Memory

A Memory Test!

(but first, we need a volunteer)

Remember These Words

candy	sour	tart	sugar
honey	chocolate	cake	tooth
taste	treat	bitter	good
soda	nice	eat	pie

Memory

A Memory Test!

Who remembers…

cake

sweet

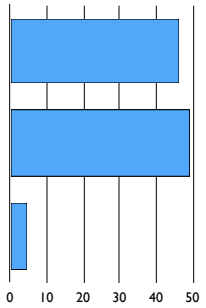
anger

Who remembers…

A cake

B sweet

C anger

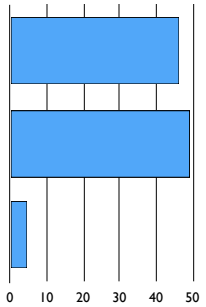


Who remembers…

A cake

B sweet

C anger

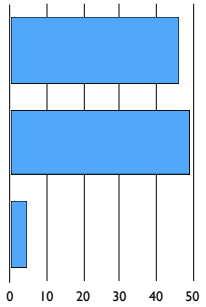


Who remembers…

A cake

B sweet

C anger



Remember These Words

candy	sour	tart	sugar
honey	chocolate	cake	tooth
taste	treat	bitter	good
soda	nice	eat	pie

?

Questions + Themes

How are memory systems **organized**?

How **much** can we remember?

Is memory **reliable**? When and when not?

What do we remember?

Facts
Ideas
Concepts

Semantic Memory

Experiences
Events
First-Person Knowledge

Episodic Memory

Skills
Tasks
Habits

Procedural Memory

When do we remember?

Sensory Memory

vs

Short-Term Memory

vs

Long-Term Memory

How do we remember?

How do we remember?



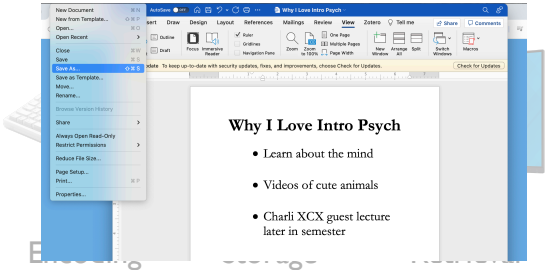
Encoding Storage Retrieval

How do we remember?



Encoding Storage Retrieval

How do we remember?



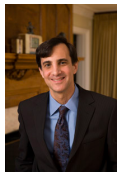
Consolidation

Distinctions

that make a

Difference

?



Facts
Ideas
Concepts

Semantic Memory

vs

Skills
Tasks
Habits

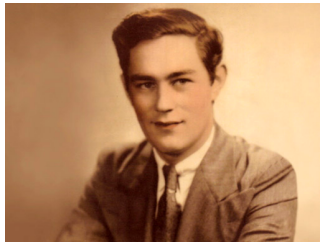
Procedural Memory

vs

Encoding

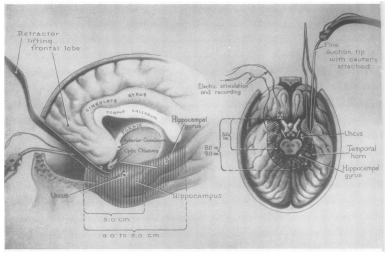
Storage

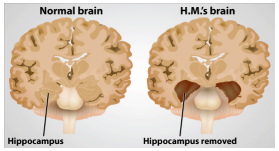
Dissociability



Henry Molaison
1926-2008

Patient HM





PAGE-TURNER

THE MAN WHO FORGOT EVERYTHING

By Steven Shapin October 14, 2013

Amnesia

inability to remember

Volunteer?

