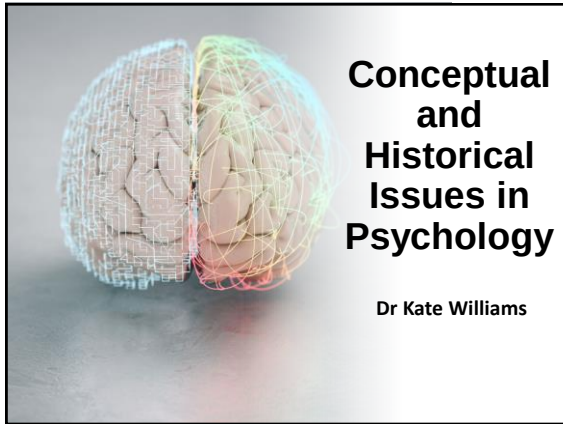




1

Session Outline:

-  Overview of Cognitive Psychology
-  Approaches to studying Cognition
-  Attention:
Theory, Research, and Interactive tasks
-  Perception:
Theory, Research, and Interactive tasks
-  Memory:
Theory, Research, and Interactive tasks

2

**Core Domain:
Cognitive Psychology**

**ONE OF THE
BPS CORE
AREAS!**

**SCIENTIFIC
STUDY OF
MIND
(AND BRAIN)**

3

Cognitive Psychology

Cognition: from Latin Cognoscere – to know

Mind: workings of living brain

Mind: Determines and controls behaviour

Mind: Allows us to make sense of world

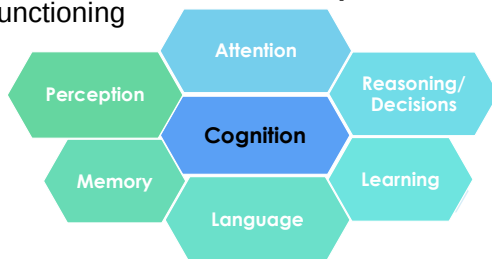
Mind: Helps us decide action to take when necessary



4

Cognitive Psychology

Aims to understand **mental processes** and functioning



Some are well understood, others not so much...
I.e., higher-order cognitive processes – Executive functioning.

5

Cognitive Psychology

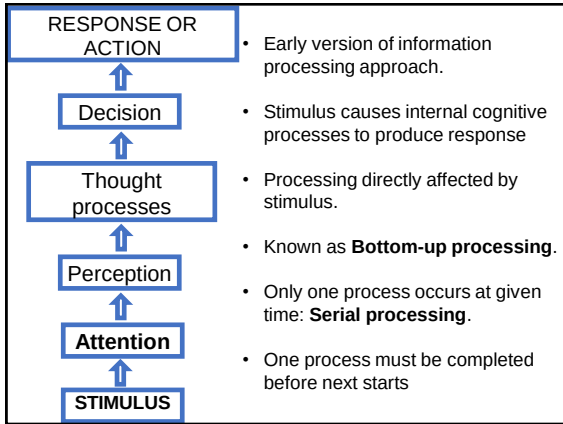
Adhered to an approach called **Information Processing**

Info from senses is systematically and actively **processed** by various brain systems

That processing enables our mind to make sense of what we experience

Info from external world is acquired, selected, represented, stored, organised, transformed, and used according to rules

6



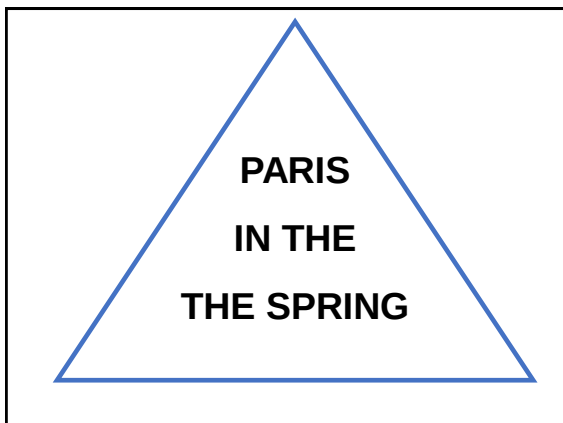
7

Major issue 1: Direction of processing

- Oversimplified explanation of complex mechanisms.
- **Top-down processing** also exists:
 - Influenced by expectations and knowledge rather than just looking at stimulus.
 - E.g., look at the triangle and read the words out aloud...

