



Memento (2000)

Memory

Chapter 8

Psy 12000.003

The Phenomenon of Memory

Memory is *any indication* that learning has persisted over time. It is our ability to store and retrieve information.

What are typical indications?

Memorizing Pi



http://www.yourdailymedia.com/media/1162388377/Pi_Freak

Daniel Tammet: Pi to 22,500 decimals 3

Memory

Memory is the basis for knowing your friends, your neighbors, the English language, the national anthem, and yourself.

If memory was nonexistent, everyone would be a stranger to you; every language foreign; every task new; and even you yourself would be a stranger.

What Would Life Be Like Without Memory?

The case of Clive Wearing, Pts. I & II



<http://www.youtube.com/watch?v=wDNRDJv-vo>

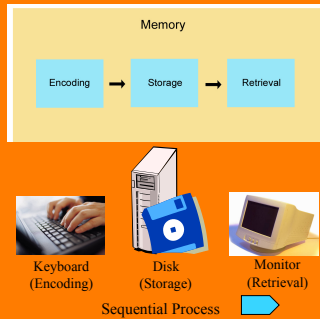
Flashbulb Memory

A unique and highly emotional moment may give rise to a clear, strong, and persistent memory called **flashbulb memory**. However, this memory is not free from errors.



President Bush being told of 9/11 attack.

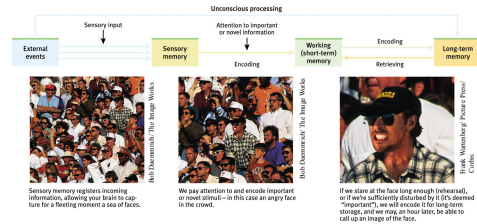
Stages of Memory



7

Information Processing

The Atkinson-Schiffirin (1968) three-stage model of memory includes a) **sensory memory**, b) **short-term memory**, and c) **long-term memory**.



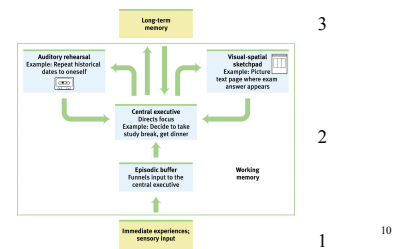
Problems with the Model

- Some information skips the first two stages and enters long-term memory automatically.
- Because we cannot focus all the sensory information in the environment, we select information (through attention) that is important to us.
- The nature of short-term memory is more complex.

9

Working Memory

Alan Baddeley (2002) proposes that working memory contains auditory and visual processing controlled by the central executive through an episodic buffer.



10

Encoding: Getting Information In

How We Encode

- Some information (where the dairy section is in the grocery store) is *automatically* processed.
- However, new or unusual information (friend's new cell-phone number) requires attention and effort.

11

Automatic Processing

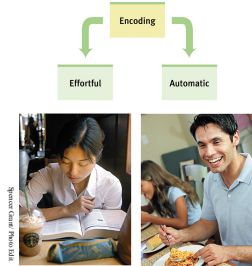
We process an enormous amount of information effortlessly, such as the following:

- Space:** While reading a textbook, you automatically encode the place of a picture on a page.
- Time:** We unintentionally note the events that take place in a day.
- Frequency:** You effortlessly keep track of things that happen to you.

12

Effortful Processing

Committing novel information to memory requires effort just like learning a concept from a textbook. Such processing leads to durable and accessible memories.



13

Rehearsal

Effortful learning usually requires rehearsal or conscious repetition.

Ebbinghaus studied rehearsal by using nonsense syllables: TUV YOF GEK XOZ

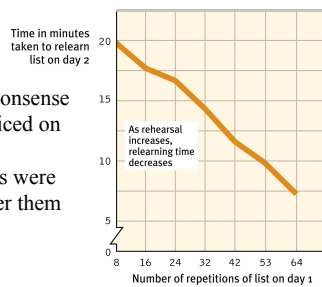


Hermann Ebbinghaus (1850-1909)

14

Rehearsal

The more times the nonsense syllables were practiced on Day 1, the fewer repetitions were required to remember them on Day 2.



15

Spacing Effect

Distributing rehearsal (**spacing effect**) is better than practicing all at once (*massed practice*). Robert Frost's poem could be memorized with fair ease if spread over time.

