Short-Term Memory, Working Memory, and Attention
Lecture 17
Perception and Memory

• Perception Draws on Memory
  – Permanent Repository of World-Knowledge
  – Momentary Expectations

• Perception Changes Memory
  – Memory “Trace”
    • Mental Representation of Stimulus
    • Persists After Termination of Stimulus
The Multi-Store Model of Memory
After Waugh & Norman (1965); Atkinson & Shiffrin (1968)
Alternative Terminologies in the “Modal Model” of Memory
Atkinson & Shiffrin (1968); Waugh & Norman (1965), after James (1890)

• Sensory Registers
  – Sensory Memory, Sensory Store
• Short-Term Memory
  – Primary Memory
  – Working Memory
• Long-Term Memory
  – Secondary Memory
Sensory Registers

• One (or More) per Sensory Modality
  – Icon, Echo

• Unlimited Capacity

• Veridical Representation of Sensory Input
  – Precategorical

• Transfer to Short-Term Memory

• Forgetting via Decay or Displacement
The Sperling Experiment
Sperling (1960)

- Visual Presentation
- 3x4 Array of Letters
- Retention Interval
  - 0-1 sec
- Whole Report
- Partial Report

<table>
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<tr>
<th>X</th>
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Retrieval from the Icon

Sperling (1960)

The graph shows the number of items available (vertical axis) for different delay times of the tone (horizontal axis). The categories include 'Before', '0', '0.1', '0.3', '1', and 'Whole'. The number of items available decreases as the delay time increases.
The Function of the Icon?
Haber (1983)

Iconic memory may only be useful for reading a book in a lightning storm.
Properties of Short-Term Memory
Miller (1956)

• Acoustic Recoding
  – Verbal Rehearsal

• Limited Capacity
  – “The Magical Number 7, Plus or Minus 2”

• Maintained by Rehearsal

• Transfer to Long-Term Memory
  – Passive Storage

• Forgetting via Decay or Displacement
Digit-Span Test

Read List of Digits
Write Them Down After I Stop
Digit-Span Test

1. 5 9 0
2. 4 8 6 1
3. 7 3 0 9 4
4. 2 4 9 6 5 8
5. 1 4 6 8 2 4 5
6. 3 9 2 1 5 7 6 0
7. 6 2 5 7 3 9 1 8 4
8. 0 6 3 8 9 4 1 7 2 5
An Alphabetical “Digit-Span” Test

Read List of Letters
Write Them Down After I Stop
Chunking
After Rado & Ragni (Hair, 1967)

YSPBCUJBLDSLGBGKAICIBF
FBICIAKGBLSDLBJUCBPSY
Properties of Long-Term Memory

• Passive Repository of Knowledge
  – Enables Pattern Recognition
• Essentially Unlimited
• Retrieval
  – Copies information into short-term store
The Serial-Position Effect

- Single-Trial Free Recall
- Retention as a Function of Serial Position
  - Bowed Curve
- Primacy Effect
  - Retrieval from LTM
- Recency Effect
  - Retrieval from STM

![Diagram showing percentage of words recalled over serial position](image)
Effect of Spacing on the Serial-Position Effect

![Graph showing the effect of spacing on serial-position effect](image)

- **Slow presentation**
- **Fast presentation**

Percentage of Words Recalled vs Serial Position
Effect of Retention Interval on the Serial-Position Effect

Fig. 28. Probability of correct recall as a function of serial position for free verbal recall with test following 0 seconds and 30 seconds of intervening arithmetic. After Postman & Phillips (1965).
Amnesia and Short-Term Memory
(Wickelgren, 1968)

Patient H.M.
Medial Temporal Lobes
Hippocampus, Mammillary Bodies

• Normal Digit Span
  – Normal Short-Term Memory
• Impaired Free Recall After Distraction
  – Impaired Long-Term Memory
Short-Term and Long-Term Memory Revisited
Shallice & Warrington (1970)

Patient K.F.
Left Parieto-Occipital Area

• Impaired Digit Span
  – Impaired Short-Term Memory

• Normal Free Recall of 10-Item Lists
  – Normal Long-Term Memory
Working Memory
Baddeley & Hitch (1974)

• Not a Route to Long-Term Memory
• Maintains Item in Active State
  – While *Work* is Being Performed
Working Memory
Baddeley, 1986
Attention
Links Perception and Memory
James (1890)

