3.1 Cogni**tive level of analysis:**

Cognitive Process
Outline Principles that define the cognitive level of analysis
Cognitive Psychology

- Cognitive psychology concerns itself with
  - the structure
  - and functions of the mind.

- How the human mind comes to know things about the world and how it uses this knowledge.
PRINCIPLES WHICH DEFINE LEVELS OF ANALYSIS

- Mental representations and process guide behavior
- Mental processes can be scientifically investigated
- We are not passive responders to our environment, but we are actively processing information.
Cognitive Neuroscience

- Combines knowledge about the brain with knowledge about cognitive process
EXPLAIN HOW PRINCIPLES THAT DEFINE THE COGNITIVE LEVEL OF ANALYSIS MAY BE DEMONSTRATED IN RESEARCH
How do we study cognition?

- Experiments – memory studies are simple experiments
- Interview – verbal protocols
- Observations – moderns scanning equipment
- Case studies – there are several famous case studies with memory, the one we will look at is the case of HM
COGNITIVE PROCESSES

- Perception
- Thinking
- Problem solving
- Memory
- Language
- Attention

Cognition: is based on one’s mental representations of the world, such as images, words, concepts.
3 PRINCIPLES OF COGNITION

- Human beings are information processors
- The mind can be studied scientifically
- Cognition processes are influenced by social and cultural factors
Human beings are information processors...

...Mental processes guide behavior.

- Neisser (1967) defines cognition as, “all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered and used.”
**Computer Analogy**

- Brain = hardware
- Mental images or representations = software

- **Bottom-up processing:** information comes from sensory systems
- **Top-down processing:** information if processed via pre-stored information in the memory. Where it is displayed in behavior
HOW PEOPLE THINK ABOUT THEMSELVES EFFECTS THE WAY THEY BEHAVE

- Carol Dweck
  - A person's mindset is important in predicting his or her behavior.
- People who have fixed ideas (stereotyping) are more likely to discriminate.
MEMORY

- **Reconstructive nature** of memory:
  - People only store outlines of their experiences, the details are filled in only when we recall the event

- **False memory**: individual cannot distinguish between what they experienced and what they have heard about the event.
PERCEPTION

- The cognitive process that interprets and organizes information from the senses to produce some meaningful experience of the world.

- What influences perception?
  - Context
  - Frequency
  - Recency

- What is thought to be objectively experienced may be the result of the brain's interpretation of the object.
“our experience of the world - how we see it, remember it and imagine it – is a mixture of stark reality and comforting illusion.” David Gibert
Discuss how and why particular research methods are used at the cognitive level of analysis.
The Mind can be studied scientifically

- 6 main research methods in psychology
  - Experiments
  - Case Studies
  - Observational Studies
  - Interviews
  - Surveys/questionnaires
  - Correlation studies
PROCEDURE

- Outline the strengths and limitations of each type of research method. Provide one research study to support.

- Process in summary format.
Explain how principles that define the cognitive level of analysis may be demonstrated in research.
HOW TO PROCESS THE QUESTIONS

- State the 3 principles of the CLA
- Purpose of the principles
- Define cognition
- Connection of a study to a principle
  - Aim
  - Method
  - Findings
  - conclusion
- Final Conclusion
Discuss ethical considerations related to research studies at the cognitive level of analysis

Command Term Discuss: present a balanced argument
ETHICS

- In psychology, ethics must be considered to ensure participants (humans and animals) are not harmed and that research conducted is ethically valid.
- Researchers should always conduct research in an ethical manner and studies should always be critically evaluated for ethical issues.
Ethical standards made by the American Psychology Association (APA) that all research done in psychology must abide by.

- These ethics are:
  - **Protection of participants**
    - Participants should be protected from physical and mental harm and distress
    - This includes humiliation, stress, injury, etc.
    - Participants should not be forced to reveal personal information.
Consent

- Participants must be informed of the true aims and nature of research before giving consent.
- Sometimes it is not possible to give full information about research.
  - Participant bias: knowing the true aims of a study may affect participants' behavior and thus the results of a study.
  - It is considered acceptable not to give full informed consent if no harm is expected.
- A guardian or family member should also give consent to the study if the participants are
  - Children under 18 years of age
  - Adults incompetent of understanding the true nature and aims of the study.
Right to withdraw
- Participants should be informed of their right to withdraw their participation and data at any time in the study (even at the end) without penalty.

Confidentiality
- Data collected in a study should remain confidential and anonymous to protect participants from possible consequences that may result from their data.

