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Course Title:

Basic Cognitive Processes

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Lecture 05: Foundations of Cognitive Psychology

A brief recap...

- In the last lecture we were talking about:
 - Scientific method to approach the mind & explain behavior.
 - We talked about the Behaviorist approach, its implications & limitations.

The Cognitivist View

- the **Cognitivist View**:
 - assumes that there is an abstract entity called the mind & that is composed of mental states and mental processes; &
 - is concerned with exploring the nature of these mental states & processes.
- Cognitive Psychology may be defined as the study of mind, to the extent that we can generate testable statements about these abstract entities.

- How?
 - we operate within a framework where we make certain assumptions about the subject of enquiry, & on the basis of these assumptions we generate certain hypotheses that result in testable predictions.
 - importantly though, for our science to work properly we must attempt to generate falsifiable theories.

- e.g. in designing a new aircraft, one needs to test the safety of the aircraft in order to evaluate performance & safety standards.
- it would be foolish to only test the aircraft on a clear, sunny day; when the chances of failure are anyways minimal.
- we would like to test the aircraft in the hardest of flying conditions, in order to be sure about the safety standards of the design.

- Similarly, theories of human cognition will be useful only if they are falsifiable.

- Karl Popper (1963, 2000) concluded the following in order to evaluate the theory of anything:
 - it is easy to verify.
 - it is refutable, else unscientific.
 - every genuine test of the theory is any attempt to falsify it.
 - confirming evidence does not count unless it is a result of a genuine test of the theory.

- in line with the above, Cognitive Psychologists are allowed to posit abstract entities on the assumption that they can be tested in a scientific way.
- theories in cognitive psychology, must be testable, refutable, & falsifiable.
- Further, theories in cognitive psychology also should be extremely simple i.e. parsimonious.

- Let us try an example:
 - Mental Arithmetic, i.e. a set of numerical operations that are carried out in the mind. e.g. compare (14×5) with (17×3)
 - although we differ in our abilities to carry out mental arithmetic, from a cognitive perspective it seems fairly reasonable to assume that this ability depends upon mental representations (of numbers) & mental processes (for calculations).

- Whether the cognitive explanation is necessary to postulate mental operations?
 - It could be possible that there exists a rather simple device that can 'solve' these kinds of problems.
 - But we are reluctant to accept a cognitive operations theory.
 - So, maybe a physical device.

