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Course Title:

Basic Cognitive Processes

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Lecture 06: Foundations of Cognitive Psychology

A brief recap…

- In the last lecture, we talked about the Cognitive Perspective on human behavior.
- We also talked about the issues of functional description of the mind's architecture.

Flow charts: the mind, the brain…

- the hardware/software distinction!
  - hardware refers to any physical device that is either a computer itself or a peripheral that may be linked up to a computer (e.g. printer).
  - software refers to the programs that run on the computer.

- We know that, the computer us a physical device but its programs are abstract (remember ‘abstract’).

- so we talk about the software without reference to the physical hardware involved in the computer.

- by adopting such a functional approach, we can argue that, by analogy, '**The mind is to the brain as the program is to the hardware**' (Searle, 1994; p.20).

- So, cognitive psychologists endeavor to understand the programs that collectively make up the mental activity: they essentially deal with **flowcharts of the mind.**

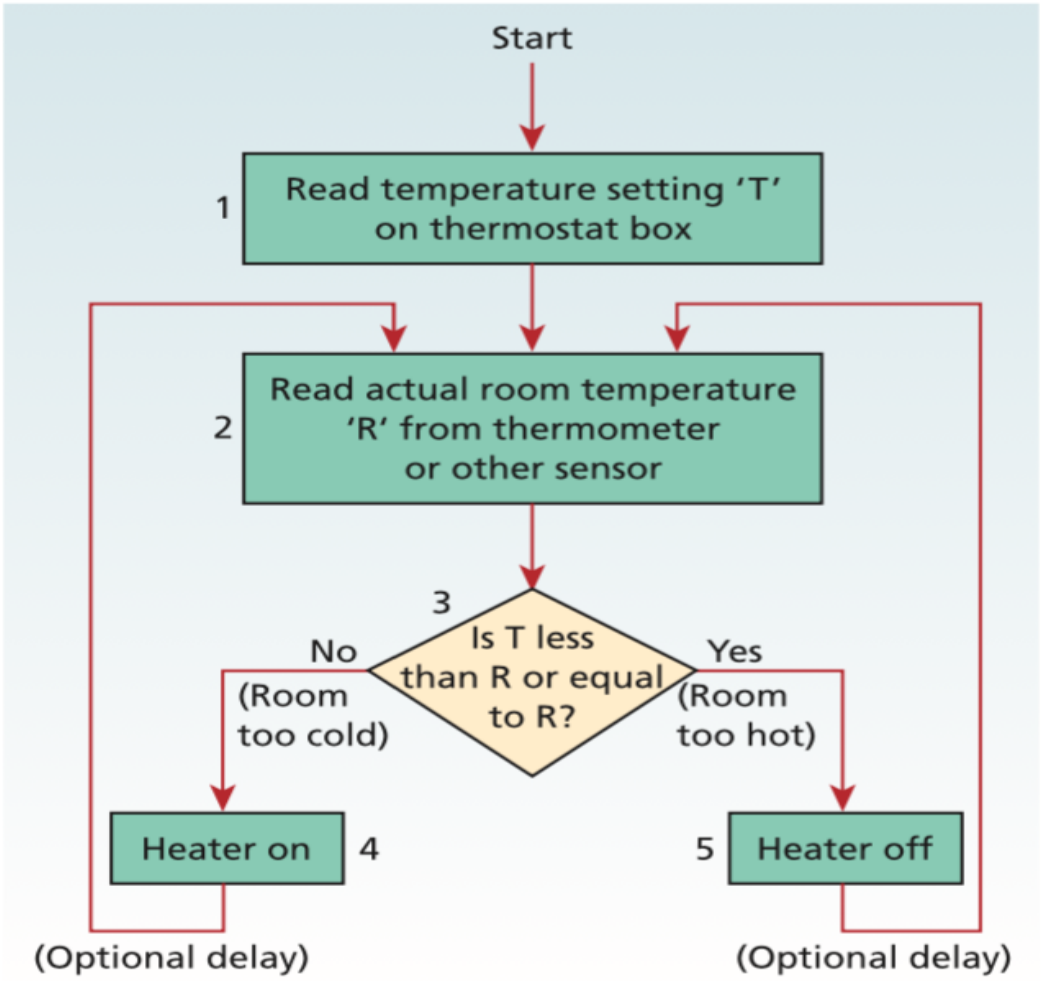

Figure 1.6 A flow chart of the operation of a thermostat

Source: Zaks, R. (1980). *Programming the 6502* (fig. 1.1, p. 9). Berkeley, California: Sybex.

