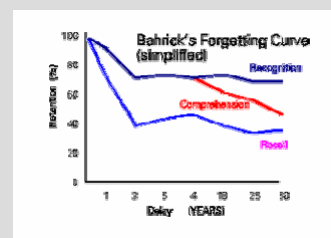
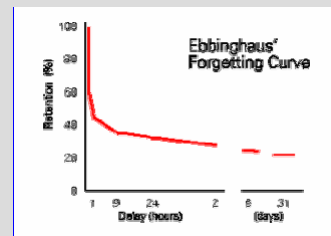


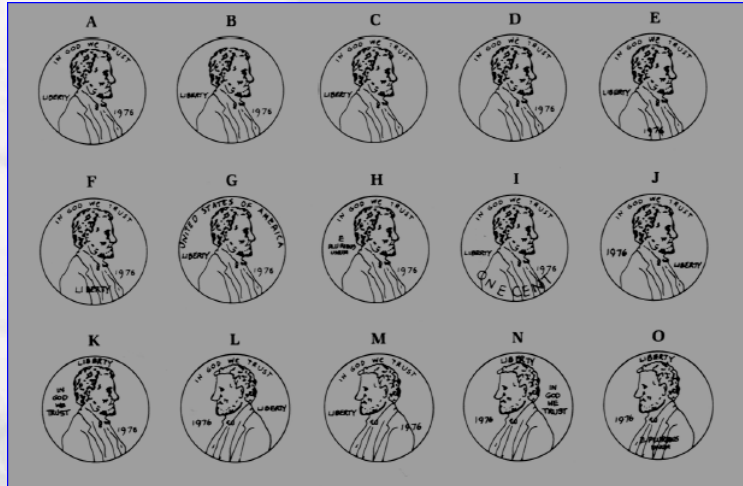
The Fragility of Memory

Forgetting

- “Forgetting, though often frustrating, is an adaptive feature of our memories. We don’t need to remember everything that has ever happened to us; engrams that we never use are probably best forgotten.” (Schacter, p. 81)
- Some things, like memory for words in a foreign language, we retain for a very long time



Will the Real Penny Please Come Forward?



Recall Failure: Encoding Failure, Retrieval Failure, or Loss of Engram?

Which of the following appear on a US penny?

The word JUSTICE	NO
The words UNITED STATES OF AMERICA	YES
The words LEGAL TENDER	NO
The word VERITAS	NO
The words ONE CENT	YES
The date (year of mint)	YES
The presidential seal	NO
The word COIN	NO
The words WASHINGTON, D.C.	NO
The left side of Lincoln's face	NO
The right side of Lincoln's face	YES
The White House	NO
An eagle with spread wings	NO
The Lincoln memorial	YES
The words IN GOD WE TRUST	YES
The word LIBERTY	YES
Sheaves of wheat	NO
The Roman numeral I	NO
The words E PLURIBUS UNUM	YES
The words MINTED IN USA	NO

Memory Test

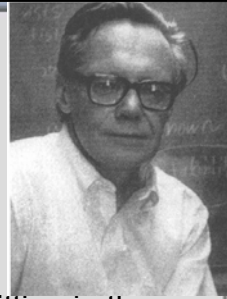
- Recall as much as you can about how you heard the news of the attack on the World Trade Center
- Recall as much as you can about what you did on the morning of September 10, 2001

Flashbulb Memories



- Term coined by Roger Brown and James Kulik
 - Memory of the circumstances where one learned of a major event (personal or public)
- These memories are usually especially vivid—“live” quality
- Robert B. Livingston’s idea of “Now Print” mechanism—causing a particularly vibrant trace to be left