ACQUAINTED WITH THE NIGHT

Robert Frost

I have been one acquainted with the night.
I have walked out in rain — and back in rain.
I have outwalked the furthest city light.

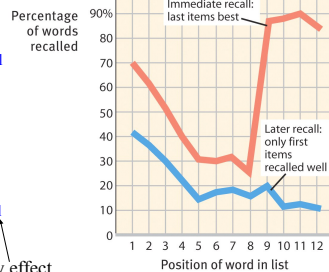
....

16

Serial Position Effect

Primacy effect

1. TUV
 2. ZOF
 3. GEK
 4. WAV
 5. XOZ
 6. TIK
 7. FUT
 8. WIB
 9. SAR
 10. POZ
 11. REY
 12. GU
- Annotations: 'Better recall' for items 1-4 and 10-12; 'Poor recall' for items 5-9.



17

Memory Effects

- **Next-in-line-Effect:**
 - When you are so anxious about being next that you cannot remember what the person just before you in line says, but you can recall what other people well before or after you say.



18

What We Encode

- Encoding by meaning
- Encoding by images
- Encoding by organization

19

Encoding Meaning

“Whale”

Q: Did the word begin with a capital letter?

Structural Encoding

Shallow

Q: Did the word rhyme with the word “weight”?

Phonemic Encoding

Intermediate

Q: Would the word fit in the sentence?
He met a _____ in the street.

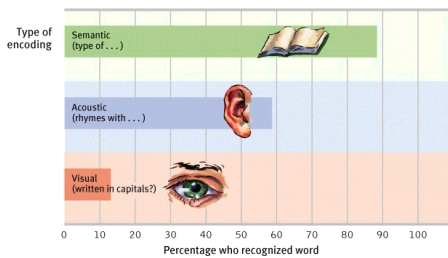
Semantic Encoding

Deep

Craik and Lockhart (1972)

20

Results



21

Visual Encoding

Mental pictures (imagery) are a powerful aid to effortful processing, especially when combined with semantic encoding.



Showing adverse effects of tanning and smoking in a picture may be more powerful than simply talking about it.

22

Mnemonics

Imagery is at the heart of many memory aids. Mnemonic techniques use vivid imagery in aiding memory.

1. Method of Loci
2. Link Method

23

Method of Loci

List of Items

Charcoal
Pens
Bed Sheets
Hammer
.
.
.
Rug

Imagined Locations

Backyard
Study
Bedroom
Garage
.
.
.
Living Room

24

Link Method

<http://www.youtube.com/watch?v=9NROegsMqNe>

List of Items

Newspaper
Shaving cream
Pen
Umbrella
.
.
.
Lamp



Involves forming a mental image of items to be remembered in a way that links them together.

25

Organizing Information for Encoding

Break down complex information into broad concepts and further subdivide them into categories and subcategories.

1. Chunking
2. Hierarchy

26

Chunking

Organizing items into a familiar, manageable unit.
Try to remember the numbers below.

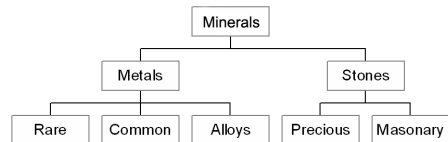
1-7-7-6-1-4-9-2-1-8-1-2-1-9-4-1

If you are well versed with American history, chunk the numbers together and see if you can recall them better. 1776 1492 1812 1941.

27

Hierarchy

Complex information broken down into broad concepts and further subdivided into categories and subcategories.



28

Chunking

Acronyms are another way of chunking information to remember it (these are also mnemonics).

HOMES = Huron, Ontario, Michigan, Erie, Superior

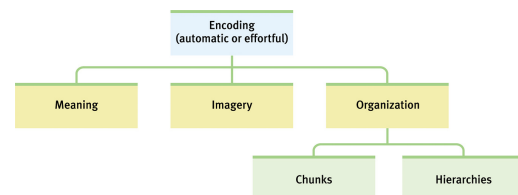
PEMDAS = Parentheses, Exponent, Multiply, Divide, Add, Subtract

ROY G. BIV = Red, Orange, Yellow, Green, Blue, Indigo, Violet

OCEAN = Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism (also CANOE)

