Education 173
Cognition and Learning in
Educational Settings

Memory

Fall Quarter 2007

Problems With Behaviorism

- Research Showed That Humans:
  - Are pre-wired
    - They have native (innate) knowledge (Chomsky)
  - Can learn by imitation
    - Not always by direct reinforcement (Bandura)
  - Have goals and purpose
    - Even rats! (Tolman)
- So, Behaviorism Can't Explain Everything.

An Alternative To Behaviorism

- Can the Computer Provide Us With a Metaphor for Human Thinking?
- Computers have Different Kinds of Memory.
- So Do Humans.

Two Kinds of Memory

- Short-Term Memory
  - What are you thinking about right now?
  - Your current thoughts
  - Only a few at a time!
  - Thoughts are fleeting
- Long-Term Memory
  - What is the totality of your knowledge?
  - Lots and lots of knowledge!
  - Different *kinds* of knowledge
    - People, words, mental pictures, facts, personal experiences, domain knowledge, skills (and so on).

The Duplex Model

- Short-Term Memory
  - Small capacity
    - 7±2 pieces of information
  - Short duration
  - Locus of consciousness
  - Also called "working" memory"
- Long-Term Memory
  - Large capacity
    - Unlimited information
  - Very long duration
  - Multiple "codes"
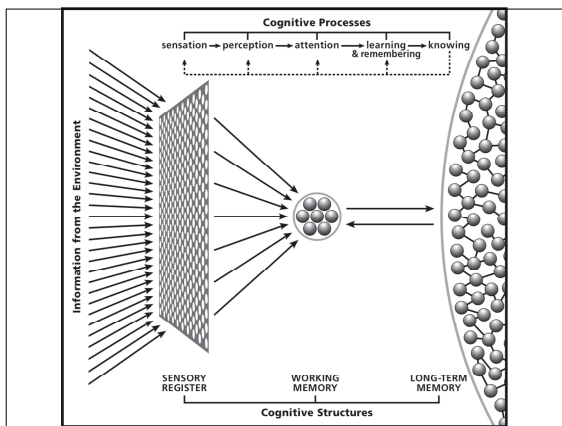 - The warehouse of the mind

A Third Memory Structure: The Sensory Register

- Noticeable In Real Life
  - Pardon me (hearing)
  - The double-take (vision)
- Auditory Sensory Register (Echo)
- Visual Sensory Register (Icon)
- Common Properties
  - Very short duration
    - (< 2 seconds)
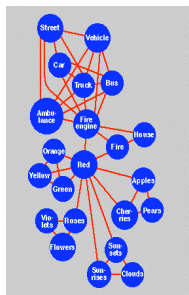 - High fidelity
    - (raw, uninterpreted)

Cognitive Architecture

- The Sensory Register
- Working Memory
  - Why "Working"?
- Long-Term Memory
- We Can Define Learning and Remembering in Information-Processing Terms
  - *Learning* is WM to LTM
  - *Remembering* is LTM to WM

Spreading Activation of Thought

- Thinking About One Idea Can Lead to Thinking About a *Related* Idea.
- That's Because, in LTM, Ideas Are Associated by Meaning.
- Which Explains:
  - Tip of the Tongue Phenomenon
    - *Almost* remembering
    - But just below threshold of awareness
  - Thought Pathways
    - Wow! How did we get onto that subject?
    - Retrace your cognitive steps
- In LTM, Words are Not the Only Way We Think.

Mental Imagery

- Dual Coding Theory
  - Learning can involve both words and images
  - Visual and verbal representations
  - Multiple ways to know and to remember
- Are Mental Images Like Vision?
  - In some ways, yes.
    - Mental rotation; zooming.
  - In some ways, no.
    - Count the stripes

Your Tenth Birthday Party

Human memory is not like a video camera

Production Systems

- Two Kinds of Knowledge
  - Declarative (knowing *that*)
  - Procedural (knowing *how*)
- Procedural Knowledge (If-Then Rules)
  - If red, then stop
  - In a restaurant
    - If you are finished eating, and
    - If you have money
    - Then call for check
- Some Artificial Intelligence (AI) Programs Are Based Production Systems

Chunking & Automaticity

- There are Two Ways Around the Limitations of WM
  - Chunking
    - Seven what? Seven "chunks."
    - But the size of a chunk can change
  - Automaticity
    - Driving a car
    - No distractions *at first*
      - But later . . . turn up the music and pass the burrito.
- Complex Performance Relies on Chunking and Automaticity