Lecture 1.1
“What is Cognition?”

Central Idea:
The human mind, and in particular our mental processes/structures, can be scientifically studied.

Cognition Defined
- Cognition is the scientific study of mental processes (Robinson-Riegler & Robinson-Riegler, 2012).
- Mental processes involve how the mind represents and processes information.

What does a cognitive psychologist study?

How does the study of cognition impacts us?
Shuttle and plane cockpits (and your car) – designers take into account how people pay attention, and shift their attention between controls.

Classroom – educational programs now consider how students learn and use knowledge.

Telephone companies – design better communication systems that take advantage of how we perceive.
Why does Cognition Deserve Your Attention?

- According to Mayer (1981), cognition is:
  1. **Widespread**: cognition is a dominant theme in psychology, and ranges from the study of memory to friendships.
  2. **Current**: cognition offers a fresh point of view.
  3. **Promise**: cognition provides a way of looking at psychological processes from the “inside” – it is unique to psychology and science.

Omnipresence of Cognition

- Neisser (1967) stated:
  
  “… It is apparent that cognition is involved in everything a human being might possibly do; that every psychological phenomena are cognitive phenomena.”

Omnipresence of Cognition

- What are you aware of?
- Does hypnosis improve our memories?
- Are children really “blank slates”?
- Why is my grandmother using shorter, simpler words? How can this effect be slowed?

Cognition is everywhere…

- Cognitive psychology is a **science**, and as such, we will focus on experimental research.

Cognition in the 21st Century

- Cognitive methods have expanded to embrace current neuroimaging tools.
- Cognitive themes:
  - Cognition is embodied
  - Cognition and emotion cannot be separated
  - Cognition varies
  - Cognition is big: Metacognition.

Learning Outcomes

- **Knowledge**: list and discuss the key people and events that contributed to the rise of cognitive psychology.
- **Skill**: research the key people and events that contributed to the rise of cognitive psychology.
- **Value**: express how key people and events contributed to the rise of cognitive psychology.
Quick Overview

1. Pillars and Brief History
2. Challenges to Behaviourism
3. Early Influences on Cognition
4. Recent Metaphors for Cognition

A Brief History of Cognition

- Psychophysics, structuralism, functionalism, and behaviourism all contributed to the development of cognition.

The Misbehaviours of Rats

- Behaviourism predicts that the rats would select path 1, then 2, and final 3 when Block B was in place. The rats selected path 3 on the first trial 90% of the time!!

The Misbehaviours of Humans

- Failed to accurately predict complex interactive behaviour
  - Infant Attachment Theory
- Could not account for the behaviour / thought control relationship
  - Theory of Ironic Processes
3. Early Influences on Cognition

1. **Computer** – learning, storage, manipulation, and memory: internal components and processes; flow diagrams.
2. **Linguistics** – shift from behaviourist accounts to theories that emphasized the structures underlying comprehension (e.g., Chomsky’s, 1957, *Syntactic structures*).
3. **Developmental psychology** – Piaget’s emphasis on the internal structures and processes of human development.

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4. Metaphors for Information Processing

- There are two main models of cognitive processing:
  - **Computer metaphor** → information processing
  - **Brain metaphor** → connectionism

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**Computer metaphor** → information processing

- Based on the following assumptions:
  1. Cognition is best understood by analyzing it into a series of (mostly) sequential stages.
  2. Each stage (input, recall from long-term memory, decision, output) requires a unique process.
  3. Each stage works on its own set of internal representations.

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**Brain metaphor** → connectionism

- Contrast between **Computer and Mind**
  - Humans quickly figure out variations in patterns (e.g., a A a A a A)
  - Computers can do error-free calculations.
  - Humans speed up their processing (e.g., you are faster to provide an answer to the problem 2*6 = ? After seeing this problem many times)

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4. Metaphors for Information Processing

- There are two main models of cognitive processing:
  - **Computer metaphor** → information processing
  - **Brain metaphor** → connectionism
Biological Principles of the Brain:
- (McLeod, Plunkett, & Rolls, 1998)
1. Neurons integrate information.
2. Neurons pass information about the level of their input.
3. Brain structure is layered.
4. The influence of one neuron on another depends on the strength of the connection between them.
5. Learning is achieved by changing the strengths of the connections between neurons.

Brain metaphor → connectionism
- Cognitive processes are similar to the brain processes:
  1. integrate information.
  2. pass information about the level of their input.
  3. cognitive structure is layered.
  4. The influence of one node on another depends on the strength of the connection between them.
  5. Learning is achieved by changing the strengths of the connections between nodes.