29

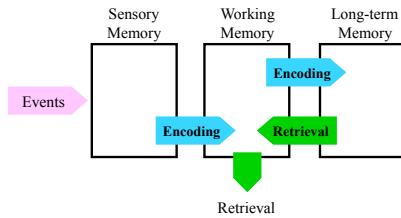
Encoding Summarized in a Hierarchy



30

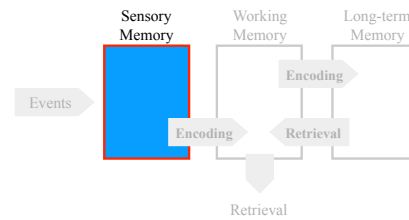
Storage: Retaining Information

Storage is at the heart of memory. Three stores of memory are shown below:



31

Sensory Memory



32

Whole Report

Sperling (1960)

R	G	T
F	M	Q
L	Z	S

50 ms (1/20 second)

“Recall”
R T M Z
(44% recall)

The exposure time for the stimulus is so small that items cannot be rehearsed.

33

Partial Report

S	X	T
J	R	S
P	K	Y

50 ms (1/20 second)

Low Tone

Medium Tone

High Tone

“Recall”
J R S
(100% recall)

Sperling (1960) argued that sensory memory capacity was larger than what was originally thought.

34

Time Delay

A	D	I
N	L	V
O	G	H

50 ms (1/20 second)

Time
Delay

Low Tone

Medium Tone

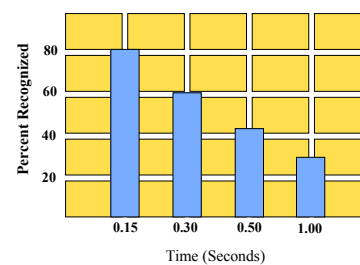
High Tone

“Recall”
N _ _
(33% recall)

35

Sensory Memory

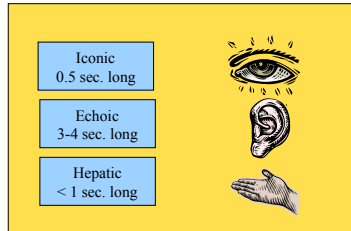
The longer the delay, the greater the memory loss.



36

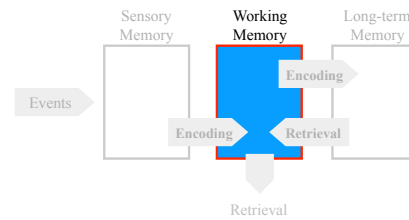
Sensory Memories

The duration of sensory memory varies for the different senses.



37

Working Memory



38

Working Memory

Working memory, the new name for short-term memory, has a limited capacity (7 ± 2) and a short duration (20 seconds).



Sir George Hamilton observed that he could accurately remember up to 7 beans thrown on the floor. If there were more beans, he guessed.

39

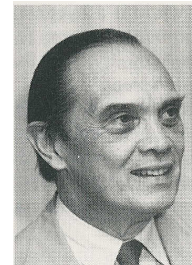
Capacity

The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information (1956).

Ready?

MUTGIKTLRSYP

You should be able to recall 7 ± 2 letters.



George Miller

40

Chunking

The capacity of the working memory may be increased by "Chunking."

F-B-I-T-W-A-C-I-A-I-B-M

FBI TWA CIA IBM
4 chunks

41

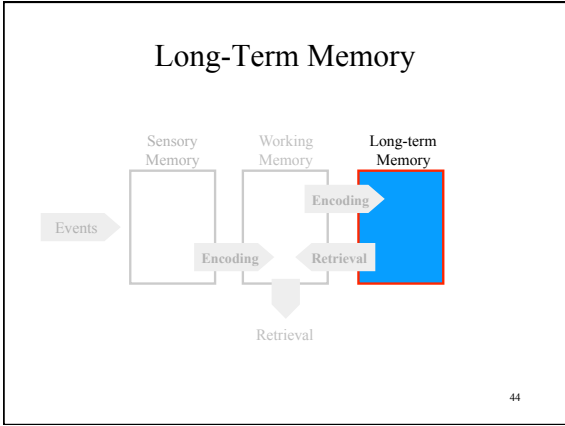
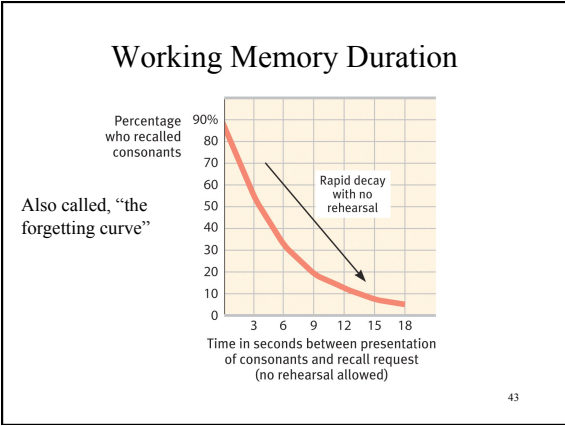
Duration

