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Consciousness: The Webcourse

Lecture 9 – The functions of consciousness.

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Readings: Chapters 8 and 9 in *Theater*.

When we think about our consciousness from a common sense viewpoint, it is hard to imagine that it's useless. In teaching, we constantly ask students "to pay attention" to the material, and most of us have had an enormous amount of schooling by historical standards – sometimes decades. In all that time we have had to stay constantly conscious of what we want to learn, and we notice that when we drift off, we stop learning. So to common sense, consciousness seems important and useful.

Oddly enough, that idea has been very controversial in philosophy and science over the past century or longer. Our readings for this week quote Darwin's famous contemporary Thomas Henry Huxley, who compared consciousness to the steam whistle of a locomotive, a sort of side effect of the powerful steam engine that pulls the train. Huxley suggested that consciousness was at best a kind of side effect of the human brain, and a surprising number of authors still take such a position. (For example, Benjamin Libet in recent years, but also behaviorists and many analytic philosophers.)

From the beginning of this WebCourse we have defined our question in terms of contrastive analysis: To understand concious experience *we need to understand the differences between similar conscious and unconscious brain events.* The most important evidence for us has been the difference between waking and sleeping, between unconscious stored memories and conscious recall, between unconscious perception (in the case of visual masking, for example) and normal, conscious vision, and so on. That is the basic evidence for this course.

If we look at the world in terms of such contrasts, the idea that consciousness has no function seems to contradict the plain facts. For example, "fading out" in a college classroom will cause us to flunk the next exam. We know that. Using brain imaging methods, we can show that even when we are not conscious of someone speaking, the words are still momentarily activated in part of the brain, but they are not "broadcast" to the rest of the brain. The actor is speaking in the theater, but the bright spot is lighting up something else. Maybe we are dreaming about our friends, or we're planning a party, or just staring into space. Whatever we are doing, being conscious of whatever we want to learn isn't part of it, and so we end up not learning. It happens all the time, because our capacity to take in challenging information is limited.

(There's nothing to be embarassed about in drifting off, by the way. Some studies suggest that most people drift off in the first three minutes of a talk. It's just hard work to pay attention to difficult material, to keep it in consciousness. We constantly need to renew our efforts to direct attention, just as much as we need to renew our motivation when we do hard physical work.)

In spite of this common sense point of view, "epiphenomenalism" (epi = on the surface, "phenomenal" = experiential, conscious) is still very popular. It is always (as far as we can tell) based on evidence that is *not* the contrastive evidence of this course. Epiphenomenalism, like Huxley's idea that consciousness is like the steam whistle of a locomotive, comes from believing that there are two realms, one our own subjective experience, and the other the world of public evidence, which is the world of science. We have tried to make the case in this course that based on contrastive evidence, there is a tremendous convergence between those two apparently different realms. They are not separate, but just two sources of information, which converge in their results more often than not. The mind-body problem, the never-ending debate about "which is primary, the subjective or objective world?" --- is much like a Necker Cube. We can it flip back and forth between the 1P and 3P perspective all day, and not be able to resolve it. It is an ambiguous figure.

The approach we have taken to the evidence, contrastive analysis, does not raise the same mind-body worries.

(We are sure that there are philosophers who take issue with us on this point, but have not heard any decisive counter-arguments yet. It is worth mentioning that many scientists have independently arrived at their own versions of contrastive analysis; we have cited them throughout the course).

From this viewpoint, therefore, consciousness looks like it make a big difference in life --- such a big difference that it is tempting to see it as a great biological adaptation. For example, we have observed that the great core of the brain, the thalamus and cortex, support conscious experiences. If we lose a chunk of cortex, our conscious experiences are likely to be different (especially in posterior cortex, which is heavily dedicated to sensory functions). But if we lose a piece of the cerebellum, we do not see the same kinds of losses. But of course both of these giant brain structures took hundreds of millions of years to evolve. If consciousness depends upon cortex (at least in human beings), then the rapid expansion of cortex in humans must have something to do with our specific conscious capacities. It seems to reflect something special about our brains.

The same reasoning suggests that animals with thalami and cerebral cortices are likely to be conscious. That includes all the mammals and some transitional reptiles. Salamanders have some neocortex (i.e., a six-layered sandwich of neurons). However, some scientists have argued that the same "wiring" that exists in mammalian cortex also exists in birds and perhaps some other species; but it looks different. The connectivities in the brains of birds are not so obvious, and perhaps they have been less well studied. So there is a reluctance to deny that birds, some reptiles, even some cephalopods like octopi and squid might have something like our thalamocortical system. (To be sure about that, one has to study the submicroscopic connectivities of the neurons in the brains of other species, still a very difficult project to do.) It is probably fair to say, however, that there is little debate among brain scientists that mammals share the same brain basis of sensory consciousness that humans have.

Specific functions.

Well, let's be more specific. What particular capacities are enabled by consciousness? We have made the case above that we cannot learn very well when we are distracted. That suggests that learning may be one of the biological functions of conscious experience. There are some people who raise the question why that must be so --- after all, simple neural networks can do some learning, and not many people argue that they are conscious. But that is putting the cart before the horse. In psychology and brain science, we are trying to understand something we can't fully define, i.e., consciousness. That's what we are always trying to do in science, wrestling with the unknown. If you'll remember, we made the comparison with "heat" in a previous lecture. The real nature of "heat" wasn't fully understood until about 1900, with the advent of thermodynami theory. In the same way, the real nature of "consciousness" is not yet understood today. We don't have a fulfledged theory that can give us the answers.