The diagram illustrates top-down processing, showing a top-down flow of information. A central point (represented by a diamond) has arrows pointing down to two boxes, indicating that the process is influenced by expectations and knowledge rather than just looking at the stimulus.

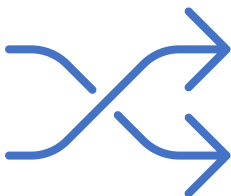
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Major issue 2: Type of processing

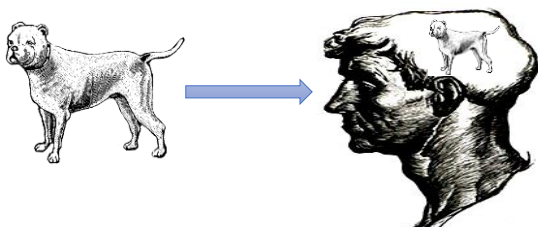
- Oversimplified assumption that processing is serial
- **Parallel Processing** also exists:
 - Some processes must be carried out simultaneously during a cognitive task.



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Representation

An important word in Cognitive Psychology!!
Does the mind represent info as it exists in the world?
The question of 'representation' in cognition



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Approaches to studying Cognition

1. **Experimental Cognitive Psychology**
 - Uses behavioural evidence
2. **Computational Cognitive Science**
 - Uses computer models
3. **Cognitive Neuropsychology**
 - Study brain-damaged patients
4. **Cognitive Neuroscience**
 - Biological (brain) + cognitive evidence

Most research now uses combination

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Experimental Cognitive Psychology



Test relationship between cognition and behaviour



Understand thinking from action/response



Manipulate research variables: Independent Variables



Response/output = Dependent Variable (DV)



Conducted in highly controlled environments (lab)

Participant shown/hear stimuli via PC
Time &/or accuracy as response measure

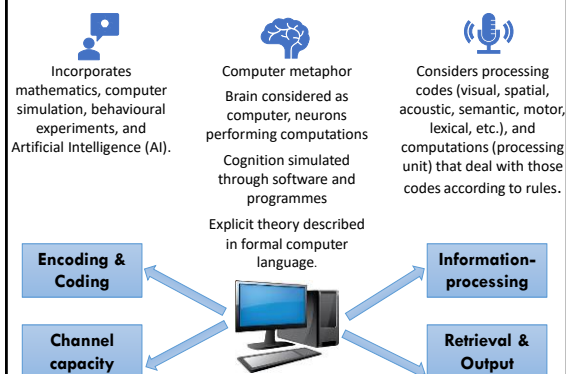
13

Evaluation: Experimental Cognitive Psychology

Strengths	Limitations
Highly Rigorous/Scientific - Uses standardised procedures	Typically, only examines healthy adults
Produces reliable/objective data	Lacks ecological validity
Easy to replicate	Only infers mental processing
Paved way for other approaches	Reductionist: other factors also influence responses/behaviour
Leads to refinement of new theories	Paradigm specific
Good internal validity - extraneous variables controlled	Emerging theories can be vague

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Computational Cognitive Science



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Evaluation: Computational Cognitive Science

Strengths	Limitations
Explicit in theory explanation	Difficult to falsify models as they account for numerous findings
Helps provide overarching framework to understand cognition	Ignores cognition is influenced by conflicting motivation and emotion factors
Includes depth, clarity, and specificity	Code not made available – regulating issues
New models easily developed to account for conflicting data	Dreyfus: we are not incidental to cognition - we are involved in open-ended tasks with infinite ways to perform
Links with other approaches	Embodied cognition

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Cognitive Neuropsychology

- Examine intact & impaired cognitive performance of brain-damaged patients via neuropsychological tests
- Theoretical Assumptions (Coltheart, 2001)
 1. Modularity of mind: Independent/domain specific cognitive modules
 2. Anatomical modularity: Each module in specific brain area
 3. Uniformity of functional architecture: Structure of mind is same for all
 4. Subtractivity – Brain damage impairs modules, not add anything
- Impaired = location of damage involved in that functioning
- Dissociation technique: patient performs typically on one task but impaired on another
 - But one type of task may be more difficult than other?
 - **Double dissociation:** one patient performs well on task X but impaired on task Y, while another patient performs well on task Y, but impaired on task X