Brown/Peterson and Peterson (1958/1959) measured the duration of working memory by manipulating rehearsal.



The duration of the working memory is about 20 sec.

42



Long-Term Memory

Unlimited capacity store. Estimates on capacity range from 1000 billion to 1,000,000 billion bits of information (Landauer, 1986).

The Clark's nutcracker can locate 6,000 caches of buried pine seeds during winter and spring.

45

Memory Feats

WORLD MEMORY CHAMPIONSHIP RECORDS

From world memory competition, here are some current records, as of 2005:

Contest	Description	Record
Speed cards	Shortest time to memorize a shuffled pack of 52 playing cards	33 seconds
One-hour cards	Most cards memorized in one hour (52 points for every pack correct; 26 points if 1 mistake)	1170 cards
Speed numbers	Most random digits memorized in 5 minutes	324 digits
Names and faces	Most first and last names memorized in 35 minutes after being shown with faces (1 point for every correctly spelled first or last name; 1/2 point for every phonetically correct but incorrectly spelled name)	167.5 names
Binary digits	Most binary digits (101101, etc.) memorized in 30 minutes when presented in rows of 30 digits	3705

Sources: usamemorial.com and worldmemorychampionship.com

46

Memory Stores

Feature	Sensory Memory	Working Memory	LTM
Encoding	Copy	Phonemic	Semantic
Capacity	Unlimited	7±2 Chunks	Very Large
Duration	0.25 sec.	20 sec.	Years

47

- ### Shallow vs. Deep Processing
- Deeply processed information is better remembered than shallowly processed information
 - Shallow instructions:
 - look at word list and determine if each word has a capital letter in it or not
 - Is the word a verb or noun?
 - What rhymes with each word?
 - Deep instructions:
 - What is the meaning of each word? Does each word have more than one meaning?
 - Relate each word to yourself
- 48

Adaptive Memory

Journal of Experimental Psychology:
Learning, Memory and Cognition
2007, Vol. 33, No. 2, 250-255

Copyright 2007 by the American Psychological Association
0278-7393/07/\$12.00 DOI: 10.1037/0278-7393.33.2.250

Adaptive Memory: Survival Processing Enhances Retention

James S. Nairne, Sarah R. Thompson, and Josefa N. S. Pandeirada
Purdue University

The authors investigated the idea that memory systems might have evolved to help us remember fitness-relevant information—specifically, information relevant to survival. In 4 incidental learning experiments, people were asked to rate common nouns for their survival relevance (e.g., in securing food, water, or protection from predators); in control conditions, the same words were rated for pleasantness, relevance to moving to a foreign land, or personal relevance. In surprise retention tests, participants consistently showed the best memory when words were rated for survival; the survival advantage held across word recognition, and for both within-subject and between-subjects designs. These findings suggest that memory systems are “tuned” to remember information that is processed for fitness, perhaps as a result of survival advantages accrued in the past.

Keywords: memory, evolution, recall, survival, adaptation

- Another example of evolutionary psychology’s influence; this time on memory.

49

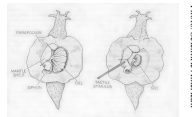
Storing Memories in the Brain

- Through electrical stimulation of the brain, Wilder Penfield (1967) concluded that old memories were etched into the brain.
- Loftus and Loftus (1980) reviewed Penfield's data and showed that only a handful of brain stimulated patients reported flashbacks.
- Using rats, Lashley (1950) suggested that even after removing parts of the brain, the animals retain partial memory of the maze.

