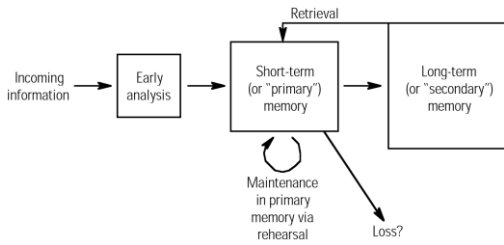# Chapter 5

Memory

The Modal Model of Memory

<u>Three-part Model of Memory</u> (Atkinson & Shiffrin)

<u>Sensory Stores</u> – visual sensory trace (.25 sec)
- auditory echoic memory (several seconds)
- book uses the term "early analysis"

<u>Short-term Memory</u> – recall Baddeley's model
- working memory – active information
- mental "desk top"
- limited capacity, interference from new information
- information in STM is available, no retrieval difficulty.

The Modal Model of Memory - 2

Long-term Memory
- reference library
- unlimited capacity
- most material in LTM is inactive, must be retrieved (activated or put into STM). Retrieval is effortful.
- bottle neck at input form STM to LTM: Can learn limited amount of information in given period of time.
- forgetting mainly due to retrieval failure
- not clear whether there is decay
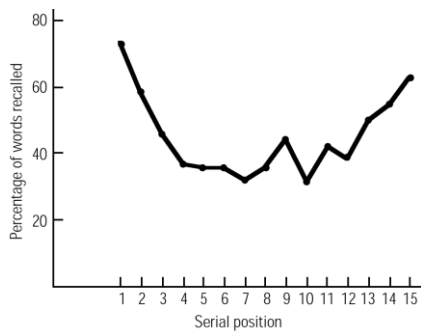- information transferred from STM to LTM through rehearsal

Evidence for the Modal Model

Task: Immediate free recall of list of 12 – 30 words

Get U-shaped _serial position curve_

Primacy Effect: recall of 3 – 5 words from beginning of list better than words from middle

Recency Effect: recall of last 5 – 7 words better than words from middle

Evidence for the Modal Model - 2

- Primacy effect due to more rehearsal of first words.
- Recency effect due to recall from STM. Last list items recalled first.
- Difference between auditory and visual presentation only on recency items due to echoic memory.
- Variable that disrupts STM → affects recency effect
- Variable the disrupts LTM affects primacy & mid-list items only

Evidence for the Modal Model - 3

Glanzer & Cunitz (1966)

Free recall of list of 15 words.

List followed by (1) immediate free recall of words, (2) unfilled delay for 30 sec, or (3) counting backwards by threes for 30 seconds

Results

Recall of primacy and mid-list items not affected much by backward recall. Recall of recency items reduced with more counting.

Delaying recall 30 sec with no backward counting has virtually no effect on recency items (see page 136 in text).
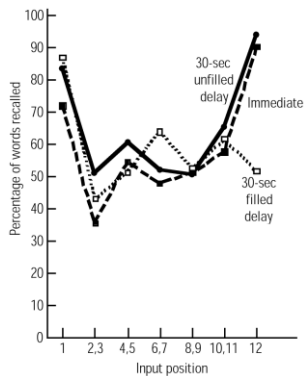
Evidence for the Modal Model - 4

Rundus & Atkinson (1970)
- Had subjects rehearse aloud. Recorded the number of rehearsals for each items
- Number of rehearsals decreased throughout the list with the primacy items getting the most
- Except for recency items, recall probability correlated strongly with number of rehearsals. (See paper handout.)
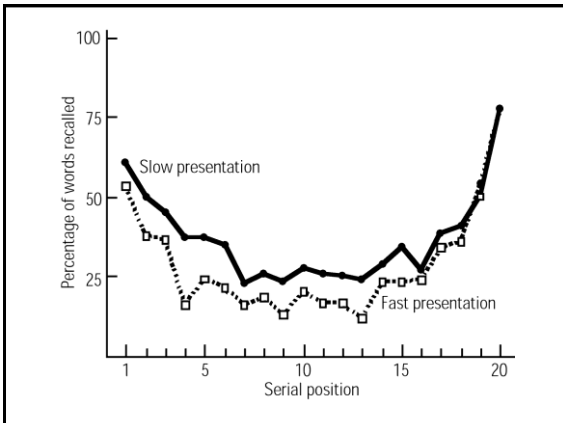
Memory Demonstration

