Memory: Encoding Processes

Lecture 18
Taxonomy of Knowledge Stored in Memory

- Procedural: Directions for Action
  - Mental
  - Behavioral

- Declarative: Factual Statements
  - Episodic
  - Semantic
Declarative Knowledge

- Factual Statements
  - About World, Past
- Sentence Format
  - Propositions
    - Subject - Verb – Object
- Types of Representations
  - Meaning-Based
    - Verbal Description
  - Perception-Based
    - Mental Image

A bicycle is a two-wheeled vehicle with seat and handles, propelled by pedaling.

A bicycle looks like this:
Procedural Knowledge

• Directions for Goal-Directed Action

• “If-Then” Format (Productions)
  – Goal - Condition – Action
  – Production System

• Motor
  – Actions Take Form of Overt Behavior
    • Alter Objective, Publicly Observable World

• Mental
  – Actions Take Form of Mental Transformation
    • Alter Internal, Private Mental Representations

\[ \text{X} + 6 = 38 \]
Types of Declarative Knowledge

• Episodic
  – Autobiographical Memory
  – Factual Knowledge About Personal Experiences
    • Spatio-Temporal Context
    • Self-Reference

• Semantic
  – Mental “Dictionary” or “Encyclopedia”
  – Abstract, Conceptual Knowledge about the World
Taxonomy of Knowledge Stored in Memory

- Procedural
  - Directions for Action
    - Mental
    - Behavioral

- Declarative
  - Factual Statements
    - Episodic
    - Semantic
Stage Analysis of Memory

- **Encoding**: Creating a Memory Trace
  - Perception Leaves Representation in Memory
- **Storage**: Retaining Trace in Memory
  - Latent, Available for Use
- **Retrieval**: Recovering Trace from Storage
  - Activating, Accessing Available Knowledge
The Verbal-Learning Paradigm

• Study Phase (Encoding)
  – Present List of Familiar Words
    • Episodic, not Semantic Memory
    • Alternative Materials
      – Nonsense Syllables, Sentences, Paragraphs, Stories
      – Pictures, Scenes, Film/Video
      – Sounds, Smells, Tastes, etc.

• Retention Phase (Storage)
  – Interval (Distraction)
    • Long-Term or Secondary Memory
    • \textit{Not} Short-Term, Primary, or Working Memory

• Test Phase (Retrieval)
  – Remember Items of Word List
Example

• I’ll read you a list of familiar words
• Listen to each one as I read it
• After I’ve finished, do “Serial Sevens” task
  – I’ll give you a 3-digit number --
    • Subtract 7 from that number…
    • and then 7 from that result…
    • and then 7 from that result…
  – until you are told to stop.

Ready?

Go To the Next Slide
Listen to the List

When You Hear the Number, Begin Subtracting “7s”

Go to the Next Slide
When I Instruct You to Do So
Study List

Anger
Bread
Cold
Foot
Girl
King

Mountain
Needle
Rough
Slow
Spider
Thief
Research Strategy for the Study of Memory

• Each List, and Each Word on the List, Represents an Episode of Experience

• Vary Conditions at Some Stage of Processing
  – Encoding
  – Storage
  – Retrieval

• Observe Effects on Subject’s Ability to Remember the List Items
The Encoding Phase of Memory Processing

• Assume that a Subject has Just Experienced an Event

• How Does a Mental Representation of that Event get Stored in Memory?
The Role of Rehearsal in Encoding Long-Term Memory

• Memory as a Product of Perception

• Traditional Associationism
  – Thorndike (1898)
    • Law of Exercise
      – Stimulus-Response Associations Strengthened by Use
  – Ebbinghaus (1885)
    • Law of Repetition
      – Retention a Function of Repetition
Nonsense-Syllable Paradigm  
Ebbinghaus (1885)

• Memorize List of Nonsense Syllables  
  – Consonant-Vowel-Consonant (e.g., *TUL*)  
  – Memorized in Strict Serial Order  