“Every one knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others….”
Dichotic Listening
Cherry (1953)

- The “Cocktail-Party” Phenomenon
- Shadowing
- Memory for Unattended Channel
  - Switch in Language
  - Switch Between Forwards and Backwards
  + Switch Between Male and Female Voice
Filter Model of Attention
After Broadbent (1958)
Problems with the Filter Model

• Moray (1952)
  – Attention to One’s Own Name

• Treisman (1960)
  – Shift Shadowed Message Between Ears

• Preattentive Semantic Analysis
  – Can Go Beyond Physical Structure
Late- and Early Selection Compared

Physical Analysis

Awareness and Response

Semantic Analysis

Early Selection

A

S1
S2
S3
S4
S5

Physical Analysis

Semantic Analysis

Awareness and Response

Late Selection

B

S1
S2
S3
S4
S5
Persisting Problem: Extent of Preattentive Processing

• Analysis Without Conscious Attention
  – Limited to Physical Structure?
  – Extends to Semantic Meaning?

• Debate over Subliminal Perception
  – Is Subliminal Perception Limited to Analyses of Physical Structure?
Capacity Theory of Attention
Kahneman (1973)

• Attention = Mental Effort
  – Arousal

• Cognitive Resources are Limited

• Attention and Task Demands
  – Demanding: Controlled Processing
    • Require Allocation of Attentional Resources
  – Undemanding: Automatic Processing
    • Require No Attentive Effort
    • Result of Extensive Practice
Views of Attention and Automaticity

• Traditional “Filter” View
  – Elementary Processes are Preattentive
    • Physical/Spatial Analyses
  – Complex Processes Must be Post-Attentive
    • Meaning Analysis/Categorization

• Revisionist “Capacity” View
  – Elementary Processes Typically Preattentive
    • Performed Automatically
  – Complex Processes can be Preattentive Too
    • Once Automatized through Practice
**The Stroop Interference Experiment**  
Stroop (1935)

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Automatic vs. Controlled Processes
After LaBerge & Samuels (1974); Posner & Snyder (1975); Schneider & Shiffrin (1977); Schiffrin & Schneider (1977)

- Inevitable Evocation
- Incorrigible Completion (Ballistic)
- Efficient Execution
- Parallel Processing
- Unconscious in the Strict Sense of the Term
  - Operate Outside Phenomenal Awareness
  - Operate Outside Voluntary Control
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:

Strand Theatre, Shelbyville IN
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

\[ X + 6 = 38 \]
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
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
    - *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
chair
potato
book
egg
cat
window

punt
radio
music
spiral
position
bell
parking
Repetition and Recall
Craik & Watkins (1972, Exp. 1)
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

Orienting Task

- Structural
- Phonemic
- Category
- Sentence

Proportion Recognized

- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100
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

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<td>Finger</td>
<td>Tie</td>
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<tr>
<td>Coat</td>
<td>Purple</td>
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Category Clustering in Free Recall
Bousfield & Cohen (1953)
A List of Associates
Promoting Associative Clustering

Boy
Black
Table
Long
Eagle
Flowers

Chair
Short
Girl
White
Blossom
Bird
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
Memory:
Storage and Retrieval
Lecture 19
The Storage Phase of Memory Processing

• Assume that a Memory Trace has been Adequately Encoded
• What Happens over the Retention Interval?

Forgetting
Retention as a Function of Time

Ebbinghaus (1885)

- **Savings in Relearning (%):** 100, 60, 40, 20, 0
- **Retention Interval (hrs):** 0.33, 1, 8.8, 24, 48, 144, 744

The graph illustrates the percentage of savings in relearning over time, as a function of the retention interval.
The Time-Dependency Principle

Memory diminishes as a function of the length of the retention interval.