Deception
- Deception should be avoided
- But slight deception is considered acceptable if:
  - Participant bias would result from participants knowing the true aims of the study
  - The research has potential significant contribution
  - It is unavoidable
  - The deception does not cause any distress to the participant, including upon being informed of the deception
- If deception is involved, informed consent is not obtained
- Any deception must be revealed at the earliest opportunity
Debriefing

- Any deception must be revealed and justified
- Participants should leave the study without undue stress
- Findings of the research should be made available to participants as soon as possible
Cognitive Process: Evaluate Schema Theory with Reference to Research Studies

Schema Theory – informational processing
COGNITIVE PROCESSES ARE INFLUENCED BY SOCIAL AND CULTURAL FACTORS.

- **Schema** – a mental representation of knowledge
  - How do cultural schema influence remembering?
- **Bartlett**: people had difficulty remembering a story from one another culture, and that they reconstructed the story to fit their culture schema.
  - People remember in terms of meaning and what makes sense to them.
  - Hence memory is subjected to **distortions**.
    - **Assimilation** – consistent with ones own culture
    - **Leveling** – story gets shorter
    - **Sharpening** – order of the story changes
Will it ever be possible to develop robots that can think like humans?

TED Talk
Cognitive Schemas

- Mental representations of how we store images and ideas in memory
- Memory is organized into categories to create a stored memory
- Manipulation of these categories allows humans to:
  - propose hypothetical situations
  - imagine,
  - calculate risks,
  - plan or just to be creative.
The reading of a book – how many times have you imagined yourself being on the streets of Paris, when the heroine of your novel is there?

Does what we know effect the way we interpret events and store knowledge in our memory?
SCHEMAS

- Schemas describe how specific knowledge is organized and stored in memory.
  - Knowledge
  - Beliefs
  - expectation
- Schema theory is a cognitive theory about information processing.
  - Self-schemas: how we view ourselves (+/-)
  - Social Schema: how we group people
Cognitive Schema can be defined as networks of knowledge, beliefs, and expectations about a particular aspect of the world.

Organizes information about the world with fixed and variable slots;

- What we already know will influence the outcome of information processing.
- if a slot is left out or unspecified, it is filled by a default value (best guess) – distortions?

Can be related to form systems

Are active recognition devices (patterns)

Help to predict future events based on what happened before

Represent general knowledge rather than definitions.
IB – Evaluate schema theory with reference to research studies

- Evaluate = what are the strengths and limitations

- Key Studies
  - Bartlett “War of the Ghosts: (1932)
  - Anderson and Pichers (1978)
  - Brewer & Treyens – “picnic basket” (1981)
  - French & Richards (1933)
SCHEMA THEORY AND MEMORY PROCESSES
3 STAGES OF MEMORY PROCESS

- **Encoding:**
  - Transforming sensory information into a meaningful memory
- **Storage:**
  - Creating a biological trace of the encoded information in memory, which is either consolidated or lost.
- **Retrieval**
  - Using the stored information

Does schema processing affect memory at any stage(s) of the memory process?
ANDERSON AND PICHERT (1978) (KEY STUDY SHEET)

- Memory Processing

Aim: Do schema processes influence encoding and retrieval?

Method:

Results:

Conclusion: new schema influence recall at the retrieval stage

Evaluations
- Strengths – controlled lab experiment
- Limitations – lacks ecological validity, cannot generalize to the population
BREWER AND TREYENS (1981) “PICNIC BASKET”

- **Aim:** to see whether a stereotypical schema of an office would affect recall of an office
- **Method:**
  - participants entered a university student office and were left for 35 seconds, then moved into another room.
  - They were asked to write down as much as they could remember from the office
- **Results:**
  - participants recalled office things
  - They did not notice the wine and picnic basket that were in the office
- **Conclusion:**
  - schema influenced their memory.
  - Picnic basket not part of an office schema
- **Evaluations**
  - + = controlled
  - - = lab setting, lacks ecological validity
Aim: how does schema influence memory recall

Method:
1. shown a clock with roman numerals and asked to draw for memory
2. told before hand that they would be required to do the above task
3. The clock was left in full view for participants to draw.
   - The clock used represented the number 4 as IIII vs IV.

Results:
- Group 1 & 2 reverted to using IV
- Group 3 used IIII

Conclusions:

Evaluations:
BARTLETT – “WAR OF THE GHOSTS”

- Aim: how social and cultural factors influence schemas and hence can lead to memory distortion.