50

Synaptic Changes

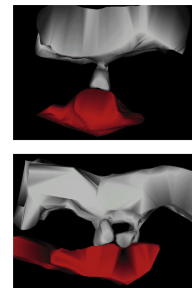
When *Aplysia Californica*, (a type of large sea slug), are threatened, they release clouds of ink to blind the attacker. Thus, this ink-release behavior can be conditioned, and neurobiologists can study changes that result. Kandel and Schwartz (1982) showed that serotonin release from neurons *increased* after conditioning. Therefore, a biological trace that represents memory.



51

Synaptic Changes

Long-Term Potentiation (LTP) refers to synaptic enhancement after learning (Lynch, 2002). An increase in neurotransmitter release or receptors on the receiving neuron indicates strengthening of synapses.



52

Stress Hormones & Memory

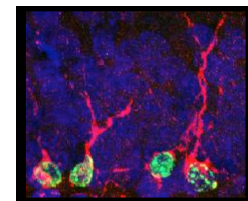
Heightened emotions (stress-related or otherwise) make for stronger memories (but still vulnerable to misinformation effects).
Prolonged stress may disrupt memory.



53

Neurogenesis

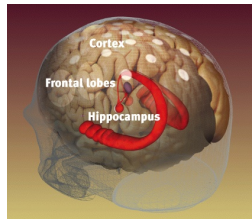
- The creation of new neurons, even in adulthood, as a result of positive stress and learning responses to novel information/ stimuli
 - Previously thought not to occur in adults
- E. Gould (2010)*



54

Hippocampus

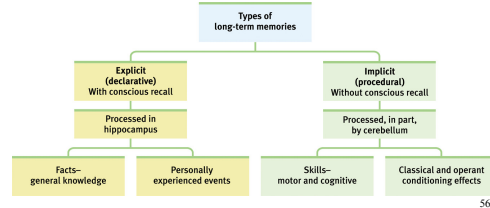
Hippocampus – a neural center in the limbic system that processes explicit memories.



55

Storing Implicit & Explicit Memories

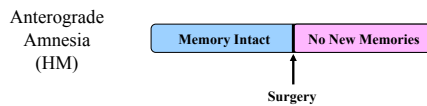
Explicit Memory refers to facts and experiences that one can consciously know and declare. **Implicit memory** involves learning an action while the individual does not know or declare what she knows.



56

Anterograde Amnesia

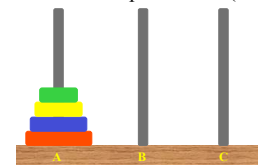
After losing his hippocampus in surgery, patient Henry M. (HM) remembered everything before the operation but cannot make new memories. We call this **anterograde amnesia**.



57

Implicit Memory

HM is unable to make new memories that are declarative (explicit), but he can form new memories that are procedural (implicit).

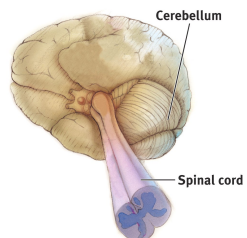


HM learned the Tower of Hanoi (game) after his surgery. Each time he plays it, he is unable to remember the fact that he has already played the game.

58

Cerebellum

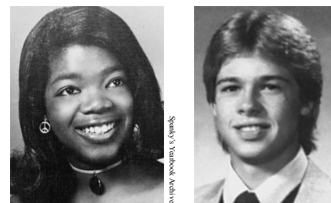
Cerebellum – a neural center in the hindbrain that processes implicit memories.



59

Retrieval: Getting Information Out

Retrieval refers to getting information out of the memory store.



60

Measures of Memory

In **recognition**, the person must identify an item amongst other choices. (A multiple-choice test requires recognition.)

1. Name the capital of France.
 - a. Brussels
 - b. Rome
 - c. London
 - d. Paris

61

Measures of Memory

In **recall**, the person must retrieve information using effort. (A fill-in-the blank test requires recall.)

1. The capital of France is _____.

62

Measures of Memory

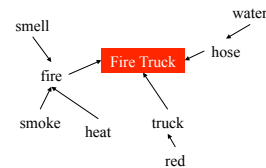
In **relearning**, the individual shows how much time (or effort) is saved when learning material for the second time.