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Evaluation: Cognitive Neuropsychology

Strengths	Limitations
Informs theory (e.g., language, reading, and memory)	Modules more flexible, parallel, and brain plasticity occurs
Can show association between brain damage and cognitive performance	Patients develop compensatory strategies masking extent of deficit
Examine behaviour from brain lesions that could not be done experimentally	Likely only one person with that specific damage – cannot compare
Allows in-depth study of patient over a long period of time (Case Study)	Cognitive function before brain damage? Medication? Other damage?
Can examine and compare patients with same symptoms together to gather more data (Group studies)	Unclear if only one module required for one type of task and only useful for showing differences between two systems
	Cannot control area of damage, not know which areas are involved

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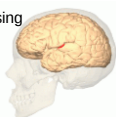
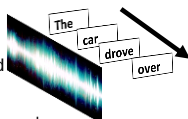
Cognitive Neuroscience

- Study brain in detail via structure/function measuring techniques (see Biological Psychology session).

- If part/process in brain becomes active, suggests involvement in aspect of cognition under investigation.

Wild et al. (2012): Using fMRI

- Degraded speech of sentences accompanied by matching or non-matching text.
- More activity in primary auditory cortex (involved in early auditory processing), when visual and auditory input matched.
- So, knowledge of what is presented affects auditory processing
- Link to McGurk Effect:
<https://www.youtube.com/watch?v=2k8fHR9jKVM>



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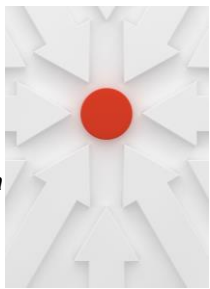
Evaluation: Cognitive Neuroscience

Strengths	Limitations
Helps provides evidence to deal with theoretical debates – e.g., are unattended stimuli processed	Activity of brain area does not necessarily mean it is involved in cognitive process
Helps construct cognitive models	Relies too much on reverse inference
Is a self-correcting approach	Specific brain area do not just deal with one type of cognitive processing
Acknowledges functional specialisation and functional integration	Only reveals associations and correlations
	Low ecological validity and underpowered

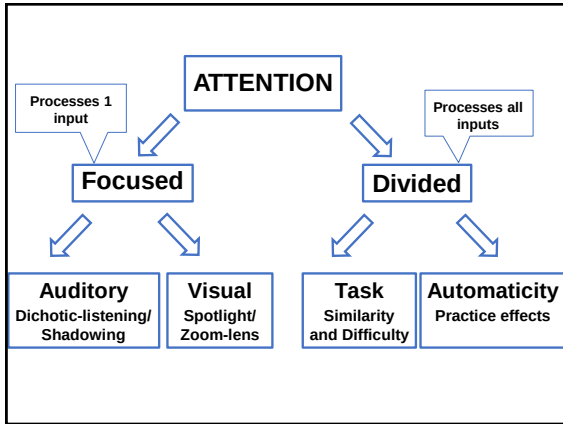
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Attention

- Gatekeeper to perception and knowledge.
- Mechanism for continued cognitive processing.
- “Sustained concentration on a specific stimulus, sensation, idea, thought, or activity.” Coleman (2001).



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Focused Attention: Cocktail Party Effect

- Cherry (1953): Play different messages to each ear
- Left ear: shadow, Right ear: not attend
- What can you hear in unattended ear?
 - Voice (or not)
 - Man or woman
 - Voice change to tone
 } Physical info retained
- What do you miss in unattended ear?
 - Content
 - Language
 - Change in language
 - Nonsense speech
 } Semantic info lost

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Modified version revealed most choose to report digits by ear rather than pair.