- Method:

- Results

- Conclusion:

- Evaluation:
  - Bartlett did not ask participants to be as accurate as possible in their reproductions
  - Experiment was not very controlled
    - Instructions were not standardized
    - Disregard for environmental settings
EVALUATION OF SCHEMA THEORY

- *How* schemas are acquired and *how* they actually influence the cognitive process is not entirely clear.

- US psychologist Daniel Gilbert,
  - The brain is a wonderful magician but a lousy scientist – the brain searches for meaningful patters but does not check whether they are correct.
A MODEL OF MEMORY: THE WORKING MEMORY MODEL
A MODEL OF MEMORY: THE WORKING MEMORY MODEL

- Multi store Model (Atkinson and Shiffrin, 1968)
THE COMPONENTS OF THE MULTI-STORE MODEL

- **Sensory Memory** – input from the world
  - Touch, hearing, vision, smell
  - Stays for a few seconds
  - Moves to short term memory (STM)

- **Short Term Memory (STM)**
  - Can only hold about 7 items
  - Can only maintain for 6-12 seconds
  - Information is quickly lost if not given further attention.

- **Long Term Memory (LTM)**
  - Storehouse of information/indefinite duration
  - Unlimited capacity
  - Information is an outline of facts vs a replication of an event.
WORKING MEMORY MODEL
BADDELEY AND HITCH (1974)
THE DIFFERENT COMPARTMENTS OF WORKING MEMORY

- Central Executive (CEO of memory)
  - Controlling system that monitors/coordinates other systems, known as *slave systems*.
  - Modality free (i.e. it can process any type of sensory information)
  - Major job = attentional control
    - Automatic level
      - Routine procedures (i.e. cycling), habit based behaviors (autopilot)
    - Supervisory attentional level
      - Emergencies or creates new strategies
Episodic buffer
- Acts as a temporary and passive display store until information is needed.
- Details of a landscape or the sound of a favorite band.

Phonological loop (phonology = organization of sounds)
- Articulatory control system
  - Inner voice
  - e.g. trying to remember a number sequence, so you repeat it to yourself
- Phonological store or inner ear
  - Holds speech based material in phonological form.
  - Only good for 1.5 – 2 seconds unless reinforced by articulatory control.

Visuospatial sketchpad (also called the inner ear)
- Visual and spatial information from either sensory memory (SM) or LTM
Evidence of Working Memory

- Dual-task-techniques
  - Participant is asked to carry out a cognitive task that requires working memory (telling a story), while at the same time performing another cognitive task (learning a list of numbers)

- Baddeley and Hitch (1974) experiment (pg 75)
EVALUATION OF THE WORKING MEMORY MODEL

- Multi-store model assumes mental process is passive
- Working model memory may explain why some people can perform different cognitive tasks at the same time without disruption (multi-tasking)
  - Working memory may play an important role in learning.
  - Pickering and Gathercole (2001) found increased performance in working memory between the ages of 5 and 15; the capacity of working memory during childhood varies widely across individuals of the same age.
    - e.g. deficits in phonological loop have been linked to problems in math and reading.
Holmes et al., (2008) studied the association between the visuospatial sketchpad and mathematics in relationship to age.

- Age related differences in visual and spatial memory and math skills.

Eysenck (1988), “there is reasonable evidence that individual differences in intelligence may depend partly on the differences in working memory capacity.”
MEMORY AND THE BRAIN
Pgs 76 - 79
BIOLOGICAL FACTORS OF MEMORY

- Neural network – the wiring connections that are strengthen by learning, practicing or recalling.
- How do scientist go about determining the area of the brain that a specific task is performed?
  - Lesioning
Long Term Memory

Explicit Memory
declarative

- Memory of facts
  Semantic Memories
- Memory of events
  Episodic Memories

Implicit Memory
Non-declarative

- How to do things
  Procedural memories
- How emotional states
  Emotional memories
LONG TERM MEMORY (LTM)

- **Explicit Memory**: or declarative – fact based information
  - Semantic Memory
    - memory of facts
    - WHAT
  - Episodic Memory
    - memory of events, personal experiences
    - WHEN
LONG TERM MEMORY (LTM) cont.,

- **Implicit Memory** – memories we are not consciously aware of.
  - Procedural memories
    - Skills, habits, actions
    - “knowing how”
  - Emotional memories (what system do you think this is associated with?)
    - Not very well understood
    - Hippocampus places important role – damage to hippocampus - individuals cannot form new explicit memories (what, when), BUT they can still form implicit memories. (how).
  - Amygdala plays role in storage od emotional memories
    - May contribute to why people with PTSD have problems forgetting