Setting Aside…

Reminiscence

Hypermnesia
Four Hypotheses Concerning Time-Dependency

• Decay
  – Memories “Fade” with Time

• Displacement
  – Loss from Storage

• Consolidation
  – Encoding Takes Time

• Interference
  – Failure of Retrieval
Four Factors in Time-Dependency

• Decay
  – Sensory Registers

• Displacement
  – Sensory Registers
    • Masking in “Subliminal” Perception
  – Short-Term Memory

• Consolidation
  – Traumatic Retrograde Amnesia

• Interference
  – Long-Term Memory (Episodic or Semantic)
Law of Regression
Ribot (1882)

• Path of Dissolution of Memory
  – Recent Events
  – General Ideas
  – Feelings
  – Acts
Temporal Gradient in Memory
Traumatic Retrograde Amnesia
Following “Cerebral Shock”
ECT and Retrograde Amnesia
Squire & Chase (1975)

• Electroconvulsive Therapy for Depression
  – Electrodes Placed on Scalp
    • Right and Left Temples; or Temple and Vertex
  – Brief Electrical Current
  – Convulsive Seizure

• Between-Subjects Design
  – Patients Receiving ECT
    • Tested 6 Hrs. After Last ECT
  – Controls
    • No ECT
ECT and Retrograde Amnesia
Squire & Chase (1975)

![Bar chart showing % Correct for different time periods with and without ECT]

- Y-axis: % Correct
- X-axis: Time Period
- Legend: ECT, No ECT
Recovery from Traumatic Retrograde Amnesia
“Final” Residual Amnesia Following Recovery

Memory vs. Time Graph
Two Kinds of Consolidation?

• Short-Term
  – Byproduct of Encoding
  – Occurs within Seconds of Event
  – Disruption Causes Anterograde Amnesia

• Long-Term
  – Persists After Initial Encoding
  – Transpires Over Longer Periods of Time
    • Facilitated by Sleep
  – Disruption Causes Retrograde Amnesia
Interference

*Storage is Essentially Permanent*

Forgetting over Time Occurs by Virtue of Interference by Accumulated Memories

*The Paradox of Interference:*

The More You Know, the Harder it is to Remember to any Particular Item of Information.
Retrieval from Episodic Memory
Anderson (1974)

• Learn Facts about People, Locations
  • The doctor is in the bank (1-1)
  • The fireman is in the park (1-2)
  • The lawyer is in the church (2-1)
  • The lawyer is in the park (2-2)
– Memorize to Criterion of Perfect Recall
– Recognition
  • Studied targets
    – The doctor is in the bank
  • Unstudied lures
    – The doctor is in the park
The Fan Effect
Anderson (1974)
The Time-Dependency Principle Restated

Memory diminishes with time, mostly by virtue of interference among competing memories.

Retroactive

Proactive
Availability vs. Accessibility

• Availability of memory
  – In Storage
  – Impaired by Decay, Displacement, Consolidation Failure

• Accessibility of memory
  – At Retrieval Attempt
  – Impaired by Interference
Availability vs. Accessibility

Encoded memories, available in storage, may not be accessible when retrieval is attempted.
The Retrieval Phase of Memory Processing

• Assume that a Memory Trace has been Adequately Encoded...
• …and Remains Available in Storage Over the Retention Interval…
• How Do We Gain Access to Available Memories?

Queries and Cues
Memory Tests

• Free Recall
  – Query Specifies Spatiotemporal Context
    • What were the words on the last list studied in class?

• Cued Recall
  – Query Adds Information About Target
    • What were the color words on that list?

• Recognition
  – Query Contains a Copy of the Target
    • Was orange one of the words on that list?
Free Recall, Cued Recall, and Recognition

Tulving & Watkins (1975)

![Bar graph showing % Remembered by type of test: Free Recall, Cued Recall, and Recognition.](image-url)
The Cue-Dependency Principle

Memory depends on the informational value of the cues provided at the time of retrieval.
Interactions Between Encoding and Retrieval Processes

• Retrieval Cues Can Compensate for Poor Encoding
  – Cued Recall, Recognition

• “Deep” Encoding Can Compensate for Impoverished Retrieval Cues
  – Elaboration, Organization

• Encoding Sets the Stage for Retrieval
  – Encoding Constrains Retrieval
Study List from Last Lecture

- Foot
- Lion
- Blouse
- Orange
- Finger
- Coat

- Elephant
- Amber
- Mouth
- Rat
- Tie
- Purple
The Encoding Specificity Principle

Memory is best when
the cue information
processed at the time of retrieval
matches the cue information
processed at the time of encoding.