• Study the following sequence of letters for a recall test

List 1

- LPJ   QAR   WIB   SYD

- Study the following sequence of letters for a recall test

List 2

- CBC   MUN   ROM   CEQ

Working Memory Capacity

- STM holds 7 + or – 2 chunks of information, e.g. *digit span*
- Chunk is meaning unit to memorizer
- Chunk can be letter, digit, word, phrase, as long as these are *meaningful* units
- Cost to larger units – can recall 7 – 8 letters or digits, 5 – 6 words, 3 – 4 short phrases, 2 - 3 short sentences.
- Some mental resources → chunking
- Memory span can e improved by practice.

What is Working Memory?

- "Box" model (modal model) developed from information processing analogy
- Flow diagrams used to illustrate flow of information, various processes & storage systems
- Notion of "boxes" for storage and "transfer" of information not appropriate
- Better to think of WM as factory or busy office with work being done.

Measure of *Working* Memory

- Working memory involves processing some information while temporarily storing other info.
- Operation Span: Tasks involve alternately processing (e.g. making true-false decisions about sentences or equations) and concurrently remembering words, numbers etc.
- Involve executive processes
- Highly correlated with problem solving, reasoning, reading comprehension etc.
- Stronger correlations than for "pure" rote memory (e.g. digit span)
- Trade off between storage & processing in WM. WM not passive storage system.

Baddeley's Model of Working Memory

- See Chapter 1
- <u>Central Executive</u> – related to attention
  - setting goals, planning, response selection & launching, inhibition of habitual responses etc.
- - carries out operations on different kinds of information
- Temporary Storage Systems:
  - Rehearsal Loop + Phonological Store
 - Visual-spatial sketchpad

Baddeley's Model of Working Memory - 2

- Two "simple" temporary storage systems
- <u>Rehearsal Loop</u> (Articulatory Loop + Phonological Store)
- - word-length effect, effects of articulatory suppression (concurrent articulation)
- Visual-spatial Sketch Pad

Baddeley's Model of Working Memory - 3

- <u>Central Executive</u> – mental resources like response selector, planner, goal setter, inhibitor of habitual responses etc.
- Many sites in prefrontal cortex active in working memory tasks
- Lesions in frontal lobe →
  - Goal neglect – use inappropriate but habitual responses
  - Perseveraton – card sorting task
  - Copy a drawing – no overall plan, lose sight of goal
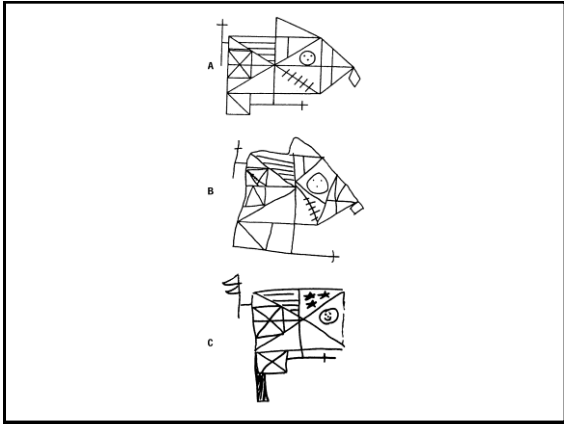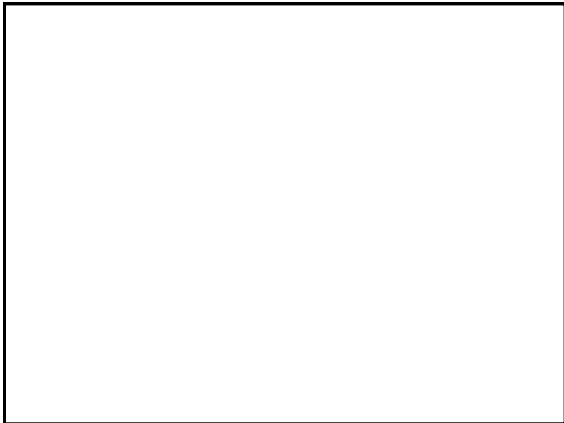
Two Types of Rehearsal