reasoning

language

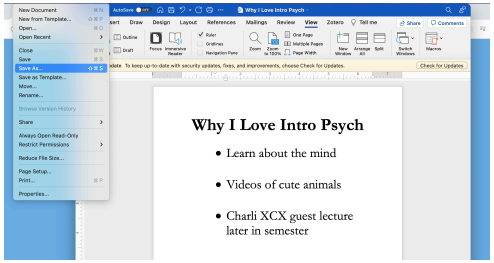
motor skills

visual recognition

explicit/semantic memory

Anterograde Amnesia

inability to form new memories



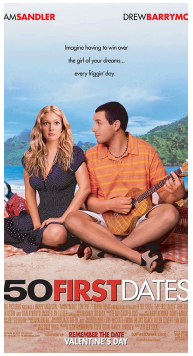
Consolidation

Anterograde Amnesia

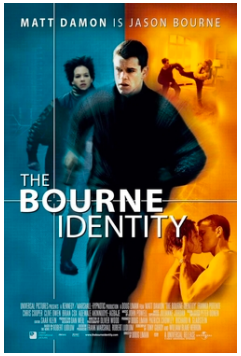
inability to form new memories

Retrograde Amnesia

inability to retrieve old memories



Anterograde

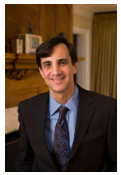


Retrograde

vs

Encoding

Storage



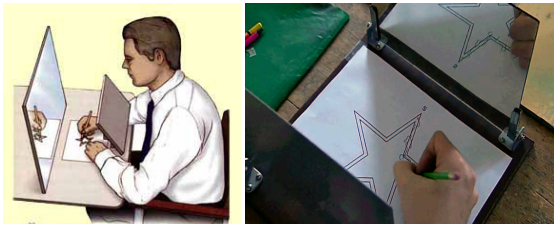
Facts
Ideas
Concepts

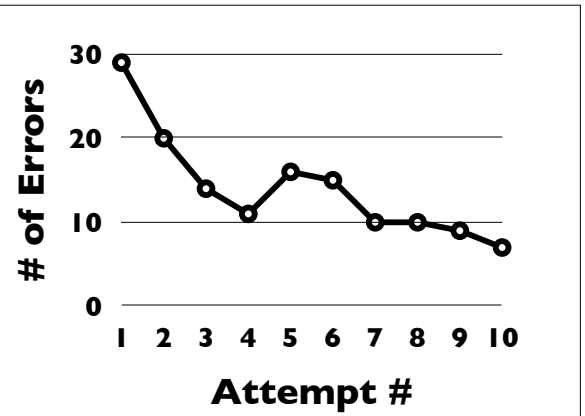
Semantic Memory

vs

Skills
Tasks
Habits

Procedural Memory





HM improves over time!

but doesn't remember ever having completed the task

(Squire, 2009)

Capacity

Hard

candy	sour	tart	sugar
honey	chocolate	cake	tooth
taste	treat	bitter	good
soda	nice	eat	pie

Easy

When do we remember?

Sensory Memory

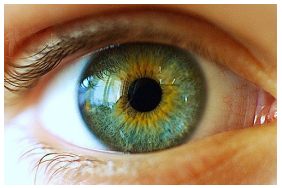
vs

Short-Term Memory

vs

Long-Term Memory

Sensory Memory



Iconic Memory

Echoic Memory

A Memory Test!

X L W F

J B O V

K C Z R

Most people: ~4 letters

(Sperling, 1960)

X L W F

J B O V

K C Z R

Most people: ~4 letters

!

(Sperling, 1960)

X L W F

J B O V

K C Z R

X L W F

J B O V

K C Z R


vs

vs


Sensory Memory

Short-Term Memory

Long-Term Memory

High Capacity
(but decays quickly)

A Memory Test!

6 9 1

8 7 4 5 4

5 7 4 2 2 9 6

3 5 6 7 1 8 4 8 5

4 7 2 0 8 2 7 4 2 6 4

Short-Term Memory

Decays without rehearsal

Position matters:
Effects of **Primacy** and **Recency**

7 ± 2

Sensory Memory

vs

Short-Term Memory

vs

Long-Term Memory

High Capacity

Low Capacity

Short-Term Memory

7 ± 2

whats?

A Memory Test!

24 60 365 100

big pop cat run

Chunking

combining small pieces of information
into larger, meaningful clusters

7 ± 2 *Chunks* ?

A Memory Test!

心理学

In West Philadelphia born and raised, on the
playground is where I spent most of my days

Increase Capacity?

A Memory Test!

Remember This Paragraph

A newspaper is better than a magazine. A seashore is a better place than the street. At first it is better to run than to walk. You may have to try several times. It takes some skill but is easy to learn. Even young children can enjoy it. Once successful, complications are minimal. Birds seldom get too close. Rain, however, soaks in very fast. Too many people doing the same thing can also cause problems. One needs lots of room. If there are no complications it can be very peaceful. A rock will serve as an anchor. If things break loose from it, however, you will not get a second chance.

