennett says

> "There is no single, definitive "stream of consciousness," because there is no central Headquarters, no Cartesian Theater where 'it all comes together' for the perusal of a Central Meaner. Instead of such a single stream (however wide) there are multiple channels in which specialist circuits try, in parallel pandemoniums, to do their various things, creating Multiple Drafts as they go." [4]

3 In the Theater of Consciousness.

4 *Consciousness Explained*, p.253.

Dennett describes the "binding problem" as a "single representational space in the brain" where the various results come together.[5] In our consciousness model, the playback of all the combined sensations of a past experience fire exactly the same neurons wherever they were originally recorded, anywhere in the entire cortex, including the association areas, for example.

Dennett says the idea has been around for several years that human consciousness might be the activity of some sort of serial virtual machine implemented on the parallel hardware of the brain.[6]

But our consciousness model is not a machine at all. It is simply the idea that whatever we are aware of at any moment is stimulating the firing of the complex network of neurons that were wired together in many similar past moments, giving the current moment a vast collection of contextual references that supply the information needed for interpretation.

Like Dennett's model, there is no Cartesian Theater for a "Central Meaner." In the ERR as mind model, we expect the mind would interpret the new firing of multiply connected neurons coming from visual, auditory, olfactory, tactile areas, as reproducing the original experience (much more than a simple memory). These are likely pale shadows, mere "gists" of the original conscious experience, and likely very noise-susceptible, but they provide context, meaning, and emotional reactions to past actions.

David Chalmers is a philosopher of mind whose characterization of consciousness as "the hard problem" has set a very high bar for understanding the mind. Chalmers describes his position as a naturalistic dualism. Chalmers says that the failure of supervenience implies that materialism - as a monistic theory of the complete contents of the world, that there is "nothing but" matter, and that the world is "causally closed," for example - is "false." We agree with this and believe that the reductionist arguments of Jaegwon Kim can be shown wrong. Chalmers says:

5 *ibid*,, p.254.
6 *ibid*, p.258.

> In our world, there are conscious experiences.
>
> There is a logically possible world physically identical to ours, in which the positive facts about consciousness in our world do not hold.
>
> Therefore, facts about consciousness are further facts about our world, over and above the physical facts.
>
> So materialism is false.[7]

Chalmers suggests that the dualistic (non-physical) element might be information. Indeed it might. With this idea, information philosophy completely agrees. Mind/body is a property dualism

Chalmers says that "physical realization is the most common way to think about information embedded in the world, but it is not the only way information can be found. We can also find information realized in our phenomenology."[8]

He is quite correct. Information is neither matter nor energy. It needs matter to be embedded temporarily in the brain. And it needs energy to be communicated. But information is *immaterial*.

Four "Levels" of Consciousness

• *Instinctive Consciousness* - by animals with little or no learning capability. Automatic reactions to environmental conditions are transmitted genetically. Information about past experiences (by prior generations of the organism) is only present implicitly in the inherited reactions

• *Learned Consciousness* - for animals whose past experiences guide current choices. Conscious, but mostly habitual, reactions are developed through experience, including instruction by parents and peers.

• *Predictive Consciousness* - The Sequencer in the ERR system can play back beyond the current situation, allowing the organism to use imagination and foresight to evaluate the future consequences of its choices.

• *Reflective (Normative) Consciousness*– in which conscious deliberation about values influences the choice of behaviors.

All four levels are emergent, in the sense that they did not exist in the lower, earlier levels of biological evolution.

7 *The Conscious Mind*, p.123
8 *ibid.* p.284