<p>List Jet Dagger Tree Kite ... Silk Frog Ring</p> <p>It took 10 trials to learn this list</p>	<p>1 day later</p>	<p>List Jet Dagger Tree Kite ... Silk Frog Ring</p> <p>It took 5 trials to learn the list</p>	$\text{Saving} = \frac{\text{Original Trials} - \text{Relearning Trials}}{\text{Relearning Trials}} \times 100$ $= \frac{10 - 5}{10} \times 100$ $= 50\%$
--	--------------------	--	---

63

Retrieval Cues

Memories are held in storage by a web of associations. These associations are like anchors that help retrieve memory.



64

Priming

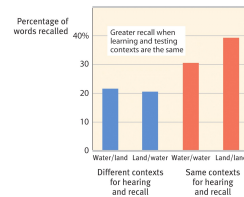
To retrieve a specific memory from the web of associations, you must first activate one of the strands that leads to it. This process is called **priming**.



65

Context Effects

Scuba divers recall more words underwater if they learned the list underwater, while they recall more words on land if they learned that list on land (Godden & Baddeley, 1975).



66

Déjà Vu

Déjà Vu means “I’ve experienced this before.” Cues from the current situation may unconsciously trigger retrieval of an earlier similar experience.



67

Context Effects

After learning to move a mobile by kicking, infants most strongly respond when retested in the same context rather than in a different context (Butler & Rovee-Collier, 1989).



68

Moods and Memories

We usually recall experiences that are consistent with our current mood. Emotions, or moods, serve as retrieval cues.



69

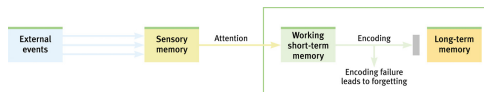
Forgetting

An inability to retrieve information due to poor encoding, storage, or retrieval.

70

Encoding Failure

We cannot remember what we do not encode.



71

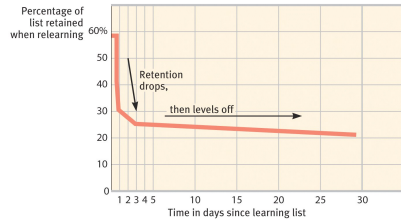
Which penny is real?



72

Storage Decay

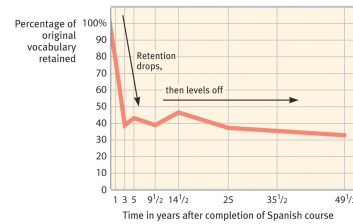
Poor durability of stored memories leads to their decay. Ebbinghaus showed this with his *forgetting curve*.



73

Retaining Spanish

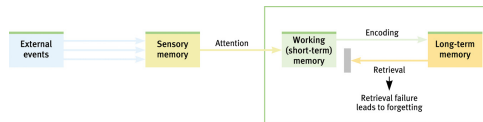
Bahrick (1984) showed a similar pattern of forgetting and retaining over 50 years.



74

Retrieval Failure

Although the information is retained in the memory store, it cannot be accessed.

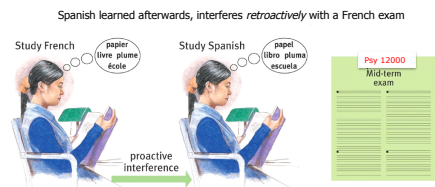


Tip-of-the-tongue (TOT) is a retrieval failure phenomenon.

75

Interference

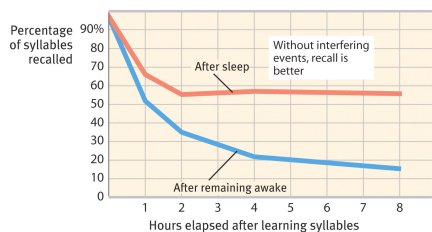
- Older learning may interfere with learning new material (*proactive interference*).
- Learning new information may disrupt retrieval of old information (*retroactive interference*).
- Retrieval of information may interfere with other retrieval (*output interference*).



76

Retroactive Interference

Sleep prevents retroactive interference. Therefore, it leads to better recall.



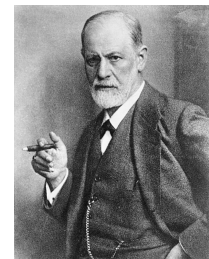
77

Motivated Forgetting

Motivated Forgetting: People unknowingly revise their memories.