This paragraph is about flying a kite

Remember This Paragraph

A newspaper is better than a magazine. A seashore is a better place than the street. At first it is better to run than to walk. You may have to try several times. It takes some skill but is easy to learn. Even young children can enjoy it. Once successful, complications are minimal. Birds seldom get too close. Rain, however, soaks in very fast. Too many people doing the same thing can also cause problems. One needs lots of room. If there are no complications it can be very peaceful. A rock will serve as an anchor. If things break loose from it, however, you will not get a second chance.

Increase Capacity?

Depth of Processing and the Retention of Words in Episodic Memory

Fergus I. M. Craik and Endel Tulving
University of Toronto, Toronto, Ontario, Canada

SUMMARY

Ten experiments were designed to explore the levels of processing framework for human memory research proposed by Craik and Lockhart (1972). The basic notions are that the episodic memory trace may be thought of as a rather automatic by-product of operations carried out by the cognitive system and that the durability of the trace is a positive function of "depth" of processing, where depth refers to greater degrees of semantic involvement. Subjects were induced to process words to different depths by answering various questions about the words. For example, shallow encodings were achieved by asking questions about typescript; intermediate levels of encoding were accomplished by asking questions about rhymes; deep levels were induced by asking whether the word would fit into a given category or sentence frame. After the encoding phase was completed, subjects were unexpectedly given a recall or recognition test for the words. In general, deeper encodings took longer to accomplish and were associated with higher levels of performance on the subsequent memory test. Also, questions leading to positive responses were associated with higher retention levels than questions leading to negative responses, at least at deeper levels of encoding.

"Shallow"

1. Uppercase?
2. Rhyme with "weight"?
3. Make sense with: "He met a ____ in the street"?

"Deep"

STRANGER

cloud

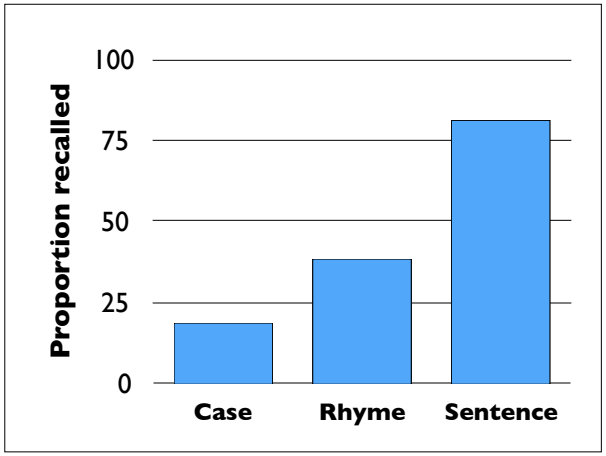
crate

MARKET

FRIEND

GATE

...

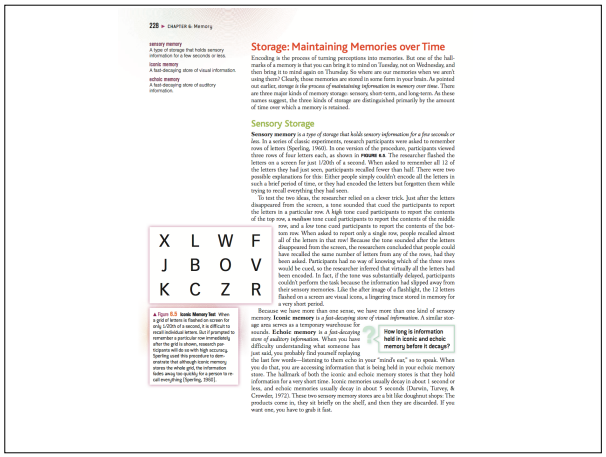


Increase Capacity?

"Method of Loci"

or, the memory palace

Simonides of Ceos
(5th-6th Century BCE)



228 ▶ CHAPTER 6: Memory

sensory memory
A type of storage that holds sensory information for a few seconds or less.

iconic memory
A fast-decaying store of visual information.

echoic memory
A fast-decaying store of auditory information.

Storage: Maintaining Memories over Time

Encoding is the process of turning perceptions into memories. But one of the hallmarks of a memory is that you can bring it to mind on Tuesday, not on Wednesday, and then bring it to mind again on Thursday. So where are our memories when we aren't using them? Clearly, those memories are stored in some form in your brain. As pointed out earlier, *storage is the process of maintaining information in memory over time.* There are three major kinds of memory storage: sensory, short-term, and long-term. As these names suggest, the three kinds of storage are distinguished primarily by the amount of time over which a memory is retained.