(a) ear-by-ear order of report



(b) Pair-by-pair order of report

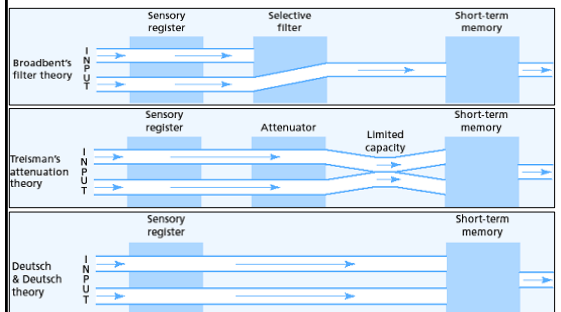


Broadbent (1958): Dichotic Listening task

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Theories of Focused Auditory Attention

- Single channel Models see attention as *serial processing*...
 - With "bottleneck" to filter out information before being further processed
 - Models differ as to where filtering occurs – early or late in attentional process.



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Evaluation

Meaning of unattended stimuli is sometimes processed.

- Difference in shadowing expertise (Underwood, 1974)
- More processing if inputs dissimilar (Allport et al., 1972)
- Unconscious processing – physiological response to word previously paired with shock (Von Wright et al., 1975).
- Name or significant info to person processed (Moray, 1959).

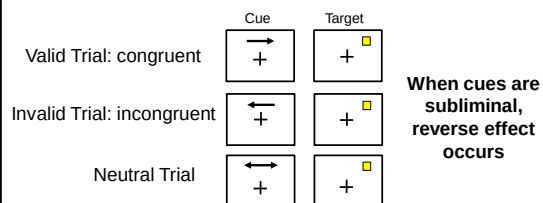


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Theories of Focused Visual Attention

- Two major systems of visual attention
 - Endogenous: controlled by intentions and expectations
 - Exogenous: automatically shifts attention

- Examined by Posner's (1980) - Cueing Paradigm:



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Theories of Focused Visual Attention

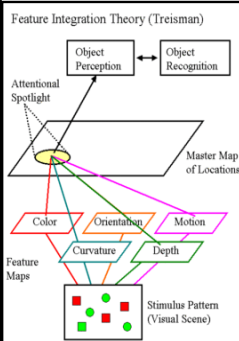
- Posner: focused visual attention = Spotlight
 - Attention illuminates part of visual space
- Info in spotlight processed further
- Info outside spotlight not really processed
- Eriksen and St. James (1986): Zoom lens of spotlight
 - We adjust area of focus by increasing/decreasing in same way as zoom lens on a camera
- Multiple Spotlights theory now dominates:
 - Visual attention is flexible: we can split attention



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Feature Integration Theory (FIT):

Treisman (1988, 1992); Treisman and Gelade (1980)



- Parallel processing of features in visual field produce maps of where features are located.
- Attention uses master map to show features binding into a construct of the object in a representation format, which enters an object file in STM.
- Extends spotlight of attention to a "moving window"
- Distinction between Features of objects (e.g., size, shape, colour) vs. Whole objects
- Parallel processing of features (fast) to begin, then....
- Serial process to combine features (slow)
- More objects to be searched = more difficult task
- Focused attention = "glue" to form object
- Stored knowledge can influence combinations (e.g., we know oranges are orange in colour).

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Interactive Tasks:



- Inattention Blindness:
 - <https://www.youtube.com/watch?v=0grANlx7y2E>
 - What does this tell us about attention?
- Change Blindness:
 - Where observer does not notice change in visual stimulus.
 - Undetected changes can be quite large.
 - Examined through flicker paradigm.
 - Stand up to watch these clips and sit down when you detect a change:
 - <https://www.youtube.com/watch?v=Ks2LzKz3wc>
 - <https://www.youtube.com/watch?v=eUKettbndDk>
 - https://www.youtube.com/watch?v=bh_9XFzbWV8

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Divided Attention

- Maximum amount of info attended to at one time.
- Studied through Dual-task Technique:
 - Attend/respond to multiple stimuli to examine continuous performance
- Provides info about limitations and capacity of attention.



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Divided Attention

- Constrained by:
 1. **Task difficulty:** worse when task components are demanding (Wickens, 1980)
 2. **Skill:** protects from interference, possibly through automatization reducing need for resource allocation (Hirst et al., 1980)
 3. **Task similarity:** interference increases when tasks are similar or involve same modalities (Wickens, 1984b)
 4. **Emergent properties:** e.g., tapping head while rubbing stomach – time and direction make them incompatible (Wickens, 1992).

