LECTURE WEEK 5

PSYCHOLOGY OF MATHEMATICS LEARNING

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Where are we up to ...

- Week-1: Behaviourist vs cognitivist
- Week-2: How students process info
- Week-3: Knowledge & Schema
- Week-4: Schema construction & automation
- Week-5: Encoding – how get the knowledge into LTM
- Week-6: Retrieval – how take the knowledge out from LTM
- Week-7, 8, 9: Social cognitive factors
- Week-10: Mid-term exam

Can you explain?

- How students process information during mathematics learning

- How perception, attention and pattern recognition influence mathematics learning

- How the limitation of working memory when dealing with new or complex information influences mathematics learning

- How student construct mathematics knowledge (schema)

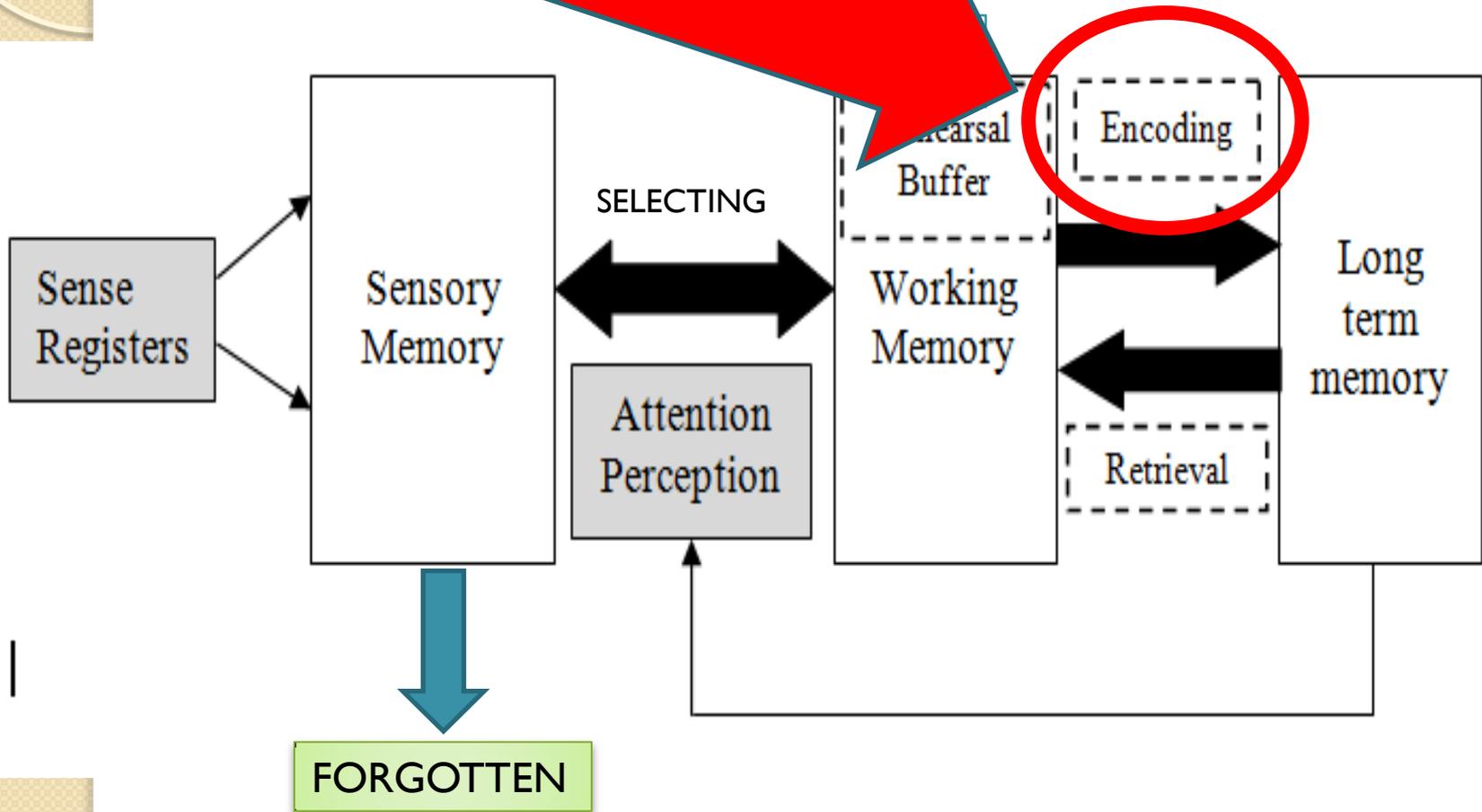- The implication schema automation on mathematics learning

Today ....