Sensory Storage

Sensory memory *is a type of storage that holds sensory information for a few seconds* or less. In a series of classic experiments, research participants were asked to remember rows of letters (Sperling, 1960). In one version of the procedure, participants viewed three rows of four letters each, as shown in **FIGURE 6.5**. The researcher flashed the letters on a screen for just 1/20th of a second. When asked to remember all 12 of the letters they had just seen, participants recalled fewer than half. There were two possible explanations for this: Either people simply couldn't encode all the letters in such a brief period of time, or they had encoded the letters but forgotten them while trying to recall everything they had seen.

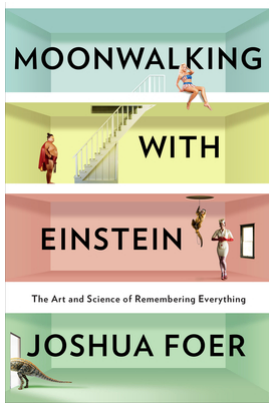
To test the two ideas, the researcher relied on a clever trick. Just after the letters disappeared from the screen, a tone sounded that cued the participants to report the letters in a particular row. A high tone cued participants to report the contents of the top row, a *medium* tone cued participants to report the contents of the middle row, and a *low* tone cued participants to report the contents of the bottom row. When asked to report only a single row, people recalled almost all of the letters in that row! Because the tone sounded after the letters disappeared from the screen, the researchers concluded that people could have recalled the same number of letters from any of the rows, had they been asked. Participants had no way of knowing which of the three rows would be cued, so the researcher inferred that virtually all the letters had been encoded. In fact, if the tone was substantially delayed, participants couldn't perform the task because the information had slipped away from their sensory memories. Like the after image of a flashlight, the 12 letters flashed on a screen are visual icons, a lingering trace stored in memory for a very short period.

X L W F
J B O V
K C Z R

▲ **Figure 6.5 Iconic Memory Test** When a grid of letters is flashed on screen for only 1/20th of a second, it is difficult to recall individual letters. But if prompted to remember a particular row immediately after the grid disappears, most people (or participants) will do so with high accuracy. Sperling used this procedure to demonstrate that although iconic memory stores the whole grid, the information fades away too quickly for a person to recall everything (Sperling, 1960).

Because we have more than one sense, we have more than one kind of sensory memory. **Iconic memory** *is a fast-decaying store of visual information.* A similar storage area serves as a temporary warehouse for sounds. **Echoic memory** *is a fast-decaying store of auditory information.* When you have difficulty understanding what someone has just said, you probably find yourself replaying the last few words—listening to them echo in your "mind's ear," so to speak. When you do that, you are accessing information that is being held in your echoic memory store. The hallmark of both the iconic and echoic memory stores is that they hold information for a very short time. Iconic memories usually decay in about 1 second or less, and echoic memories usually decay in about 5 seconds (Darwin, Turvey, & Crowder, 1972). These two sensory memory stores are a bit like doughnut shops: The products come in, they sit briefly on the shelf, and then they are discarded. If you want one, you have to grab it fast.

How long is information held in iconic and echoic memory before it decays?



A Memory Test!

big
naked
bicycle
cookie
horse
speech
oatmeal
spear
dance
baby
yellow
road
lion

big
naked
bicycle
cookie
horse
speech
oatmeal
spear
dance
baby
yellow
road
lion


vs


vs


Sensory Memory

High Capacity

Short-Term Memory

Low Capacity
?

Long-Term Memory

Prof. Jonathan Flombaum

Prof. Janice Chen

vs

vs

Sensory Memory	Short-Term Memory	Long-Term Memory
High Capacity	Low Capacity ?	???

Visual long-term memory has a massive storage capacity for object details

Timothy F. Brady*, Talia Konkle, George A. Alvarez, and Aude Oliva*

Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139

Edited by Dale Purves, Duke University Medical Center, Durham, NC, and approved August 1, 2008 (received for review April 8, 2008)

