A Hard Problem

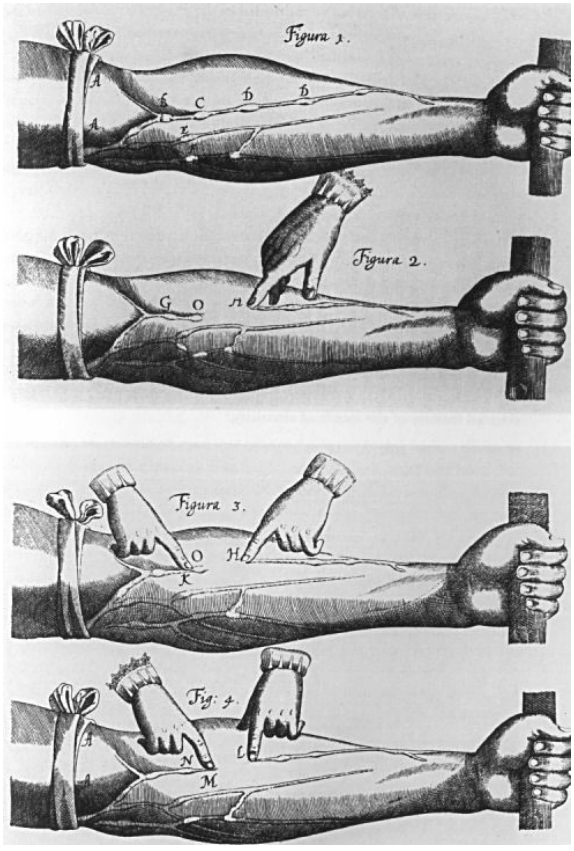
Foundational metaphor of Cognitive Science: *"idea that human mind or animal minds can be modeled by a digital computer".*

In the history of science, many such metaphors are used.

Examples:

1. **William Harvey - "Heart acts like a pump"**

   Wiliam Harvey was an English physician. In his book about working of the heart which he wrote in the early 1600s, he used this metaphor. Before this, the metaphor of "heart was kind of brewery" was used.



2. **Newton - "Solar System is like a clock"**

   Prominently by Newton followed by his successors, the metaphor of "Solar System is like a clockwork, a giant sort of well-tuned mechanism" was widely used. But this was proved to be false when the erratic nature of pluto was discovered.

3. **Analogous of Solar System with the structure of an atom**

   Atoms being tiny little solar systems was another prominent metaphor which was used.

4. **Water analogous to electricity**

   Students of electricity often used the resemblance of water flowing through pipes same as that of electricity flowing through the circuits. Potential current and resistances can be mapped to the water pressure and water flow.

None of these particular metaphors is exactly correct. They're helpful and a good metaphor is defined by its being helpful. It helps you to ask new questions, to propose new directions for research, to conduct new experiments, the way that William Harvey did. But that doesn't mean that a metaphor has to be a sort of perfect match.

Mind and the Computer

In any event, the innovation here was that once computers arose, that is once there were computers to use as a foundation of this metaphor starting in the **late 1940s and early 1950s** and thereafter. People began to look at the operation of the computer as an information processing device. And they were willing to sort of go out on a limb with a new metaphor and say that the mind, the human mind is itself like a computer, it's an information processing device.

Behaviorist's opinion:
Behaviorists might argue that you really should not talk about things like ideas or concepts or beliefs or desires or anything internal to the mind. Because those things cannot be directly seen or measured. And since they cannot be directly seen or measured, they are scientifically illegitimate.

Cognitive Science revolution:
The Cognitive Science revolution in Psychology was based on a metaphor where people were now able to say, no we can talk about things like ideas and concepts and beliefs and desires if we say that the mind is in fact like a computer. So just as we can study the behavior of a computer and we can write programs for it, similarly, we can use those programs as a metaphor for the operations of the mind.

That is software is to hardware as mind is to brain. The brain runs the mind as software much as a digital computer runs its software to perform all kinds of different actions. That's a very strong version of the computational metaphor of mind.

And these are again, controversial conclusions, but they follow from the sort of most direct interpretation of this metaphor. First, if software is to Hardware as the mind is to the brain, then if you want to understand the mind, you don't really have to understand the brain to do it. You don't have to, in other words, you don't have to explain the level of Neuroscience. If you're a computer

programmer, you don't really have to have a very deep idea about the hardware of the machine that you're writing for. So you can study the algorithms and the computational ideas in software without knowing much of anything about hardware.

If you take this metaphor of mind seriously, then to talk about the mind in software terms, you need not talk about the brain. You could talk about certain, for example, **the process of language acquisition or visual perception**. Or a variety of things without necessarily referring to the implementation of those ideas in neurons in human neurons in the brain. That as I say is a rather controversial interpretation, and I think it's fair to say that most cognitive scientists, the great majority, do not hold to that interpretation anymore.

A second thing is that if you take this metaphor seriously, then just as computer scientists study algorithms and study things like arrays or lists or data structures or whatever, then in the same way, you could treat mental representations as the data structures and you could study those data structures.

Now, since we can write programs which can mimic human behavior, we are allowed to talk about the questions of whether **humans at least behave as though they are running sets of rules** or **working with mental images** or **using context-free grammars as the basis of their language** and so forth.

Functionalism:
The idea of functionalism is that you can study things like the mind as a working system of rules, states, computational elements. And what's important is how those things work together as a system, but it doesn't particularly matter what physical machinery or substrate those things are implemented in. This is just another sort of fancy philosophical way of describing the strongest version of the computational metaphor of mind.