Encoding

LEARNING PROCESS:
organise information, build connection among information and integration with prior knowledge, and eventually the knowledge, encode knowledge to LTM

What is encoding?

- Transforming an experience into a durable memory trace (Davachi, 2008)
- Rocess of converting information from sensory to WM and WM to LTM
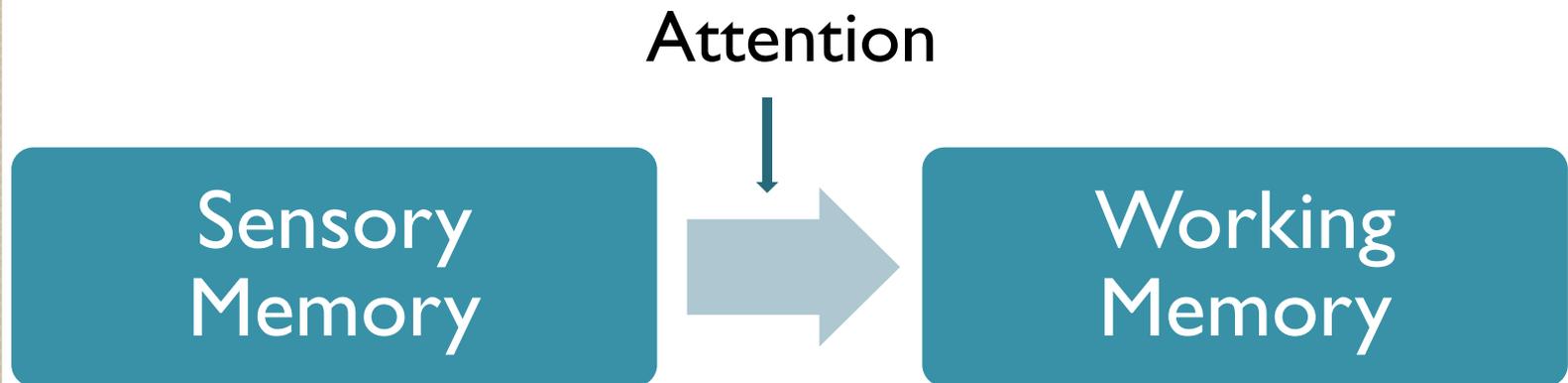- "getting information in" (Myers, 1998)

What is encoding?

- First step in information processing model
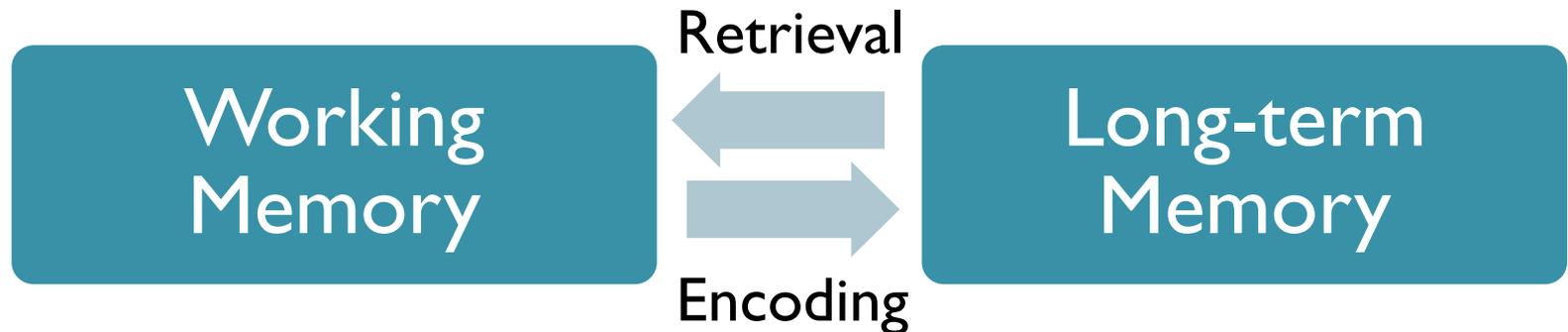
Encoding → Storage → Retrieval