Transfer-Appropriate Processing
State-Dependent Memory
Overton (1964)

Memory Depends on the Match Between
the Organism’s Physiological State
at the Time of Encoding
and Its Physiological State
at the Time of Retrieval
State-Dependent Memory Paradigm
After Overton (1964)

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Ritalin Drug-Dependent Memory in Children with ADHD
Swanson & Kinsbourne (1976)

% Errors During Relearning

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Legend:
- Drug
- No Drug
Magnitude of Drug-Induced State-Dependent Memory in Humans
Eich (1980)

• **Strong Effects**
  – Anesthetics
    • Barbiturates
    • Ethyl Alcohol
    • Chloral Hydrate
    • Ether
    • Nitrous Oxide
  – Librium
  – Nicotine

• **Moderate Effects**
  – Marijuana
  – Narcotics
  – Hallucinogens

• **Weak Effects**
  – Physostigmine
  – Chlorpromazine
  – Imipramine

• **No Effects**
  – Caffeine
  – Aspirin
  – Lithium
Mood-Dependent Memory
Environment-Dependent Memory
Godden & Baddeley (1975)

% Recalled

Study
- Land
- Water

Retrieval Condition

Land

Water

40
30
20
10
0

33
Context-Dependent Memory

• Episodic Context
  – Time, Place
  – Features of External Environment
  – Features of Internal Environment
    • Physiological State
    • Emotional State
    • Motivational State?

• Psychoactive Drugs Impair Cognition

• Context Effects are Cue-Dependent
  – Overshadowed by Other Cues
Context-Dependency and Encoding Specificity

- **Encoding**
  - Sets the Stage for Retrieval
- **Retrieval**
  - Recapitulates Encoding Processes
- **Congruent Conditions**
  - Facilitates Match with Trace
- **Incongruent Conditions**
  - Cue Information Mismatches Trace
  - Forgetting as Failure of Access
The Reconstruction of the Past

Lecture 20
Knowledge and Memory

• Semantic Memory
  – Generic Knowledge, Beliefs
    • Abstract

• Episodic Memory
  – Particular Experiences and Behaviors
    • Specific Events

What is the Relation Between General Knowledge and Memory for Specific Events?
Person Memory Paradigm

• Variant on Verbal-Learning Paradigm
  – List Items are Behaviors, Experiences
    • Rather than Words, Pictures

• Knowledge of a Person
  – Generic (Semantic) Knowledge
    • Traits, Attitudes
  – Episodic Knowledge
    • Specific Behaviors and Experiences
Phase 1:
Study Trait Ensemble

Judy is:

• Intelligent
• Intellectually Sophisticated
• Artistically Sensitive
• Refined
• Imaginative
• Witty
Unitary Impression as Schema
Bartlett (1932)

• Organized Knowledge Structure
  – Knowledge, Beliefs
  – Expectations
• Generalized, Abstract
• Cognitive Basis for Perception and Memory
• Basis for “Effort after meaning”

plural: Schemata or “Schemas”
Phase 2: Study Behaviors

• **Schema-Congruent**
  – \( p(\text{behavior} | \text{schema}) > p(\text{behavior} | \text{no schema}) \)
    • Judy won the chess tournament.
    • Judy attended the symphony concert.

• **Schema-Incongruent**
  – \( p(\text{behavior} | \text{schema}) < p(\text{behavior} | \text{no schema}) \)
    • Judy made the same mistake three times.
    • Judy was confused by the daytime television show.

• **Schema-Irrelevant**
  – \( p(\text{behavior} | \text{schema}) = p(\text{behavior} | \text{no schema}) \)
    • Judy ordered a sandwich for lunch.
    • Judy took the elevator to the third floor.
Schema-Congruence and Memory
Hastie & Kumar (1979)

Relation between Event and Schema

Proportion Recalled

Congruent | Irrelevant | Incongruent
The Schematic Processing Principle

Memory for a specific event is a function of the relationship between that event and pre-existing schemata (knowledge, expectations, beliefs).
Two Processes in Schema-Dependency

- Schema-**Congruent** Behaviors
  - Easily Encoded
  - Schema Provides Retrieval Cues
    - Cue-Dependency
- Schema-**Incongruent** Behaviors
  - Must Be Explained
  - Explanation Requires Processing
    - Elaboration
- Schema-**Irrelevant** Behaviors
  - Receive Neither Benefit
The Schematic Processing Principle Expanded

• Memory is a function of the relationship between an event and pre-existing schemata.

• *Schema-relevant* events are remembered better than schema-irrelevant events.