- Refer pg 77
Clive Wearing: How Brain Damage Can Affect Memory

- Read and discuss pg 78
- MRI studies reveal damage to hippocampus and some of the frontal regions
  - Anterograde amnesia – unable to create new memories
  - Retrograde amnesia – loss of memories that occurred prior to the injury
    - Retrograde amnesia – may be caused by trauma that disrupts the consolidation of memory.
THE CASE OF HM [KEY STUDY]

- Prepare a Key study Sheet on HM
- Discuss in class:
  - What is a case study?
  - How are case studies such as HM and C. Wearing helpful for neuroscience?
  - How would neuroscientists determine if this case study could be generalized to explain human memory?
ETHICS IN RESEARCH: HM AND CLIVE WEARING ARE FAMOUS CASE STUDIES.

1. Why are participants in case studies normally anonymous
2. Discuss the ethical consideration in studying an individual with an interesting disorder or brain damage, such as HM and Clive Wearing
EVALUATE TWO MODELS OR THEORIES OF ONE COGNITIVE PROCESS WITH REFERENCE TO RESEARCH STUDIES

Command Term Evaluate; strengths and limitations.
There are three main types of models of memory that demonstrate how our memory processes work:

- **Schema Theory**
  - Research Study

- **Multistore Model (MSM)**
  - Research Study
    - Atkinson and Shiffrin (1968)

- **Working Memory Model (WM)**
  - Research Study
    - Baddeley and Hitch (1974)
Discuss how social or cultural factors affect one cognitive process

Command Term Discuss: present balanced argument that includes a review of hypotheses about how cultural factor affect a cognitive process.
NOTICE THE “or” – pick one
CULTURAL FACTORS IN COGNITION

- Children of any culture learn through schooling and daily interactions with members of the culture/society in which they live.
- How do you organize information in your memory
- The effects of schemas on memory
  - Self schema
  - Social schema
Western bias assumed that cognitive processes (e.g. memory) that held true in one culture would surely hold true in all cultures....BUT, when western tests were applied to other cultures the results were different.

Cross culture psychologist recognize

- Must have awareness of language and culture of group being tested.
- Cole and Scribner (1974) pgs 80-81
- Although memory is universal, the strategies to remembering are not universal
- People learn to remember in ways that are relivilent to their everyday lives.
EXPLAIN HOW BIOLOGICAL FACTORS MAY AFFECT ONE COGNITIVE PROCESS

Command Term Explain: provide a detailed account, including reasons or causes for something. How and why biological factors affect cognition
RELIABILITY OF ONE COGNITIVE PROCESS: MEMORY

- Bartlett – War of the Ghost
- Loftus Palmer – eyewitness testimony
Evaluate the extent to which a cognitive process is reliable

Command term evaluate: provide the strengths and limitations of the reliability of cognitive processes: things to consider – culture, gender, ethics, age, the process itself, methodology
RELIABILITY OF ONE COGNITIVE PROCESS: MEMORY

- How reliable is your memory?
- Memories may be influenced by other factors than what was recorded in the first place
  - Reconstructive nature – the brain's active processing of information to make sense of the world.
ARE RECOVERED MEMORIES ACCURATE?

- Freud believed that forgetting was repression.
  - Repression, according to Freud, is a defense mechanism.
    - Repressions are evoked through symbolism in dreams, and can therefore haunt/taunt the individual.
    - They can only be recovered with the help of a therapist.

- False Memory
  - Victims of child abuse may not want to recall their memories, but can they simply forget them?
  - How much of memory recall is false memory vs accurate recall?

- Loftus: some recovered memories may be created by post-event information during therapy.
Empirical testing of reliability of memory

- Bartlett (1932): reconstruction AND the role of culture in schema processing influence recall.

Method:
- Experimental - Serial reproduction – the telephone game. Person one tells a story to person 2 tells who must tell the story to person 3 etc...until 6 or 7 reproductions.
- This method is meant to simulate gossip/rumors

People reconstructed the pat by trying to fit the story into existing schemas. The more complicated the story, the more likely elements will be eliminated.

Memory is an imaginative reconstruction of experience.
LOFTUS’S RESEARCH ON RELIABILITY OF EYEWITNESS TESTIMONY

- The nature of questions can influence witnesses’ memory.
- Evaluate Loftus Palmer - refer pg 84 and summer assignment
- Yuille and Cutshall (1986) counter argument (pg 85)
Explain the use of technology in investigating cognitive process

Command term explain: provide a detail account including reasons or causes for something. How and why technology is used to study relationships between cognition and behavior. Always include empirical studies in your argument.
TYPES OF TECHNOLOGY USED TO INVESTIGATE RELATIONSHIP OF COGNITION AND BEHAVIOR.