One of the major lessons of memory research has been that human memory is fallible, imprecise, and subject to interference. Thus, although observers can remember thousands of images, it is widely assumed that these memories lack detail. Contrary to this assumption, here we show that long-term memory is capable of storing a massive number of objects with details from the image. Participants viewed pictures of 2,500 objects over the course of 5.5 h. Afterward, they were shown pairs of images and indicated which of the two they had seen. The previously viewed item could be paired with either an object from a novel category, an object of the same basic-level category, or the same object in a different state or pose. Performance in each of these conditions was remarkably high (92%, 88%, and 87%, respectively), suggesting that participants successfully maintained detailed representations of thousands of images. These results have implications for cognitive models, in which capacity limitations impose a primary computational constraint (e.g., models of object recognition), and pose a challenge to neural models of memory storage and retrieval, which must be able to account for such a large and detailed storage capacity.

studied images, making it impossible to conclude whether the memories for each item in these previous experiments consisted of only the "gist" or category of the image, or whether they contained specific details about the images. Therefore, it remains unclear exactly how much visual information can be stored in human long-term memory.

There are reasons for thinking that the memories for each item in these large-scale experiments might have consisted of only the gist or category of the image. For example, a well known body of research has shown that human observers often fail to notice significant changes in visual scenes; for instance, if their conversation partner is switched to another person, or if large background objects suddenly disappear (7, 8). These "change blindness" studies suggest that the amount of information we remember about each item may be quite low (8). In addition, it has been elegantly demonstrated that the details of visual memories can easily be interfered with by experimenter suggestion, a matter of serious concern for eyewitness testimony, as well as another indication that visual memories might be very sparse (9). Taken together, these results have led many to infer that the

---

2,500 unique objects
3 seconds per object

Which have you seen?

Success Rate: **93%**!

Which have you seen?

Success Rate: **88%**!

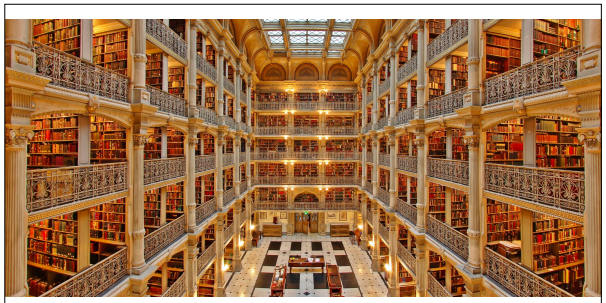
Which have you seen?

Success Rate: **87%**!

vs

vs

Sensory Memory	Short-Term Memory	Long-Term Memory
High Capacity	Low Capacity ?	**Massive** Capacity!



How to sort through it all?

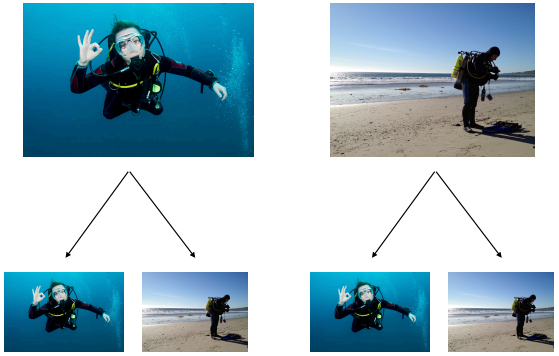
Context

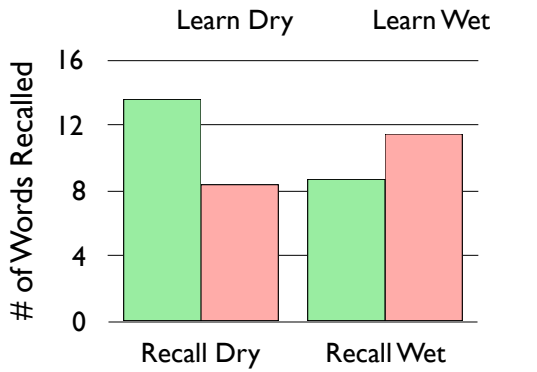
Br. J. Psychol. (1975), **66**, 3, *pp.* 325–331
Printed in Great Britain

CONTEXT-DEPENDENT MEMORY IN TWO NATURAL ENVIRONMENTS: ON LAND AND UNDERWATER

BY D. R. GODDEN AND A. D. BADDELEY
Department of Psychology, University of Stirling

In a free recall experiment, divers learnt lists of words in two natural environments: on dry land and underwater, and recalled the words in either the environment of original learning, or in the alternative environment. Lists learnt underwater were best recalled underwater, and vice versa. A subsequent experiment shows that the disruption of moving from one environment to the other was unlikely to be responsible for context-dependent memory.





(Godden & Baddeley, 1975)

Hacking your memory to get an A+

Ensure that
learning context = recall context