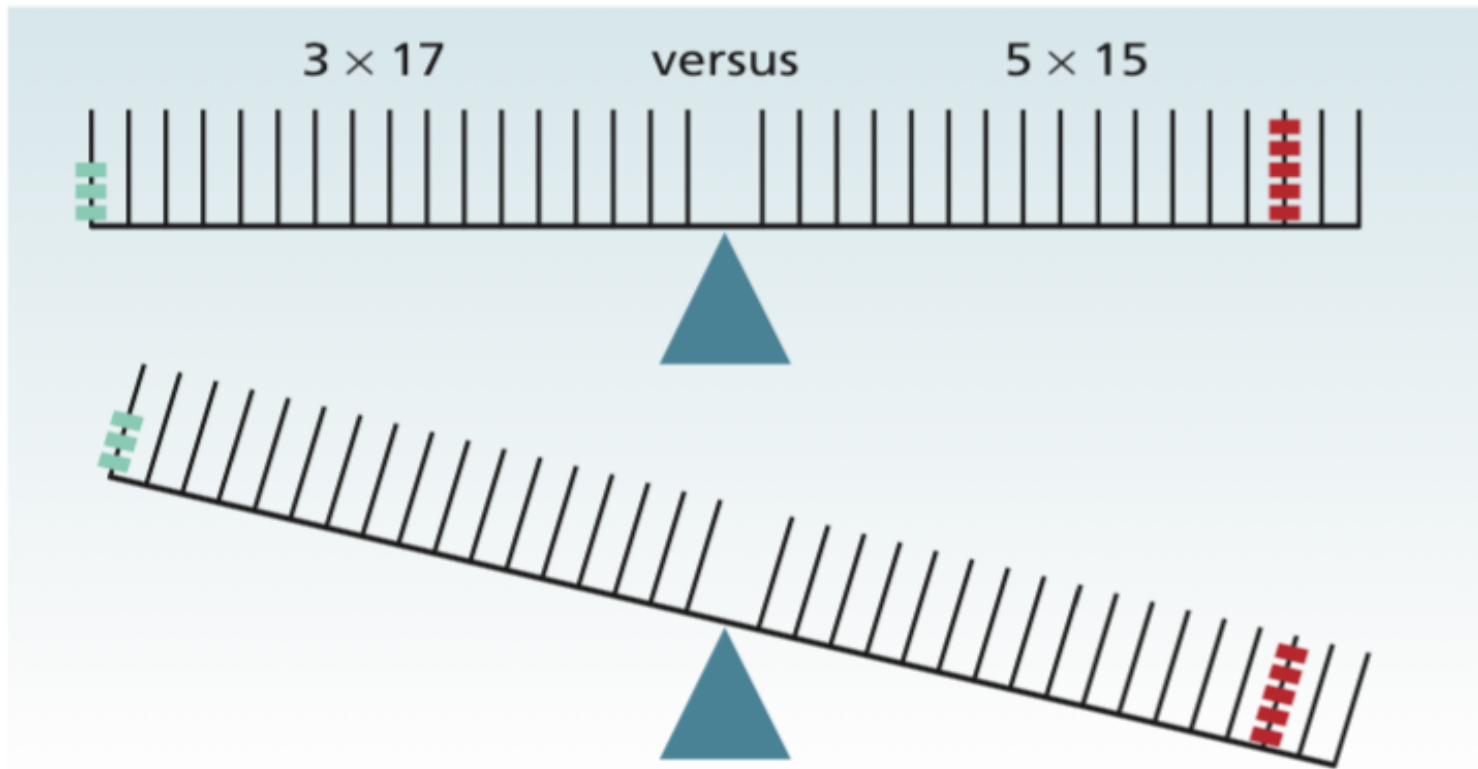


Figure 1.3 Balance beams 'do' mental arithmetic?
Schematic representations of a balance beam and its ability to 'figure out' which of two products (i.e., weights \times distance on the left vs. weights \times distance on the right) is the greater.

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

- the dilemma is that, while cognitive psychologists would wish to offer a cognitive account of the behaviour of the human in solving the problem, they would not wish to provide such an account for the balance beam.

- Solution = Considering the differences:
 - While the balance beam is stuck at the level of simple multiplication, and consequently, the special purpose mechanistic approach to mental multiplication offered by the balance beam fails to provide a more comprehensive explanation of how mental arithmetic is carried out in general.
 - Humans on the other hand can handle a versatile range of mental calculations that cannot best be handled by such a physical device.

Let us see why?

- in order to answer this question well, we have to look at the fundamental question we raised earlier: How are the mind (abstract) & the brain (Physical) related?
- Let us now explore various possibilities that have been proposed...

- **Central State Identity Theory:**

- our mental lives are intimately connected with the things that go on in our brains. e.g. brain damage results in deleterious effects on aspects of cognition & behaviour.
- Various attempts have been made to explore the mapping between mental events (e.g. thinking of a Burger) and neurological events (such as neuron assemblies firing).
- The assumption is that the two are related, its the mechanisms & processes that are still under investigation.

- The **central identity theory** therefore forms the foundation of all current work in human neuroscience/cognitive neuroscience.
- There are two versions of this theory:

- **Type Identity Theory:** each type of mental event maps onto a different type of neurological event; e.g. remembering to perform task X maps onto a pattern of nerve cells firing & choosing not to perform the task X maps onto a pattern of B nerve cells firing.
- one has to be careful with the words like “maps onto” or “corresponds to”; saying these terms we might be adopting the materialist view, which assumes only physical states & hence it is easier to say that mental states = brain states & processes.

- take an example: if you hurt yourself (say hitting the door with one of your toes!!!)
- the defining element of pain will be the sensation of hurting.
- something peculiar with pain is that is not merely a sensation but also a matter of perception/subjective experience.

- so, the problem with identity theory is that it seems to force different things to be the same, so there is the feeling of pain (a mental event) and there is this pattern of nerve cell firing (which is a physical event).
- if one follows the materialist perspective, we assume that everyone's experience will be perfectly predicted by the neural activity.

- Searle (1994) raise the **different brains problem**.
- Consider the following example:
 - Jones thinks it might rain, nerve cells A,B,C, & D fire.
 - Smith's brain is different from Jone's brain & hence when Smith thinks it might rain, nerve cells E, F, G, & H fire.
- Both men are entertaining the same thought, but different cells are firing in the different brains.

- this is the basic problem: different types of neural events might be underlying the same thoughts in the two different brains.