Image: Quinlan, P. & Dyson B. (2008). Cognitive Psychology. *Prentice Hall*.

- while the last diagram gives us an idea of functional parameters of a thermostats; it needs to be supplemented with the knowledge of actual physical components to actually be able to build a thermostat.

- The problem is more complex when you consider human cognition: we already have our device ready (the brain) & we are trying to figure out just what is going on.

- So, we do **reverse engineering**, i.e. we are trying to understand how the workings of the brain underpin the mind.

- Big Jigsaw Solving Enterprise = Cognitive Psychology!

- we have to begin by accepting in the first place, that the brain is more complicated than thermostats & beam balances!

- then we need to talk about concerns relating to mental states, representations & processes (i.e. mental entities).

- by analogy they seem akin to computer states, representations & processes. hence, metal software analogy! or the idea that the brain be characterised as a **information processing system.**

- then we need to talk about the information from the world (input), the codes that represent the input and the responses (output).

Marr's Levels of Explanation…

- Acc. to Marr (1982) there can be 3 possible levels of explanation:

    1. The level of computational theory

    2. The level of the representation & the algorithm

    3. The level of the hardware implementation

- at the level of **computational theory**, the concern is with what the device does & why it does it.

- here is where Marr spells out the 'logic of strategy' (Marr, 1982, p.28).

- e.g. how does a calculator carry out arithmetic operations.
  - analysis at this level will address the fact that the calculator carries out various arithmetic calculations (what) & the fact that it uses a particular method to carry these operations out (why).

- for instance, an early HP calculator (the HP35) used a method known as Reverse Polish.
- So expressions such as (1+ 2) X 3
- were entered as 123 X +; known as the postfix notation.
- The computational theory would here be concerned with issues like why Reverse Polish was used & what the underlying principles are.

- **at the representation & algorithm level** detailed questions are asked about the nature of the calculator's operating system & the manner in which numbers & arithmetic processes are embodied in the device.

- so, how information is stored (i.e. represented)& also how arithmetic operations are instantiated.

- more simply put, how in any information processing device, information from the outside world is represented internally within the device.

- So for example when number 2 is entered into the calculator it is represented via some form of electronic code. This form of **internal representation** stand for number 2.

- By analogy where the mind is concerned such internal (mental states) stand for (i.e. represent) actual states in the world.

- what happens to such information is a matter for the **algorithm**, or the set of operations that are carried out on these representations.

- in computer science the word ‘algorithm’ is mainly used interchangeably with the phrase ‘computer program’.

- So, if you entered a + sign into the calculator & it is working properly then it should invoke it's addition algorithm.

- the addition algorithm comprises of the sequence of operations that determine that how two numbers are added together.

- So understanding the calculator depends on trying to specify the nature of internal representations & associated processes

- in terms of understanding of human cognition, then, we need to consider both mental representations & mental processes.

- in this respect the functional account should not only provide a flow chart that maps out the relations between component processes, but also some description of the sorts of internal representations that are implicated.

- at the **hardware implementation level,** concerns are about how the designated representations & processes are implemented physically.

- what physical components are needed to build up the device?

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- If we accept some version of the central state identity theory; then we are accepting that mental states & processes are nothing other than neural states & processes.

- According to reductionists, understanding the human mind can be reduced to understanding the basic electrochemical states and processes that characterises the behaviour of neurons.

- So, if we understand these physical states and processes, we understand the mind.

- Another version of reductionism is known as **eliminative materialism**.
    - Churchland (1984) states, that once we have a full understanding of the behaviour of neurons in terms of basic electrochemical principles, we can then eliminate any mention of any other level of description from our science.
    - Maybe we can get rid of the mind after all?

- So, what would cognitive psychologists do?

- Even if one has a complete account of the nature & operation of neurons; this is a completely different level of explanation that what cognitive psychologists are actually concerned with.

- As cognitive psychologists, we are interested in uncovering the functional architecture of the mental components that constitute the mind - the flowcharts - & in this regard the properties of neurons are of little help.

To sum up…

- We talked about how the mental functions can be represented in a framework as hardware/software.
- We talked about the levels of description proposed by Marr (1982) to explain the nature of the human mind.

References

- Quinlan, P. & Dyson B. (2008). Cognitive Psychology. *Prentice Hall*.