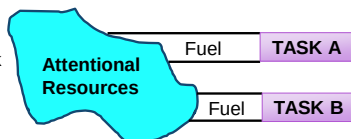


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Central Resource Theory: Kahneman (1973)

- **Central Processor** responsible for allocation of attentional resources.
- **Limited processing capacity:** dual-task interference emerges from insufficiency of processing “energy”.
 - Resources can be flexibly allocated to more than one task at a time, until all attention has been allocated.

Pool of attentional resources and fuel needed to perform task is taken from central reservoir.



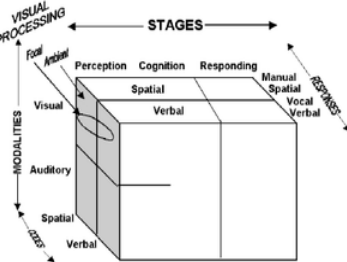
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Alternative model: Multiple Resources

- Wickens (1984):
 - Independent processing mechanisms in form of multiple resources.

Explains why task similarity is critical.

Two similar tasks compete for same resources = interference.



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Can we perform two different tasks to a similarly high standard?

If so, what process allows us to do this?

Automatic Processing

If task is practiced enough, it may become *automatic*

If *automatic* = no/little demand on attention



35

Stroop Task (Stroop, 1935)

🍌 Examines competition between colour word and colour of ink a word is presented

📋 Let's do a quick experiment:

🖥️ On next slide is list of words in columns

🗣️ Read aloud the ink colour each word is presented (not word itself)

📄 Read down each column as quickly as you can

36

Green	Red	Orange
Black	Green	Blue
Red	Orange	Purple
Purple	Black	Green
Orange	Blue	Black
Blue	Purple	Red

37

- Let's do that again, with a different set of stimuli.
- Remember:
 - Read aloud the colour of the ink the word is printed in and not the word itself
- Ready.....

38

Green	Red	Orange
Black	Green	Blue
Red	Orange	Purple
Purple	Black	Green
Orange	Blue	Black
Blue	Purple	Red

39



Stroop:

- Findings: Response times slower, and more errors made when colour of ink and word colour are incongruent (do not match)
- Shows reading involves an automatic process, resulting in cognitive interference

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What is Perception?

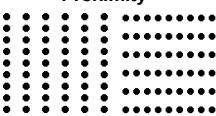
- Info received through senses
- "Raw" material
- Data driven processing
- Connects selected data to higher cognitive processes (thinking)
- Ultimately, what we 'perceive' as reality



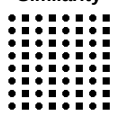
41

Gestalt Laws of perception

Proximity



Similarity



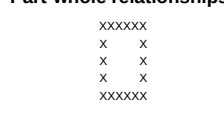
Closure



Continuity



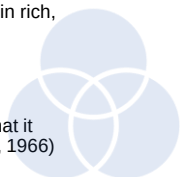
Part-whole relationships



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Theoretical accounts of cognitive perception

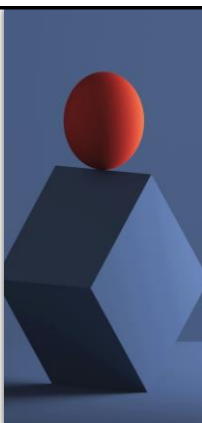
- Top-down theories (concept driven)
 - Mind **interprets** signals it receives in rich, elaborative way (Gregory, 1970)
- Bottom-up theories (data-driven/ecological)
 - Visual system evolved to derive what it needs **from environment** (Gibson, 1966)
- Computational theories
 - Deriving complex structure from basic input requires both processes (Marr)



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Top-down (Indirect) perception

- Sensory input is chaotic, unstable, and distorted
- Perceiver generates predictions about sensory information
- Perception is constructed
 - **High level concepts** (knowledge of world) or representations shape **low level percepts**.
- Visual illusions support – ‘errors’ show predictions can be inaccurate (Gregory).
 - For example?.....



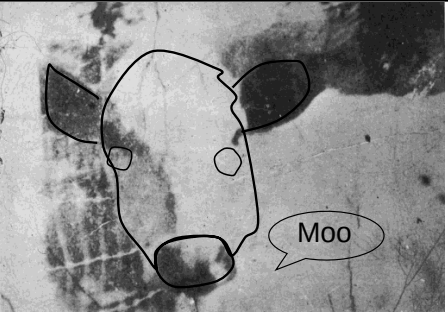
44

What can you see in this image?