- Rehearsal important for learning
- <u>Maintenance rehearsal</u> – rote repetition
  - Produces some recognition but very poor recall
- <u>Elaborative or Relational Rehearsal</u>
  - Relate individual items to overall structure in meaningful way
- fMRI recordings taken during list learning
- Brain activity compared for words which were remembered later or not.
- Greater activation in prefrontal cortex and hippocampal areas for remembered than forgotten words.

Intention to Learn

- Composite experiment. 3 X 2 design
- Levels: 1) Same or different type face
     2) Rhyme judgement
     3) Synonym judgement
- Intention: Ss informed about recall test or not
- Immediate Free recall

Intention to Learn - 2

	Incidental Learning	Intentional Learning
Same or Different Case	Very low recall	Very low recall
Rhyme Judgement	Low recall	Low recall
Synonym Judgement	Moderate recall	Moderate recall

Intentional and Incidental Learning

- Motivation to learn is not main determiner of learning.
- Nature of input processing is critical

- Hyde & Jenkins (1973)
- Shallow processing: Does word contain E or G? Is the word a noun, (or adjective, verb etc.)
  - attention directed to sensory properties
- Medium processing: How frequent is the word in English print?
- Deep processing: Rate the words on a scale from unpleasant to pleasant.
  - attention directed to meaning

Depth of Processing crossed with Intention to Learn
Results on Overhead.

Intention & Incidental Learning

- No Intention to learn → no deep processing, no relating of target items to one another
- Intention to learn → learner employs best strategy known, often rote rehearsal!
- Key factor: Depth of processing not intention to learn
- In Hyde & Jenkins' study, Ss' encoding strategy was controlled by instructing them to perform *orienting task*.
- In typical free recall study, Ss free to select strategy.

Meaning and Memory Connections

- Why is 'deep' processing more helpful for learning?
- Analogy: Learning = cataloguing a book
- Learning → creating connections so that information can later be retrieved
- Learning is effective if connections made at input match connections needed at test
- Attention to meaning → creates connections within block of material (e.g. word list, narrative)

Learning, STM & LTM

Analogies for STM-LTM
LTM = set of connections between 'concepts' or detectors
STM = activated or highly primed nodes or networks
   - information that is being processed
Learning –> changes in connections.
- Transfer of information from STM to LTM (learning)
   requires establishing new connections
     - must relate new input to existing knowledge
     - learning = indexing, cross referencing, cataloging etc.
In free recall, need to make connections between
   unconnected words

Learning, STM & LTM - 2

- Retrieval = reactivation of memory for event
- Need pathways (connections) to target information
- Retrieval – starts with probe information
  - Probe must be connected to target information for successful retrieval
- Deep processing → making many connections between new information & info in LTM

Elaborative Encoding:
Craik & Tulving (1975)

- Presented word + sentence
- Sentence: simple or complex
- Simple sentence: She cooked the (chicken or fence).
- Complex sentence: The great bird swooped down and carried off the struggling (mouse or branch) .
- Ss shown a number of sentences of both types & judged whether word fit or not.
- Better recall of words from complex sentences, and "yes" responses

Organizing & Memorizing: Mnemonics

- Mnemonic systems provide structures for organizing material to be remembered or creating retrieval paths.
- Peg Word – "One is a bun, Two is a shoe…" – rhymes make the peg words memorable.
  - Link peg word to TBR word by *interactive* visual imagery
- Method of Loci – memorize set of locations (rooms in a large building, walk along a street etc.) to use as pegs
- First letter mnemonics – HOMES – great lakes
  - Cranial nerves entering the brain