The fact that simple neural nets can do some learning is interesting, but it doesn't tell us much about the human head, which is many orders of magnitude more complex than any artificial neural network. We can imagine all kinds of things that could be done by Zombies that are not conscious. But the brute everyday facts of our lives is that *we* cannot do those things without consciousness. In science, we have to stick with the facts even if we don't understand them. Historically, if we do so, eventually we end up understanding more. So is consciousness necessary for learning *in human beings?* We believe the great bulk of evidence shows that. Is it necessary for learning in any conceivable machine? Probably not; but that's not our main topic in this course.

So learning appears to be a function of consciousness. It is one of many facts we know about consciousness. Long before 1900 people learned that you can burn your fingers at a hot stove. They invented thermometers three hundred years before physics finally figured out “what heat really was.” Blacksmiths used air-breathing bellows to heat up fires to make horse shoes. All kinds of things were known before thermodynamic theory finally gelled and the formal definition of “heat” became clear. In the same way, we can say all kinds of things about consciousness that seem to be true, or which are at least testable by evidence. We can find operational definitions of consciousness that have been used for a few hundred years with great success, such “consciousness is that which can report accurately.” That’s not a deep theoretical definition, it’s just a very useful rule of thumb in dealing with human beings who have intact brains. A lot of our technology today depends upon such reports, like the decibel scale of loudness, the color spectrum on your computer screen, and so on. There are many things we know about consciousness with a high degree of confidence, even though we do not really know what “consciousness” *is* in some final theoretical way.

Here are a set of functions from one of our readings, Chapter 10 of Baars' 1988 book. The specifics of each function are discussed in that chapter. (The words here are a little technical, but they are all defined in the Glossary of the 1988 book, available at www.nsi.edu/users/baars).

Table 10.1 The major functions of consciousness

1. *Definition and Context-setting*. By relating global input to its contexts, the system underlying consciousness acts to define the input and remove ambiguities. Conscious global messages can also evoke contexts, which then constrain later conscious experiences.

2. *Adaptation and Learning*. Conscious experience is needed to represent and adapt to novel and significant events.

3. *Editing, Flagging, and Debugging*. Unconscious processors can monitor any conscious content, edit it, and try to change it, if it is consciously "flagged" as an error.

4. *Recruiting and Control Functions*. Conscious goals can recruit subgoals and motor systems, to organize and carry out mental and physical actions.

5. *Prioritizing and Access-Control*. Attentional mechanisms exercise conscious and unconscious control over what will become conscious. By relating some particular conscious content to deeper goals, we can raise its access priority, making it conscious more ofen and increasing the chances of successful adaptation to it.

6. *Decision-making or Executive Function*. When automatic systems cannot routinely resolve some choice-point, making it conscious helps recruit unconscious knowledge sources to help make the proper decision. In the case of indecision, we can make a goal conscious to allow widespread recruitment of conscious and unconscious "votes" for or against it.

7. *Analogy-forming Function*. Unconscious systems can search for a partial match between their contents and a globally displayed (conscious) message. This is especially important in representing new information, when no close models of the input are available.

8. *Metacognitive and Self monitoring Function*. Through conscious imagery and inner speech we can reflect upon and control our own conscious and unconscious functioning.

9. *Autoprogramming and Self-maintenance Function*. The deeper layers of context can be considered as a "self-system", which works to maintain maximum stability in the face of changing inner and outer conditions. Conscious experience provide information for the self-system to use in its task of maintaining stability. By "replaying" desirable goals, it can recruit processors able to produce solutions and thereby reprogram the system itself.

Notice there are at least nine functions. That may seem surprising, but it is actually normal for major biological adaptations. Take your eyes, which would seem to have only one function, to see the world. In fact, there are more:

1. to take in light wavelengths for colors (foveal cones)
2. to take in light that signals brightness and its absence (rods)
3. to time the sleep-waking cycle (some neurons in the retina go to the nucleus that controls our sleep-waking cycle).
4. to indicate interest in other people (in mother-infant bonding)
5. to reject people who are not interesting, or who are to be made to feel that they are not interesting (in mating interactions, for example, and probably also in early chase play)
6. to establish dominance by controlling a visual space with unobstructed eye movements
7. to acknowledge submission by allowing a dominant person to control the visual space (by casting down one's eyes)

Those are only some biological functions of the human eye. Add all the cultural accountrements to those basic functions --- eye shadow, colored contact lenses, artificial eyelashes, sun glasses --- and we find even more uses added on to the basic biological ones. And when we look at advanced tools, like telescopes and microscopes, our eyes suddenly go far beyond their physiological basics.

Many biological adaptations have multiple functions. Legs are for running and walking, but they are also for dancing and kicking. Lungs are for breathing, but in humans they have a vocal apparatus added on top. Laughter makes use of vocal muscles that initially evolved mainly for breathing and chimp-like vocalizations. And so on. If consciousness is a mammalian adaptation (at the very least), it has been around for some 200 million years. That is enough time to gather all kinds of adaptations on top of whatever consciousness started off doing for early mammals or late reptiles.

Summary.

By looking at "conscious" vs "less conscious" conditions --- called contrastive analysis --- it seems to us that our experience of the world has very many functions. It is a great biological adaptation. That point can be made more specific. There are at least nine significant functions that consciousness seems to play in human brains. That doesn't mean that imaginary zombies and robots can't do similar things without consciousness. Steam engines can travel without legs; but that doesn't tell us much about legs. While there are still some who believe that consciousness is purely epiphenomenal --- just a side-effect, like the whistle of a locomotive --- such a belief seems to depend upon ignoring contrastive evidence.