• Among schema-relevant events, *schema-incongruent* events are remembered better than schema-congruent events.
Principles of Memory

• Encoding
  – Elaboration
  – Organization

• Storage
  – Time-Dependency
    • Interference

• Retrieval
  – Cue-Dependency
    • Availability vs. Accessibility
  – Encoding Specificity
  – Schematic Processing
The Library Metaphor of Memory

Principles of Memory

- Encoding
  - Elaboration
  - Organization
- Storage
  - Time-Dependency
    - Interference
- Retrieval
  - Cue-Dependency
    - Availability vs. Accessibility
  - Encoding Specificity
  - Schematic Processing

The Library Metaphor

- Encoding
  - Purchase a Book
  - Catalog a Book
- Storage
  - Book on Shelf
- Retrieval
  - Look up Book in Catalog
  - Get Book from Shelf
    - Dewey Decimal System
    - Library of Congress
  - Read Contents
Memory as Reproduction
(ever since Ebbinghaus)

• Remembering as Reproducing Event
  – Encoding makes Knowledge Available
  – Retrieval Gains Access to Knowledge

• Mechanisms of Forgetting
  – Unavailability
    • Poor Encoding
  – Inaccessibility
    • Poor Retrieval
Memory as Narrative
Bartlett (1932)

- Objections to Verbal-Learning Paradigm
  - Rote Associations
- Remembering More Like Telling Stories
- Study Memory for Stories, Not for Lists
  - Method of Repeated Reproduction
    - Subjects Repeat the Same story
  - Method of Serial Reproduction
    - Subjects Repeat Each Others’ Stories
The War of the Ghosts

Native American Folktale Collected by Franz Boas
Bartlett (1932)
The War of the Ghosts
Native American Folktale Collected by Franz Boas
Bartlett (1932)

One night two young men from Egulac went down to the river to hunt
seals, and while they were there it became foggy and calm.
Then they heard war-cries, and they thought: “Maybe this is a war-party”.
They escaped to the shore, and hid behind a log.
Now canoes came up, and they heard the noise of paddles, and saw one
canoe coming up to them.
There were five men in the canoe, and they said: “What do you think? We
wish to take you along. We are going up the river to make war on the
people”.
One of the young men said: “I have no arrows”.
“Arrows are in the canoe”, they said.
“I will not go along. I might be killed. My relatives do not know where I
have gone. But you”, he said, turning to the other, “may go with them”.
So one of the young men went, but the other returned home.
And the warriors went on up the river to a town on the other side of Kalama. The people came down to the water, and they began to fight, and many were killed.

But presently the young man heard one of the warriors say: “Quick, let us go home: that Indian has been hit”.

Now he thought: “Oh, they are ghosts”. He did not feel sick, but they said he had been shot.

So the canoes went back to Egulac, and the young man went ashore to his house, and made a fire.

And he told everybody and said: “Behold I accompanied the ghosts, and we went to fight. Many of our fellows were killed, and many of those who attacked us were killed. They said I was hit, and I did not feel sick”.

He told it all, and then he became quiet. When the sun rose he fell down. Something black came out of his mouth. His face became contorted. The people jumped up and cried.

He was dead.
Memory Errors in *The War of the Ghosts*
Bartlett (1932)

- **Errors of Omission**
  - Progressive Forgetting
    - Gist vs. Minor Details
  - Unexpected Details

- **Errors of Commission**
  - Rationalization
  - Transformation of Detail
  - Transformation of Order
Memory as Reconstruction
Bartlett (1932)

• Retrieve Dominant Details
  – Trace Information
    • Vague, Fragmentary, Ambiguous
  – General “Attitude” Toward Story

• Schema-Based Inferences
  – Attitudes
  – Expectations
  – World Knowledge

• Coherent Story
  – But May Not Be Accurate
The Reconstruction Principle

Memory reflects a blend of information contained in memory traces and knowledge, expectations, and beliefs derived from other sources.
Eyewitness Memory Paradigm
Loftus, Miller, & Burns (1978)

• Variant on Verbal-Learning Paradigm
  – List is Continuous Scene
    • Rather than Words, Pictures
  – View Slide Show, Film
  – Subsequent Memory Test
Imagine That You’re a Bystander Watching the Following Scenes

Courtesy of Prof. Elizabeth F. Loftus
UC Irvine
Now, For Some Questions
Visual Recognition Test
What Did You See?

A

B
What Did You See?

A

B
What Did You See?

A

B

Correct
What Did You See?