SM to WM

- Sensory memory is bombarded with information
  - Attention is directed to important and novel stimuli
  - Determines automatically (via LTM)

Attention

| Sensory Memory | → | Working Memory |

WM to LTM

- Most of our focus is now on encoding to LTM

Retrieval

| Working Memory | ← → | Long-term Memory |

Encoding

Importance of encoding

- Necessary part of our memory system

- How something is encoded determines:
  - How learned information is more memorable
  - How knowledge is constructed
  - How well knowledge is stored
  - How easily knowledge is retrieved

- This is integral to learning

Encoding

- How is information encoded?
  - Effortful processing
  - Automatic processing

- Effortful processing = deliberate focus of attention
  - e.g. $(x+a)^n = \sum_{k=0}^{n} \binom{n}{k} x^k a^{n-k}$

- Automatic processing = no intentional effort
  - e.g. $A = \pi r^2$

Encoding of LTM

- Implicit memory
  - Always automatic encoding and recall
  - Give example!

- Explicit memory
  - Can be automatic or effortful
  - Give example!

Automatic processing

- Automatic processing occurs:
  - Without awareness
  - Without hindering or interfering with other thoughts and processes
  - Without choice
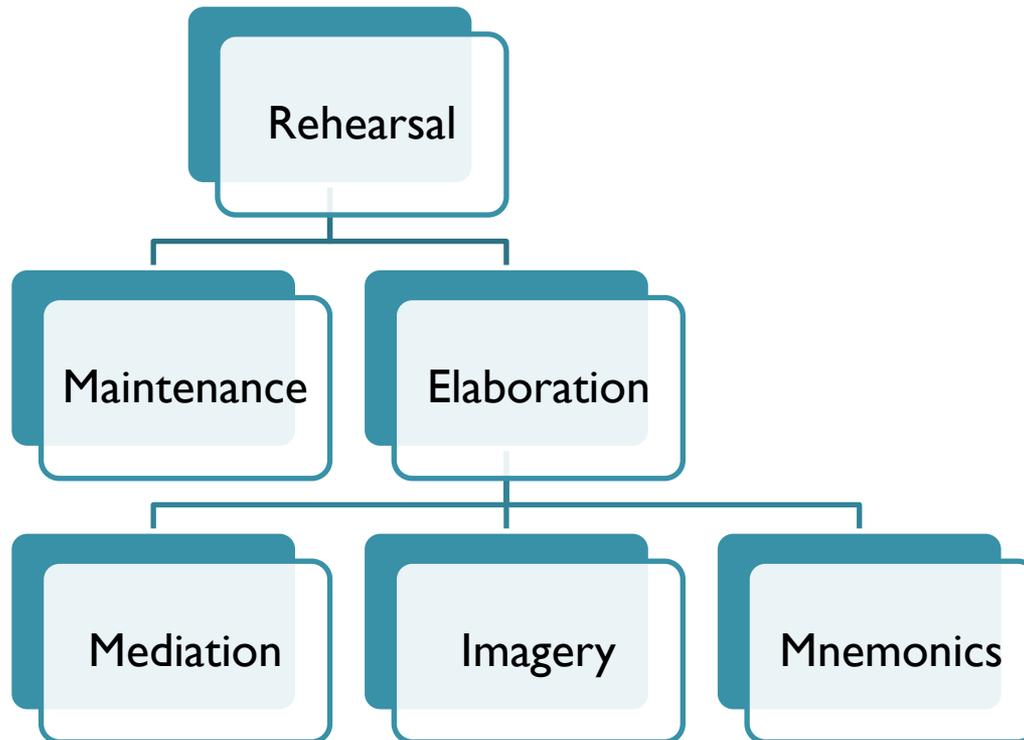
Automatic processing