Learning Outcomes
Knowledge: list and describe the key research methods used in cognitive psychology.
Value: acknowledge the importance of the diverse research methodologies used in cognitive psychology.

Quick Overview
1. Descriptive Research
2. (Quasi-) Experimental Research
3. Cognitive Experiments
4. Cognitive Neuroscience

1. Descriptive Research
- Naturalistic observation – the observation of behaviour in its natural setting
  • Issue – “thinking” is not observable
- Case Studies – in-depth examination of a small number of cases
  • Issue – generalizability
- Self-report – individuals report on their own knowledge, attitudes, feelings, and opinions.
  • Issue – purely descriptive
1. Descriptive Research Examples

- **Naturalistic observation**

- **Case Studies**

- **Self-report**
  - *used verbal report + experimental methods*

Value and Issues Associated with Descriptive Research

- Value – provides a “starting point” for new lines of experimental research
- Issue – descriptive research cannot address “how” or “why” a set of phenomena occur.

**Activity**

- Over the next day or two, observe people having conversations in the hallways. Observe how people who are walking past the conversants behave. Do they tend to interrupt the conversation (e.g., “excuse me”) or not? Pay attention to where they walk in relation to the conversants.

2. (Quassi-) Experimental Research

- Involves the systematic manipulation of independent variables and the observation that this manipulation has on a dependent (i.e., measurement) variable in a controlled setting.

- ...allows researchers to make a *causal statement* regarding the effect of the IV on the DV.

What are the differences between descriptive and experimental research?

- **Laboratory Studies**:  
  - Establish control of the IV and extraneous variables  
  - Measure the DV

- **Ecological Studies**:  
  - Limited control of IV and extraneous variables  
  - Measure the DV

Advantages and Disadvantages of Experimental Research

- **Advantages**:  
  - Systematic control  
  - Internal validity (measuring what we are supposed to measure)

- **Disadvantages**:  
  - Loss of ecological validity  
  - Potential for expectancy effects
### 3. Cognitive Experiments

- How can we “see” cognition?

- Types of DVs:
  - speed and accuracy (most common)
  - physiological measures (e.g., EEG, PET, fMRI)
  - number of solutions, frequency of responses, etc.

### Cognitive Experiments

- How can we influence cognition?

- Types of IVs:
  - Participant variables (e.g., young/elderly)
  - Material variables (e.g., regular/exception words)
  - Experimental context variables (e.g., list manipulations)
  - Performance-measure variables: a DV is used to generate a participant variable (e.g., fast or slow responders on a reading test to identify skilled and less skilled readers)

### Cognitive Experiments

- Confounds? Variables that co-vary with the IV.

- The problem with confounds is that we do not know if the effect on the DV was due to an IV or a confound.

- Look for confounds in others’ research and avoid them in your own research.

### 4. Cognitive Neuroscience

- New wave of research:

- Examples from UNBC researchers:
  - Dr. P. Siakaluk – brain trauma: inability to read nonwords
  - Dr. K. Prkachin – fMRI: differences in first person vs. second person experience of pain
  - Dr. G. Prkachin – alexithymia: temporal constraint in processing facial expressions
  - Dr. W. Owen – fMRI: neuromodel of word recognition

### Types of Cognitive Neuroscience Tools

1. **Case study** – brain injury (internal vs. external), rare conditions and diseases, …
   - Single vs. double dissociations
2. **Electroencephalogram (EEG)** – recording of electrical potentials associated with cognition (poor localization, great timing)
3. **Imaging Techniques** – PET and fMRI are based upon the principle that active neurons need food and oxygen (poor timing, great localization)

### A Cautionary Note

- Imaging research is often based on designing studies using Donders’ subtractive logic.

- In the 1960’s, Sternberg convinced most of psychology that this logic was flawed.
Donders’ RT Experiment

RT = Mental response (light perception) + Response (button press)

RT = Mental response (light perception AND decide which button to press) + Response (button press)

Decision Making

- Donders’ two-alternative forced choice decisions lead to a 100 ms increase in reaction time.

- Cognitive decisions take 100 ms.

Sternberg’s (1966) Methodological Advance

- Donders subtractive logic:
  
  Task 1 = components $A + B + C = RT_1$
  
  Task 2 = components $A + C = RT_2$
  
  $B = RT_1 - RT_2$

- Sternberg argued that one could not be sure that the process components $A$ and $C$ were not simplified.

- Sternberg figured that if you wanted to study process $B$, you had to examine process $B$ when the process was repeated one to several times per trial.