A

Correct

B
Post-Event Misinformation Effect
Loftus, Miller, & Burns (1978)

• Staged Traffic Accident
• Critical Question
  – Nonleading
    • Did you see another car pass the red Datsun while it was stopped at the *yield* sign?
  – Leading
    • Did you see another car pass the red Datsun while it was stopped at the *stop* sign?
• Recognition Tests
  – Car at *Yield Sign* or *Stop Sign*
Structure of the Study

<table>
<thead>
<tr>
<th>Stimulus</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield Sign</td>
<td>Stop Sign</td>
</tr>
<tr>
<td>Nonleading</td>
<td>Misleading</td>
</tr>
<tr>
<td>Misleading</td>
<td>Nonleading</td>
</tr>
</tbody>
</table>
Correct Recognition of Sign
Loftus, Miller, & Burns (1978)

% of Subjects

Nonleading
Misleading

Word of Question

% of Subjects
Post-Event Misinformation Effect

• Leading Questions Can Influence Eyewitness Report
  – Memory Not “Pure”

• Misinformation Gleaned from Leading Questions Can Be Incorporated into Memory for Event
The “Needle” List

Thread
Pin
Eye
Sewing
Sharp
Point
Prick
Thimble

Haystack
Thorn
Hurt
Injection
Syringe
Cloth
Knitting
The Associative Memory Illusion
Roediger & McDermott (1995)

![Bar graph showing the proportion recognized for studied items, critical lures, and unrelated lures.](image)
Semantic Associates of Needle

Needle

“Forward” Associations

Thread
Pin
Eye
Sewing
Sharp
Point
Prick
Thimble
Haystack
Thorn
Hurt
Injection
Syringe
Cloth
Knitting
Inducing the Associative Memory Illusion

Thread
Pin
Eye
Sewing
Sharp
Point
Prick
Thimble
Haystack
Thorn
Hurt
Injection
Syringe
Cloth
Knitting

“Backward” Associations

Needle
Illusions in Perception and Memory

- Perceptual Illusions
  - Perceive the *Present* Inaccurately
    - Systematic Distortion, Bias
  - Product of Constructive Activity
    - “Going Beyond the Information Given” in Stimulus

- Memory Illusions
  - Remember the *Past* Inaccurately
    - Systematic Distortion, Bias
  - Product of *Reconstructive* Activity
    - “Going Beyond the Information Given” in Trace
Implications of the Reconstruction Principle

Memory reflects a blend of information contained in memory traces and knowledge, expectations, and beliefs derived from other sources.

Memories are Not *Records Of* the Past.
Memories are *Beliefs About* the Past.
Seven (Plus or Minus Two) Principles of Memory

• Encoding
  – Elaboration
  – Organization

• Storage
  – Time-Dependency
    • Interference

• Retrieval
  – Cue-Dependency
    • Availability vs. Accessibility
  – Encoding Specificity
  – Schematic Processing
  – Reconstruction

At least so far as conscious recollection is concerned….
Explicit and Implicit Memory
Schacter (1987)

- Explicit Memory
  - Conscious Recollection of Past Event
    - Recall, Recognition

- Implicit Memory
  - Change in Experience, Thought, Action
    - Attributable to Past Event

- Dissociation
  - Explicit Memory Impaired
  - Implicit Memory Spared
“Guessing Game”

• Word-Stem Completion
  I’m thinking of a word that begins with these three letters. Can you fill in the blanks?
  Ash_____  Bel_____  
  Cle_____  Exp_____  

• Word-Fragment Completion
  I’m thinking of a word that has these letters in it. Can you fill in the blanks?
  D___k  F_I__w
Memory in the Amnesic Syndrome
After Warrington & Weiskrantz (1970)

![Bar chart showing memory test performance for Controls and Amnesics.](attachment:memory_chart.png)

- Free Recall
- Recognition
- Completion

Proportion of Targets

Group:
- Controls
- Amnesics
Priming as Implicit Memory

• Performance of One Task
  – Studying a List of Words

• Facilitates Performance of Another Task
  – Word-Stem, Word-Fragment Completion
Unified View of Perception, Memory

• Constructive Activity in Conscious Cognition
  – Perceptual Construction
    • Builds Up Representation of Present Experience
  – Memory Reconstruction
    • Builds Up a Representation of Past Experience

• Unconscious Cognition
  – Implicit Perception
    • “Subliminal” Perception
  – Implicit Memory
    • Priming Effects in Amnesia
      – and “Subliminal” Perception