- Much processing is automatic
  - Time, space, etc
    - e.g. running into a friend, recognising face, looking at volume
  - Well learned information
    - e.g. meaning of daily conversation, simple arithmetic operations
- Effortful processing typically becomes more automatic with practice
  - e.g. reading, drawing a graph, writing

Effortful encoding strategies

- Effortful processing strategy employed depends on the material to be encoded
  - Simple material
    - e.g. lists of facts, symbols, short formula, name, …
    - rehearsal
  - Complex material
    - e.g. number theory, quadratic equations, differential equations, problem solving
    - Advanced organiser
    - Schema activation

Simple material: rehearsal

- Information can be rehearsed for maintenance or elaboratively rehearsed.
- Where does it occur? Concious?

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                    Rehearsal
                   /         \
          Maintenance      Elaboration
                          /     |     \
                   Mediation  Imagery  Mnemonics
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Simple material: Rehearsal

- Maintenance rehearsal
  - Direct recycling
  - Maintains info inconsciousness
  - Often short term
    - i.e. doesn't always reach LTM
- e.g. repeating a formula over and over in preparation to do a quiz

Simple material: Rehearsal

- Elaborative rehearsal
  - Relating material in question to other material
  - Encodes for storage (into LTM)
  - More enduring than maintenance rehearsal
  - Strategies include mediation, mnemonics and imagery

Elaborative rehearsal: (1)Mediation

- Mediation involves mentally linking information to be processed with something more meaningful
- Mediation theory and research based on processing of nonsense syllables
  - e.g. 'ris kir' becomes 'race car'

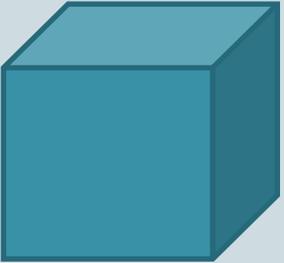# Elaborative rehearsal: (1)Mediation

- Advantages
  - Simple, easily learned rehearsal strategy
  - Mediators have better subsequent recall than do non-mediators
    - Deeper processing

- Disadvantages
  - Only applicable to a limited range of information

Elaborative rehearsal: (2)Imagery

- Recall Paivio's dual coding theory
- Information is coded via two systems (and subsequently stored in LTM):
  - Verbal
  - Imaginal
- Imagery involves creating images to accompany rehearsal of verbal material
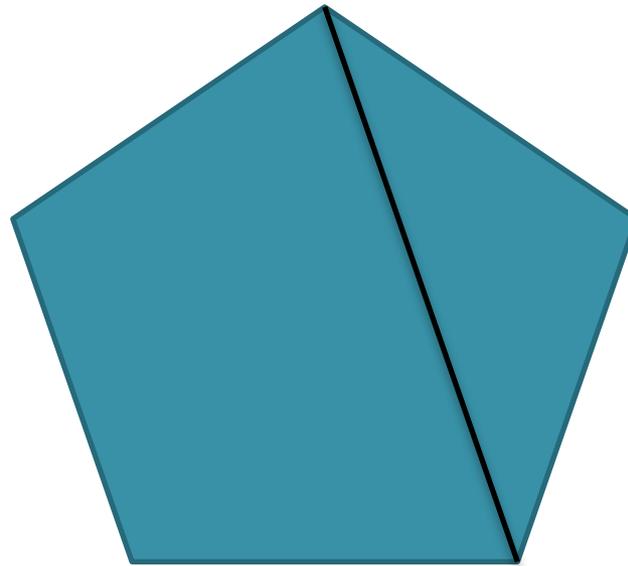 - Should enhace encoding

Elaborative rehearsal: (2)Imagery

- Recall that concrete words better visualised than abstract ones
- Imagery can be extended from words to complext concepts, people and so on

Verbal	Imaginal
CUBE	
IDEA	???

Elaborative rehearsal: (2)Imagery

e.g. remembering that 'diagonal' is a segment connecting two not-consecutive angles

Elaborative rehearsal: (3)Mnemonics

- Mnemonics are memory strategies or encoding 'tricks'
- To be learned information is paired with well learned information
- Components of a mnemonic can include:
  - Rhymes
  - Imagery
  - Acronyms