Dallenbach (1951)

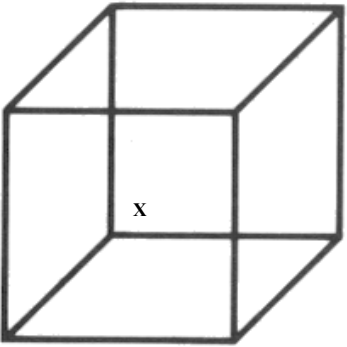
45



- Shows we are good at seeing familiar things in series of blobs
- If you did not see a cow, it shows how our visual system helps us construct (incorrect) percept of world from ambiguous input

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Where, within the cube, is the X located?

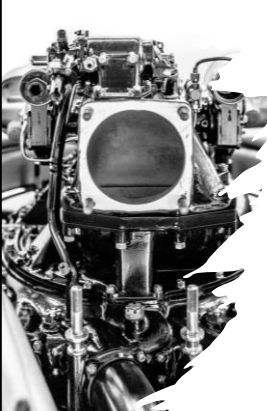


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- Necker cube shows we can derive two mutually exclusive percepts from single visual input.
 - I.e., one sensation but many possible objects.
- Gregory argues Bottom-Up theories cannot explain this.
- Bottom-Up theories suggest we should always perceive same thing from same input.

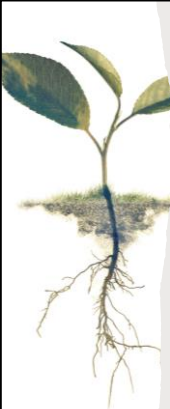
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Bottom-up (Ecological approach)

- According to Gibson (1950), Gregory's view of bottom-up processing is wrong.
- Visual system has **evolved** to detect what is important to survive.
- No need for inferences - all we need is present **in the visual array**.
- Experiments involving illusions ignore complexity of natural world – 'air theory'
- With rich array of environmental data, we do not need to make hypotheses about what we are 'perceiving'

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Comparing the approaches

- Seem opposite but tackle same issue in fundamentally similar ways
- Both rely on internal processing

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Marr: Computational Approach

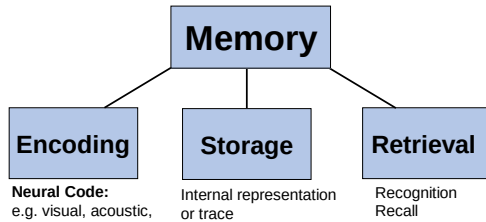
- Perception operates at different levels of description
 - Computational – function/purpose
 - Algorithmic - detailed processes
 - Hardware - what makes the object (e.g., Brain)
- Considered top-down, bottom-up, evolutionary, and neurophysiology
- Process involves producing series of increasingly detailed representations of environment (layers)
 - Four stages:
 - Raw Primal Sketch
 - Complete Primal Sketch
 - 2½D Sketch
 - Full 3D Representation



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Memory

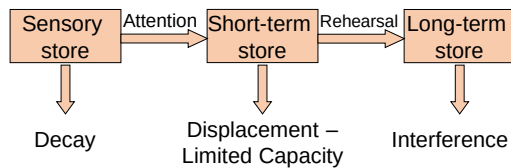
- Concerned with organisation of time: keeps record of past/future
- Why are memories important?
 - Essential for learning, Affects future, Contributes to our identity



Processes interact - e.g., encoding influences recall

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Atkinson and Shiffrin (1968/1971) Multi-store Model



Evidence for division of memory stores:

1. Behavioural Experiments
2. Neurological Case Studies

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Sensory store

- Retains copy of stimulus long enough to decide if worthy of further processing.
- Modality specific
- Information
 - Literal/un-coded
- Capacity
 - Unlimited
- Duration
 - Iconic memory (Visual) - 0.5 seconds (Sperling, 1960)
 - Echoic memory (Verbal) - 1-2 seconds (Treisman, 1964)
- Sensory attention
 - Transfer to short-term memory
- Info from sensory memory lost through decay when attention has not transferred the info to STM



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Short-Term Memory (STM)

• Capacity = Limited

- Evidence = Miller (1956): Digit span technique.
 - Repeat back list of digits: E.g., 6 7 3 6 5 1 3 8 5 2

- Typically, 7 items +/- 2 can be repeated back:
 - "magic number" 7 (± 2)

- BUT: Cowan (2000) - "magic" number is inflated:
 - Rehearsal helps –
 - Cowan et al. (2005) digit span task could stop at any time to recall last item first and work back.
 - Could now only recall ~3 to 4 items.

