

From Behaviorism to Computationalism

Introduction to Cognitive Science

The 'Historical' Argument for Materialism/Physicalism

The Biological History Argument

- Science seems to show that there was a time when the universe was just a purely physical 'soup', out of which life, and mind, somehow originated. But, if the mind is something non-physical, how can that be? How can you get something non-physical, if you start with purely physical stuff?!
- Similarly, consider one's biological development, starting at the moment of conception. As far as science can tell, a just conceived egg does not have a mind, and in fact there will be no mind present in the growing fetus or baby for until quite a while. So again, where does one's mind come from? Does it somehow 'pop' into existence out of nowhere? Or does it get 'bestowed' upon us by some unexplainable and unfathomable supernatural being for which we have zero scientific evidence?!?

More on the Biological History Argument

- In fact, in both cases, it doesn't seem like we can even indicate at what time a mind does come into existence.
- This suggests that seeing the 'mind' as a 'thing' that entities either have or don't have, may not be a very good idea in the first place.
- In fact, what this does suggest is the idea that the mind only gradually develops at the same time as the biological organisms develop.
- In fact, this argument can be seen as an important elaboration on the neural dependency argument: it seems that minds develop gradually in sync with the development of the brain.

Life and Mind: Potential Parallels

- Biologists have a hard time trying to define 'life'
 - There is no universal definition of life; there are a variety of definitions proposed by different scientists.
 - Same is true for 'mind'
 - There are many 'typical' aspects to life, such as growth, homeostasis, response to stimuli, and reproduction.
 - There are many aspects to the mind, such as perception, reasoning, learning, memory
 - While many organisms have all of these features, some have only a subset of these. Are they alive or not?
 - Similar questions can be asked about the mind

Artificial Life and Artificial Intelligence

- A branch of computer science, called Artificial Life, creates computer programs that have all of the features that biologists typically list.
 - Should they be called alive?
 - Many people object, as they are not carbon-based, and no ooze-comes-out-when-stepped-upon.
 - But is that important? Are we prejudiced when it comes to declaring things alive?
- Artificial Intelligence presents us with the same debate.

Being Pragmatical about 'Life' and 'Mind'

- In practice, many biologists really don't care very much about any exact definition of life: they find that they can just study all these different aspects of life, without having to give an exact definition of life itself.
- Maybe the same is true for 'mind'? Maybe it is more useful to just study perception, reasoning, use of language, etc. without trying to define 'mind' (or 'cognition' or 'intelligence') itself?
- Many practicing cognitive scientists see the mind as a multi-dimensional abstraction as implemented by the brain.
 - So again, the mind is not a 'thing', but it does have a purely physical basis.
 - The mind can be scientifically studied, just like other abstractions (such as economies) can be studied.

Labels, Concepts, Facts, and Science

- Asking whether or not a virus is alive, or whether a computer can think, may be less of a factual matter than most of us may think.
- Ultimately, 'life' and 'mind' may be just that: linguistic labels expressing certain concepts.
- And, concepts can change.
- In particular, concepts can change because it may be useful to change them. Why? Because concepts allow us to make sense of the world: parse it, give explanations, make predictions, and sometimes, we realize that a change in concepts may be even more effective in making sense of the world around us.
- In fact, this is not just some wishy-washy semantical issue, but something we do in science: Remember what happened to Pluto!
- So, maybe the question to ask is not "What is a mind" or "What has a mind" but rather "What would be useful to consider a mind, or consider having a mind?"

A (very short!) History of Cognitive Science

The Beginnings of Psychology: Introspectionism

- Presumably inspired by the successes of physics, chemistry, and other sciences, during the 19th century the first systematic scientific investigations of the mind began.
- The early views of the mind saw the mind as consciousness:
 - mind = consciousness (= spirit/soul?)
- Consciousness was studied through introspection: put human subjects in different situations or conditions, and have them report on their conscious experiences.

Moving Away from Consciousness

- One obvious problem with introspection is that it is not an objective or third-person measurement.
 - How can these reports be trusted?
 - Indeed, for this reason some people refused to call this even scientific
- Also, Freud's Psychoanalytic Psychology, for all its dubious theories, did develop the notion that there is an 'unconscious mind' and that unconscious mental processes in fact do a lot of work.
 - Important move away from: mind = consciousness

Psychological Behaviorism

- During much of the first half of the 20th century, the dominant school of thought became Behaviorist Psychology
 - Behaviorists stated that since introspection is not a reliable method, the mind must be studied through the observable behavioral dispositions.
 - The Stimulus -> Mind -> Response chain should be studied through the Stimulus -> Response chain only.
- Problems:
 - Not all mental states are caused by stimuli
 - Not all mental states cause observable behavior

Philosophical Behaviorism

- Psychological behaviorism has a counterpart in the philosophy of mind: philosophical behaviorism
 - Whatever goes on inside the agent obviously *contributes* to the agent having those properties, but doesn't *constitute* them.
 - So: Mental properties *are* behavioral dispositions.
 - To be intelligent *is* to behave intelligent.
 - Compare: a car's speed, traction, and maneuverability. We can look under the hood of the car to try and explain why the car is fast, but its 'fastness' is constituted by its behavior to quickly go from A to B
- Problem: What about our 'inner mental life'; our thoughts, feelings, sensations, etc.?!

