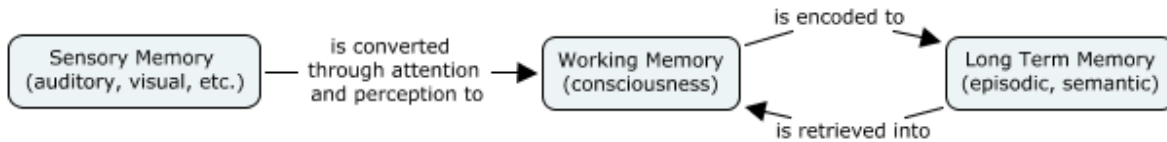


Basic Assumptions

- Sensory inputs (stimuli) are cognitively processed and integrated into existing mental structures.
- Knowledge is structured in memory as associations between concepts that are characterized by relationships.
- Computers are a useful metaphor for describing and interpreting human cognition and memory processes.
- Information in long-term memory (LTM) is stored permanently.

Mechanisms for Learning

New information is processed and encoded to LTM using three-stages of memory.



Models for Storage in LTM

Semantic Networks	Feature Comparison	Propositional Networks	Connectionist Networks	Dual Coding
Information is stored as concepts (nodes) connected by relationships (like concept maps)	concepts stored by defining (universal) features and characteristic (typical) features	primary model=ACT-R logical propositions represent nodes and always include subject & predicate (e.g., birds have feathers)	Knowledge is stored in subsymbolic connections between ideas. Networks are searched using Parallel Distributed Processing.	Stored both in verbal and image form, with strong associations between each

Experiences Forming the Basis for Learning

Our nervous system registers sensory input, it is perceived and filtered through attention and executive monitoring into WM. Features or cues in the new information initiate retrieval of pre-existing concept networks from LTM into WM. The new information is related to existing networks, encoded into LTM, and stored permanently to act as a source for new learning.

Results of the Theory

- Early results relate to memory tasks. For example, 7 ± 2 digits can be recalled in a digit-span test (Miller, 1956).
- Capacity of WM can be increased through *chunking* data into larger basic units (bits).
- Rehearsal is useful for keeping information in WM, although *primacy* and *recency* effects impact recall of lists.
- Elaborative encoding techniques promote encoding to LTM. Examples include imposing organization, hierarchies, concept trees, mnemonics, mediation, and self-questioning.
- The ability to *recall* information without cues is significantly lower than the ability to *recognize* information.
- *Forgetting* may occur in three ways: failure to encode information to LTM, failure to retrieve because of cueing problems, or interference due to related concepts. Forgetting is largely effected by the strength of memory traces.
- The *Stroop Effect*- color words written in a different color are difficult to recognize (red written in blue)-- Plain Fun!

Teaching Implications

- Instructors can use standard signals to influence attention (“thm, prf”, flashing lights, etc.) (Good & Brophy, 1984)
- Concepts should be presented in a well-organized way to promote encoding to LTM.
- Teachers should arrange for extensive and variable practice so that students can build semantic networks, produce propositions, compare features, and organize information in LTM.
- We can teach strategies for enhancing encoding and improving the trace of memory. Techniques exist to improve elaboration, rehearsal, and attention processes.
- Teachers can enhance students’ self-control (self-regulation) in learning by promoting metacognitive strategies.

Selected Contributors



Cognitive Information Processing Factsheet

Joe Champion

Note: See <http://mechanism.ucsd.edu/~bill/research/ANAUT.html> for short biographies of several hundred contributors.



John R. Anderson

John R. Anderson (1976, 1996) Adaptive Control (ACT/ACT-R) propositional network models that reflect neural structure of brain	R. C. Atkinson (1968, 1972) Proposed (with R. M. Shiffrin) the multi-store, multi-stage theory of memory. Later applied CIP to mathematical learning & instruction	George Sperling (1960) Iconic memory (sensory memory) decays rapidly (within 1000 ms) as new information is discarded or moved to working memory	Ross Quillian (1968) Proposed semantic network model for representing LTM. Allan Collins and he supported the model with the “Does a canary have feathers?”
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Reference: Driscoll, M. P. (2004). Cognitive Information Processing. In *Psychology of learning for instruction* (3rd ed., pp. 71-110). Boston, MA: Allyn & Bacon.