- Also, may use LTM whilst performing STM tasks:
 - E.g., CIAFBIIBM BMI becomes CIA FBI IBM BMI thanks to LTM.

• Duration = About 15-30 seconds

- Can recall ~6 items after 3s delay but only 1 after 12s delay – tested using Brown & Peterson technique using Trigrams
- Can also be disrupted by interference (proactive/retroactive)



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Long-Term Memory (LTM)

- Memory for info represented on (near) permanent basis

• Capacity

- Infinite?

• Duration

- Permanent?

- Inability to retrieve info from LTM is called **retrieval failure**

- What other evidence distinguishes STM & LTM?
 - Let's do a quick memory test.

- Try to remember as many of the following words...



56

Guillotine

57

Whale

58

Clock

59

Guitar

60

Bottle

61

Pillow

62

Orange

63

Hat

64

Cushion

65

Shower

66

Calculator

67

Mouse

68

Bike

69

Table

70

Leaf

71

Pen

72

Mirror

73

Sky

74

Oven

75

Box

76

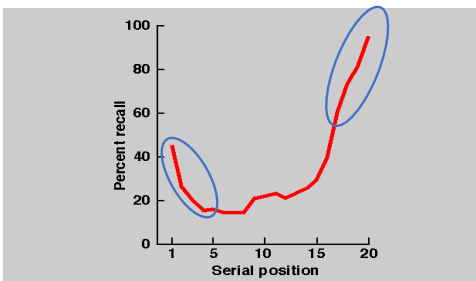
Write down all the words
you can remember.

Do you notice anything
about the words you
remember?



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Serial position effect



Murdock (1962):

Recency (still in short-term memory)

Primacy (rehearsal – transferred to LTM)

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Primacy

• Can be affected by:

- Presentation Rate: Fast = less rehearsal; Slow = more rehearsal
- Word Frequency: Rare = long rehearsal; common = less rehearsal
- Inter-item relatedness: similar = better; different = harder
- List Length: longer = less rehearsal; shorter = more rehearsal

Recency

• Can be affected by:

- Delaying recall by 10 seconds/introducing a distraction
(Glanzer & Cunitz, 1966)
- Anything requiring concentration directly following end of task

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Chunking – Miller (1956)

- Though STM limited to around 7 items...
- **Capacity** of STM can be increased by organisation & rules - Chunking
- 0385672635 can become 0385 672 635
- Each chunk imposes same memory load as each individual unit.
- Numerous 'chunks' may be held in STM
 - Larger number of items in total
 - Larger 'working' capacity in short-term store



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Problems with Multi-store model

- Too simplistic:
 - Assumes STM & LTM are separate unitary structures:
 - BUT: "Chunking" – LTM assists STM (not just one-way from STM to LTM).
 - Assumes info only transferred through rehearsal.
 - BUT: Rehearsal does not guarantee transfer to LTM.
- Phonological code only?
 - What about visual code?
 - What about semantic code?



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Levels of processing: Craik and Lockhart (1972):

- Two types of rehearsal:
 - Maintenance: simple repetition, passive, unlikely go to LTM (Shallow processing)
 - Elaborative: Attends to meaning, forms associations, likely to go to LTM (Deep Processing)
- Transfer of info to LTM dependent on level/degree it is processed in STM.

CRAIK AND TULVING (1975):

- ▶ Ask Qs on series of words: e.g., SPEECH, BRUSH, CHEEK, FLOUR
- ▶ Is word in capital letters? (Visual) **SHALLOW**
- ▶ Does word rhyme with.....? (Acoustic)
- ▶ Does word fit in following sentence.....? (Semantic) **DEEP**



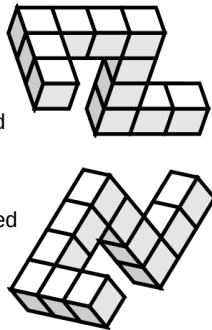
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Is storage in STM only acoustic?