Downside to Mnemonics

- Mnemonics useful for learning lists of unrelated words or objects
- Mnemonics do not promote understanding
- When retrieval circumstances unknown, want meaningful links within TBR material & existing knowledge
- Mnemonics focus on specific encoding, do not encourage multiple connections.
- Mnemonics require effort to learn (e.g. loci, visual imagery, coding schemes – e.g. translate numbers to sounds & words)

- Bransford Demonstration here

Understanding and Memorizing

- We can remember stories, essays, pictures, lectures, etc. better if we "understand" them.
- Understanding involves relating parts within the whole to one another
  - E.g. understanding the plot of a story, the argument in an essay
- Understanding involves organizing the material, finding the structure & relating various parts to the structure
  - E.g. relate episodes to plot, relate details of experiment to the theory being tested.

Understanding and Memorizing - 2

<u>Why does organization and understanding improve memory</u>?

- <u>Unifies</u> information – details connected to whole – details retrievable
  - Organization provides retrieval cues
- <u>Reduces</u> amount of material → remember framework (schema) & use knowledge to fill in details,
  - example in book (The procedure is actually quite simple…) – title makes details clear (complications may arise, facilities, arranging material into different groups)
  - Arrangement of chess pieces on a board. Experts have better memory for real chess positions but not random arrangements

Memory Acquisition: Learner's Contribution

- Retention and later retrieval depend on what learner did at input
  - Focus on meaning
  - Attend to overall structure, how details related
  - Get 'big picture'
  - Importance of prior knowledge (Schemata)
    - Helps interpretation
    - Relate new knowledge to old

Understanding and Memorizing - 2

- Linking parts to whole → promotes retrieval of details
- Understanding promotes reconstruction. Know how experiment must have been designed even if you can't remember details.
- Understanding → chunking-like effect. Rather than remembering series of unrelated numbers or objects, can sometimes remember the rule to generate them.
- Easier to remember material if there is organizing principle.

Understanding and Memorizing - 3

- 1 9 2 1 8 3 2 7 4 3 6 5 4 5 6 5 4 7 6 3 8 7 2 9 8 1 1 0 9 0 1 1 9 9

Understanding and Memorizing - 4

- 1 9 2 18 3 27 4 36 5 45 6 54 7 63 8 72 9 81 10 90 11 99

DEMO: Organization in Free Recall

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First Presentation

Sidewalk
Tomato
Bookstore
Knight
Television
Tulip
Preacher
Dictionary
Blueberry
Sandwich

- Basketball
- Juniper
- Mountain
- Elephant
- Columbine
- Easel
- Embroidery
- Helmet
- Pinafore
- Cumulus

- Canoe
- Firewood
- Anesthetist
- Tornado
- Synagogue
- Butterfly
- Spleen
- Shower
- Turquoise
- Bicycle

Second Presentation

- Blueberry
- Tornado
- Helmet
- Easel
- Cumulus
- Anesthetist
- Knight
- Juniper
- Elephant
- Tulip

- Dictionary
- Spleen
- Columbine
- Turquoise
- Canoe
- Bookstore
- Synagogue
- Firewood
- Embroidery
- Tomato

- Sandwich
- Bicycle
- Sidewalk
- Television
- Butterfly
- Basketball
- Pinafore
- Mountain
- Preacher
- Shower

Third Presentation

- Spleen
- Cumulus
- Synagogue
- Knight
- Bicycle
- Television
- Blueberry
- Bookstore
- Shower
- Tulip

- Helmet
- Basketball
- Elephant
- Embroidery
- Dictionary
- Preacher
- Canoe
- Tomato
- Columbine
- Easel

- Firewood
- Pinafore
- Juniper
- Mountain
- Tornado
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- Anesthetist