Mind-Brain Identity Theory

- Acknowledging the problems with behaviorism, and probably pushed by advances in technology that allowed for brain imaging techniques, researchers went 'back inside' around mid-20th century. But this time, the focus of study was the brain, not consciousness (and so it could still be seen as a proper science).
- One view of the mind became known as the Mind-Brain Identity Theory:
 - Mental states are physical states of the brain.
 - To have a belief X is to have certain brain neurons fire.
- Problem: the mind weighs 3 pounds?!?!?

Carbon Chauvinism

- One fruitful way to illustrate the problem with mind-brain identity theory is to ask: why does having a thought or being in other some mental state require such a specific physical configuration? In short: what is so special about carbon?!?
Couldn't there be other beings, made out of completely different materials, that have thoughts and beliefs?

(Philosophical) Functionalism

- What makes a chair a chair is that we can sit on it. The physical material of the chair is irrelevant.
- ‘Chairhood’ is ‘multiply (physically) realizable’
- Similarly, the functionalists state that the mental states of an agent can be defined relative to an abstract causal system as implemented by that agent’s sensory apparatus, motor control, and mediating mechanisms (brain!), but that could potentially be implemented by other physical means as well (e.g. we could replace a neuron with a prosthetic neuron, and as long as it would function the same way, your mind remains).

Brain or Behavior?

- Functionalism can be seen as a kind of compromise between behaviorism and mind-brain identity theory:
 - Like behaviorism (and unlike identity theory) the emphasis is on the functionality of things
 - Like identity theory (and unlike behaviorism) we are going to look what goes on inside of us
 - The mind can only be understood in terms of the brain *and* its behavior

Multiple Realizability

- Functionalism allows for completely different kinds of entities to be intelligent, as the relevant abstract causal/functional organization can be implemented in various ways.
- Can computers be such entities?

Cognitive Psychology: The Mind as Information Processing

- Functionalism was very much driven by the development of the modern computer.
- Question: What is the functionality that the brain implements and that gives rise to a mind?
- Answer: It is information-processing functionality: the ability to take in (perception), store (memory), and process (thinking) information.
- So, around the 1960's, inspired by ideas from psychology, philosophy, and computer science, cognitive psychology emerged.

Functionalism, Chairs, and Computers

- We can be functionalist about chairs:
 - What makes a chair a chair is not what it is made out of (indeed, you can have wooden, plastic, or metal chairs), but that you can sit in it, i.e. its functionality
- But, there is no way that we can program a computer so that it becomes a chair
 - ‘chairhood’ is not a functionality that can be implemented by computer program.

Computationalism

- Cognition can be defined in terms of information-processing:
 - Perception is taking in information from the environment
 - Memory/Beliefs/Knowledge is storing information
 - Reasoning is inferring new information from existing information
 - Planning is using information to make decisions
 - Etc.
- Information-processing can be done through computations
- Therefore, cognition is computation.

Materialist Theories of Consciousness

- Consciousness is:
 - quantum collapses in microtubules internal to neurons (Penrose, Hameroff)
 - thalamically modulated patterns of cortical activation (Llinas)
 - left hemisphere based interpretative processes (Gazzaniga)
 - emotive somatosensory hemostatic processes based in the frontal-limbic nexus (Damasio)
 - synchronous neural oscillations at 40-70Hz (Crick, Koch)
 - spatiotemporal patterns in electro-magnetic field produced by brain (McFadden, Pockett)
 - global workspace of cognitive activity (Baars)
 - integrated information (Tononi)
 - ...
- Conclusion: Consciousness is ... ?!??!??#%?^&!?*#^!!!!

New Dualism

- Old Dualism: Consciousness = Mind = 'Spirit' = 'Soul'
- New Dualism:
 - No Mind (as a 'thing')
 - Certainly no 'Soul' or 'Spirit'
 - Many mental processes are unconscious
 - Much of 'mind' can be explained functionally (and hence physically)
 - Except for subjective conscious experiences