- PET: Positron Emission Topography
- MRI: Magnetic Resonance Imaging
- fMRI: functional Magnetic Resonance Imaging
- EEG: Electroencephalogram
- CAT: Computerised Axial Tomography

Each method has its own advantages and disadvantages and are appropriate in varying situations.
Cognitive processes being evaluated

- Language
- Memory
MRI AND fMRI

- 3-D images
- Detect changes in the use of oxygen in the blood
  - When an area is more active it used more O$_2$
  - Used to see what areas are more active when performing cognitive tasks
    - Reading or problem solving
- It can distinguish among different types of soft tissue and allows researchers to see structures within the brain.
- Supporting Study: HM Milner and Scoville (1957)
# MRI

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent resolution</td>
<td>Expensive</td>
</tr>
<tr>
<td>Non-invasive</td>
<td>Limited to activation studies</td>
</tr>
<tr>
<td>Practical (easy to use &amp; most hospitals already have them)</td>
<td>Gives correlation but not causation.</td>
</tr>
<tr>
<td>Safer</td>
<td>It can also be inaccurate because slight movement affects quality of image and MRI images sometimes over interpret.</td>
</tr>
<tr>
<td>Individuals can be tested repeatedly</td>
<td>It cannot be used on everyone</td>
</tr>
<tr>
<td>Fast (1/2 mins for most of brain)</td>
<td>- The limited space and loudness could make patient feel claustrophobic or cause distress to claustrophobic people, and make them not concentrate on tasks.</td>
</tr>
<tr>
<td>Provides controlled experimental conditions</td>
<td>- Obese individuals may not be able to fit into the MRI machine</td>
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<td></td>
<td>- Patients with pacemakers or any metallic implants cannot be studied due to the magnetic fields.</td>
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PET

- PET scans require patients to be injected with a radioactive glucose tracer which shows the areas where glucose is absorbed in the active brain.
- More glucose metabolism means more brain activity.
- PET scans show a colored visual display of brain activity; where radioactive tracer is absorbed
  - Red indicates areas with the most activity
  - Blue indicates areas with the least activity
PET scans are used to detect:

- Brain tumors
- Memory disorders due to Alzheimer's
  - Identify metabolic activity in the hippocampus
    - Individuals who show early signs of reduced glucose metabolism in the hippocampus were associated with developing Alzheimer’s disease.
# PET

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>sensitive</td>
<td>Invasive (injection)</td>
</tr>
<tr>
<td>good resolution</td>
<td>very expensive</td>
</tr>
<tr>
<td>receptor mapping</td>
<td>takes longer than MRI scans</td>
</tr>
<tr>
<td>possible to do metabolic studies</td>
<td>limit to the number of injections</td>
</tr>
<tr>
<td>can track ongoing activity in the brain (e.g. thinking)</td>
<td>cannot do longitudinal studies</td>
</tr>
<tr>
<td></td>
<td>some people are allergic to the tracer</td>
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PET

- **Supporting Study: Tierney et al (2001)**
- An example of a study which utilizes PET scans to investigate the cognitive process of language is a study conducted by Tierney et al. (2001).
- **Aim:** To evaluate, using PET scans, the bilingual language compensation following early childhood brain damage
Background:

- 37 year old man (known as MA) with normal speech functions who was participating in a normal speech study. It was discovered that he had a lesion in his left frontal lobe. Probably as a result of encephalitis he suffered at the age of 6 weeks.
- He had no significant long-term, clinically consequences.
- Both his parents were deaf and he used sign language at home from a very young age.
- Researchers were curious to know if this might have had something to do with his ability to speak despite the brain damage (that should have prevented him from doing so).
Methods: Researchers compared MA to 12 control participants, who were fluent in sign language
- PET scanning technologies were used while the participants produced narrative speech or signs

Results: MA's right hemisphere was more active than the controls' during the production of both speech and sign language

Conclusion: Language function seems to have developed in the right hemisphere instead of the left hemisphere as an adaptation following his early brain damage.
Tierney utilized PET scans to investigate the cognitive processes of language and observe the areas of the brain (biological factor) that activated while MA produced language (cognitive process).

- The ongoing activity in the brain would not be able to be seen using other technologies such as EEGs or MRIs.