  **DAJ - GEX - MUB - TEV - WOL**

• Associations by contiguity  
  – Each CVC serves as stimulus for next one  
  – Each CVC is a response to the previous one

• Vary number of repetitions

• Savings in Relearning after 24 hours
Retention As a Function of Repetition

Ebbinghaus (1885)
The Role of Rehearsal
Craik & Watkins (1975)

• Present List of Familiar Words

• Report Most Recent Word Meeting Criterion
  – Begin with Letter \( P \) – “Critical”
  – Ignore All Other Words – “Neutral”

• Vary Amount of Rehearsal Given to Each Word

• Then Test Recall of All Critical Words
Study List
Craik & Watkins (1975)

peas  punt
chair  radio
potato  music
book  spiral
egg  position
cat  bell
window  parking
Repetition and Recall

Craik & Watkins (1972, Exp. 1)

Graph showing % Recalled against Number of Repetitions During Encoding.
Two Types of Rehearsal

• Maintenance Rehearsal
  – Rote rehearsal
  – Maintains representation in highly active state
  – Maintains representation in short-term (primary/working) memory

• Elaborative Rehearsal
  – Links representation to other knowledge
  – Encodes representation in long-term (secondary) memory
“Depth of Processing” Paradigm
Craik & Lockhart (1972)

Target: TROUT

• Structural (Orthographic)
  – Is the word printed in capital letters?
  – Does the word contain the letter “e”?
  – How many vertical lines are in the word?

• Phonemic (Acoustic)
  – Does the word rhyme with weight?

• Semantic (Conceptual)
  – Is the word a type of fish?

• Sentence (Linguistic)
  – Would the word fit the sentence:
    He met a man in the _____?
The Depth of Processing Effect
Craik & Tulving (1975), Exp. 1

![Bar Chart]

- **Proportion Recognized**
- **Structural**
- **Phonemic**
- **Category**
- **Sentence**

**Orienting Task**
The Elaboration Principle

Memory is a function of the degree to which an event is related to pre-existing knowledge.
Two Modes of Processing at Encoding

• (Rote) Rehearsal
  – Recirculating/Refreshing items
  – Primary/Short-Term Memory

• Elaboration
  – Processing individual items
  – Secondary/Long-Term Memory

But elaboration is not the only process that occurs during encoding...
A List of Category Exemplars
Promoting Category Clustering

Foot            Elephant
Lion            Amber
Blouse          Mouth
Orange          Rat
Finger          Tie
Coat            Purple
Category Clustering in Free Recall

Bousfield & Cohen (1953)
A List of Associates
Promoting Associative Clustering

<table>
<thead>
<tr>
<th>Boy</th>
<th>Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>Short</td>
</tr>
<tr>
<td>Table</td>
<td>Girl</td>
</tr>
<tr>
<td>Long</td>
<td>White</td>
</tr>
<tr>
<td>Eagle</td>
<td>Blossom</td>
</tr>
<tr>
<td>Flowers</td>
<td>Bird</td>
</tr>
</tbody>
</table>
A List of ‘Unrelated” Words Promoting Subjective Organization
After Tulving (1962)

IRON  TABLE  DOG  PEPPER  BLUE  WINDOW  BOY  STARS
The Organization Principle

Memory is a function of the extent to which individual events are related to each other.
Organization and Elaboration Compared

- **Elaboration**
  - Item-Specific (Intra-Item) Processing
- **Organization**
  - Relational (Inter-Item) Processing
- Both reflect “Effort after meaning”
  - F.C. Bartlett (1932)
    - Make sense of what is happening
    - Relate what is new to what is already known
Three Modes of Processing at Encoding

• Rote Rehearsal
  – Recirculating/Refreshing Items
  – Primary/Short-Term Memory
• Elaboration
  – Processing Individual Items
  – Secondary/Long-Term Memory
• Organization
  – Relating Items to Each Other
  – Secondary/Long-Term Memory