Repression: A defense mechanism that banishes anxiety-arousing thoughts, feelings, and memories from consciousness.

Suppression: Consciously inhibiting unwanted thoughts.

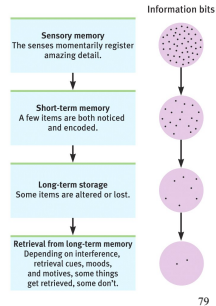


Sigmund Freud

78

Why do we forget?

Forgetting can occur at any memory stage. We filter, alter, or lose much information during these stages.



Memory Construction

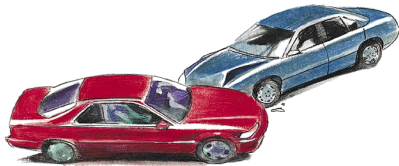
While tapping our memories, we filter or fill in missing pieces of information to make our recall more coherent.

Misinformation Effect: Incorporating misleading information into one's memory of an event.

80

Misinformation and Imagination Effects

Eyewitnesses reconstruct their memories when questioned about the event.



Depiction of the actual accident.

81

Misinformation

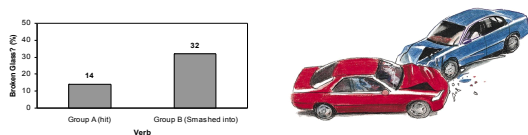
Group A: How fast were the cars going when they **hit** each other?

Group B: How fast were the cars going when they **smashed into** each other?

82

Memory Construction

A week later they were asked: Was there any broken glass? **Group B (smashed into)** reported more broken glass than **Group A (hit)**.



Source Amnesia

Source Amnesia: Attributing an event to the wrong source that we experienced, heard, read, or imagined (misattribution).

(sometimes called unconscious transference)

84

Discerning True & False Memories

Just like true perception and illusion, real memories and memories that seem real are difficult to discern.



When students formed a happy or angry memory of morphed (computer blended) faces, they made the (computer assisted) faces (a), either happier or (b) angrier.

85

False Memories

Repressed or Constructed?

Some adults actually do forget childhood episodes of abuse.

False Memory Syndrome

A condition in which a person's identity and relationships center around a false but strongly believed memory of a traumatic experience, which is sometimes induced by well-meaning therapists.

86

Children's Eyewitness Recall

Children's eyewitness recall can be unreliable if leading questions are posed. However, if cognitive interviews are neutrally worded, the accuracy of their recall increases. In cases of sexual abuse, this usually suggests a lower percentage of abuse.

87

Memories of Abuse

Are memories of abuse repressed or constructed?

Many psychotherapists believe that early childhood sexual abuse results in repressed memories.

However, other psychologists question such beliefs and think that such memories may be constructed.

88

Constructed Memories

Loftus' research shows that if false memories (lost at the mall or drowned in a lake) are implanted in individuals, they construct (fabricate) their memories.



89

Experimentally Creating False Memories



<http://www.youtube.com/watch?v=eHPQYQ3NOjg>

90

Consensus on Childhood Abuse

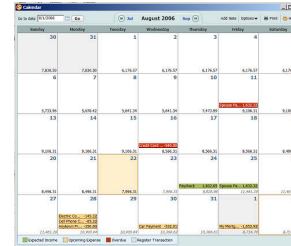
Leading psychological associations of the world agree on the following concerning childhood sexual abuse:

- Injustice happens.
- Incest and other sexual abuse happens.
- People may forget.
- Recovered memories are commonplace.
- Recovered memories under hypnosis or drugs are unreliable.
- Memories of things happening before 3 years of age are unreliable.
- Memories, whether real or false, are emotionally upsetting.

91

Prospective Memory

- Remembering TO DO something, and when



McDaniel, 2008

92

Improving Memory

- Study repeatedly to boost long-term recall.
- Spend more time rehearsing or actively thinking about the material.
- Make material personally meaningful.
- Use mnemonic devices:
 - associate with peg words — something already stored
 - make up a story
 - chunk — acronyms

93

Improving Memory

5. Activate retrieval cues — mentally recreate the situation and mood.
6. Recall events while they are fresh — before you encounter misinformation.
7. Minimize interference:
 1. Test your own knowledge.
 2. Rehearse and then determine what you do not yet know.



94