- **Token Identity Theory** asserts that mental events correspond with neurological event, but there is an acceptance that there may well be a variety of neurological events that may underlie each mental event.
- Hence, it is quite acceptable that the firings of nerve cells A,B,C, D and also E, F, G, H may separately correspond to the same thought in different brains.
- As it stands, it is token identity theory's brand of materialism that provides the foundations for all kinds of work in cognitive neuroscience.

- Even, this version may run into difficulties concerning understanding of subjective experience. But, we need to assume that it's ok & move on!
- On a different note: if we accept that different patterns of nerve cells firing may give rise to the same thought, we need to be clear about what it is about these patterns of firing that gives rise to the particular thought.

Functions & functional Roles...

- function, could be the purpose of anything.
 - as the function of the umbrella or the chalk or the board etc.
- so, the structure of something could be different from its function: i.e. what is the physical make - up & what it does!

- Take an example of a car engine.
 - we could offer a **functional description** of the engine by specifying what the purpose of each component is.
 - the assumption is that to attain a full understanding of the workings of a car's engine we need to have:
 - a description of the structure of its components
 - a specification of how these are interconnected
 - a complete description of the functional role of each component.

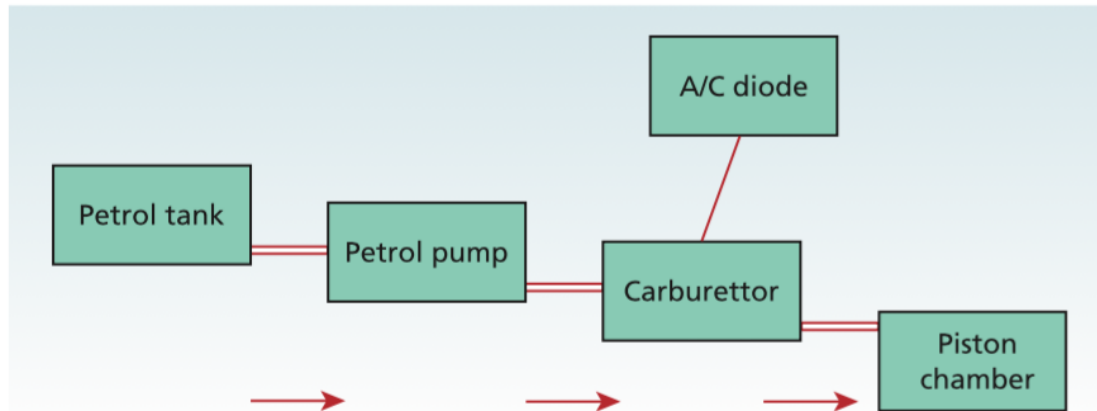


Figure 1.5 The usefulness of a blueprint
A schematic representation of some of the components of a car's engine.

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

- now, while the earlier diagram is useful because it gives an idea of what the structural components are & how they are connected; it does not help us by telling how each of these function.
- We would be better served if we have a functional description of the components...

- traditionally, such a design eventuates in a **schematic diagram** that specifies each component and shows how each component is connected with other components.
- such a diagram may also reveal the flow of control between various components. e.g. the direction of flow petrol from the tank via the pump to the carburettor.

- Another interesting aspect of this is - that at the level of the diagram we are not so bothered about how close the different components are to one another - whether the pump is next to the tank or the carburettor - we are primarily concerned with how the components are interconnected with one another.
- however, if we embellish the structural information with a description of the functions of the individual components , it would be very useful.

- In our case, such a description allows us to discuss each of the individual components in the abstract, i.e. without commitment to any particular physical entity.
- the focus shifts to the function & not so much to the structure.

- **Functionalism:**

- it is now possible to see how two different brain states may underlie the same mental state - as long as the two neurophysiological states serve the same functional role, then they capture the same mental state.
- mental state **x** is defined purely in terms of its function.
- this is called **functionalism**.

- **Function** is now defined in terms of causation – the mental state **x** has a particular function insofar as it leads to the same consequences, be the new mental states or some form of behavior.
- **E.g.** Anne thought it was going to rain & remembered that she had left her kitchen window open. She would go to close it.
- **Here**, mental state **x** caused mental state **y** and results in action/behavior **z**.

- So, as long as the functional description of the mental states and processes is the same for different individuals then our understanding the particularities of the underlying neural apparatus are generalizable.

To sum up..

- The cognitivist view of mind & behavior allows the assumption of abstract mental events as theoretical basis of human behavior.
- Further, it stresses on generation of scientifically testable assumptions which can form explain human behavior in a scientific, though simple manner.
- Further, it takes the functional description of mental states

References

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