- Shepard and Metzler (1971): Mentally rotate objects.

- The more an object was rotated from original, longer it took to recognise.

- Suggested info must be encoded visually in the "mind's eye"

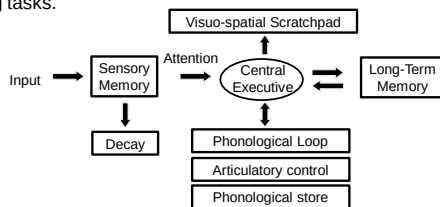


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Alternative: Working Memory Model

(Alan Baddeley & Graham Hitch, 1974; Alan Baddeley, 1986; 2000)

- Multiple sub-systems within STM, seen as set of processes rather than static unitary structure
- Acts on material just encountered to manipulate it.
- Active role in learning and involved in performing resource demanding tasks.



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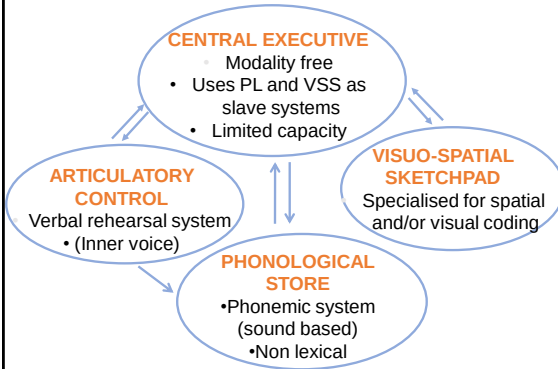
How many windows are in your home?



- To set-up and manipulate image we need...
 - Visuo-spatial scratchpad
- To sub-vocally count number of windows we need...
 - Phonological loop
- To organise whole operation, we need...
 - Central executive

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Working Memory: Dividing STM

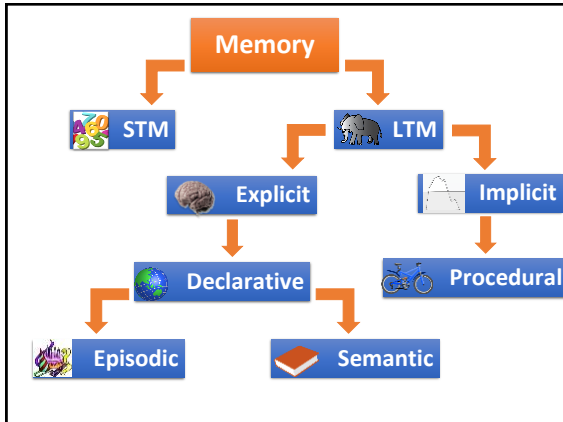


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Addition to WMM

- **Episodic Buffer** (Baddeley, 1996, 2000)
 - Aimed at functions difficult to account for in central executive
 - CE control but not storage?
 - EB provide storage and integration from other systems (visual and phonological)
 - Combining information into one form of code (as opposed to verbal/visual)
 - May pass info to LTM?

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Forgetting from memory	
Interference Proactive: Old info interferes with retrieval of new info Retroactive: Learning new info interferes with recall of old info	Motivated forgetting Think/no-think (Anderson & Green, 2001)
Cue-dependant forgetting Failure to recall info without memory cues (Tulving & Psotka, 1971).	Encoding-specificity Principle Memory is better when conditions during encoding match retrieval (Tulving, 1983). Can be external (e.g., environment) or internal (e.g., mood).
State-dependant forgetting Retrieval is better if in same state as when info was encoded. State can be physical or psychological (Eich, et al., 1975; Schab, 1990)	Context-dependant forgetting Memory performance worse when environment differs from encoding to retrieval than if two environments were same (Godden & Baddeley, 1975)

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Other effects on memory	
Misinformation effect: Distortion of memory by misleading post-event information (Loftus)	Memory biases: Process of altering memory content due to deviation from rational judgement. Can enhance or impair memory and linked to mood/emotion
Schemas: Mental framework for organising info Influenced by what we know about way things work Top-down processing from bottom-up info	Memory (Re)Construction: Adding or omitting details to memory not part of actual event

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