Accuracy of Flashbulb Memories

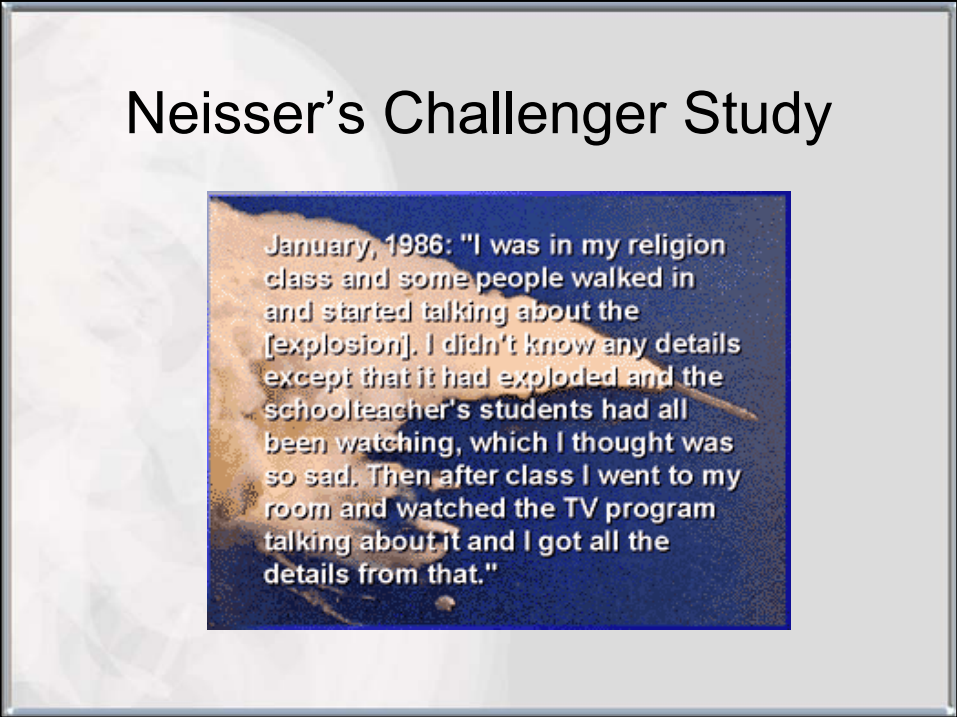


- “For many years I have remembered how I heard the news of the Japanese attack on Pearl Harbor, which occurred on the day before my thirteenth birthday. I recall sitting in the living room of our house—we only lived in that house for one year, but I remember it will—listening to a baseball game on the radio. The game was interrupted by an announcement of the attack, and I rushed upstairs to tell my mother.
- This memory has been so clear for so long that I never confronted its inherent absurdity until last year: no one broadcasts baseball games in December!” (Neisser, 1982, p. 45)

Studying the Accuracy of Flashbulb Memories

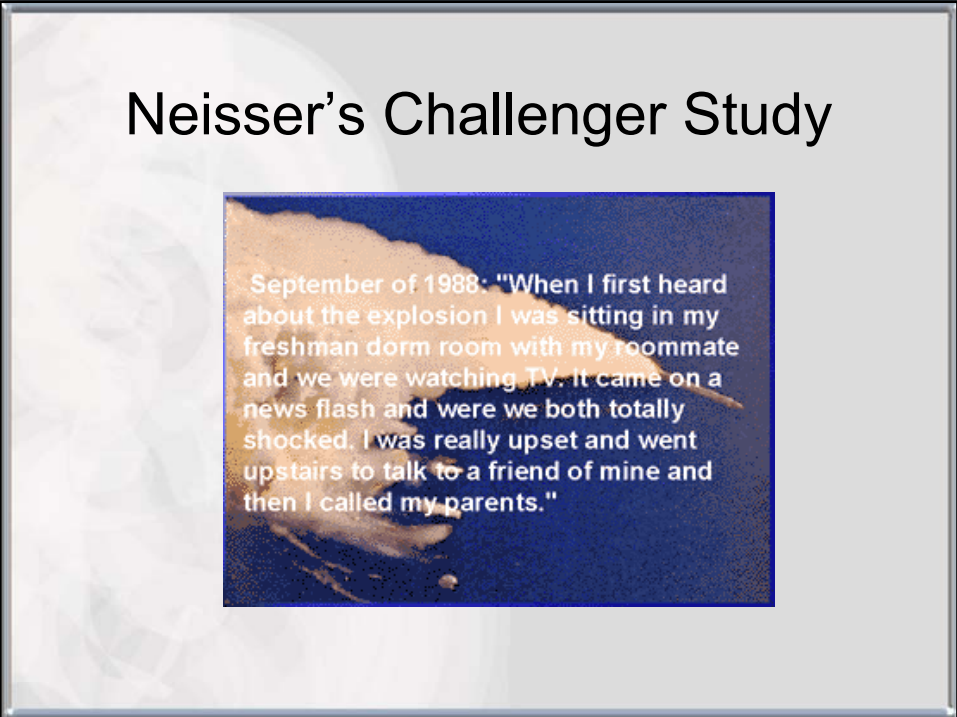
- Method: After a particularly major public event (Challenger crash, California earthquake), ask people to write down how they heard about the event. Then return as ask them again sometime (6 months, 2 years) later.
 - Frequently many discrepancies between subject’s first report and subsequent report
 - Nonetheless, the memories remain very vivid
- Those who experienced the events first hand (e.g., were in the region of the earthquake and had to take action) generally had much more accurate later recalls.

Neisser's Challenger Study



January, 1986: "I was in my religion class and some people walked in and started talking about the [explosion]. I didn't know any details except that it had exploded and the schoolteacher's students had all been watching, which I thought was so sad. Then after class I went to my room and watched the TV program talking about it and I got all the details from that."

Neisser's Challenger Study



September of 1988: "When I first heard about the explosion I was sitting in my freshman dorm room with my roommate and we were watching TV. It came on a news flash and we were both totally shocked. I was really upset and went upstairs to talk to a friend of mine and then I called my parents."

A man whose recall mesmerized a nation



John Dean's Testimony

On September 15 the Justice Department announced the handing down of the seven indictments by the Federal Grand Jury investigating the Watergate. Late that afternoon I received a call requesting me to come to the President's Oval Office. When I arrived at the Oval Office I found Haldeman and the President. **The President asked me to sit down.** Both men appeared to be in very good spirits and my reception was very warm and cordial. **The President then told me that Bob-referring to Haldeman-had kept him posted on my handling of the Watergate case. The President told me I had done a good job** and he appreciated how difficult a task it had been and **the President was pleased that the case had stopped with Liddy.** I responded that **I could not take credit because others had done much more difficult things than I had done.** As the President discussed the present status of the situation I told him that all I had been able to do was to contain the case and assist in keeping it out of the White House. **I also told him there was a long way to go before this matter would end** and that **I certainly could make no assurances that the day would not come when this matter would start to unravel** (Hearings, p. 957).

Accuracy Check

- Dean's testimony was riveting. He seemed to have a photographic memory
- Then a new source of information was discovered



Watergate Tape Transcripts

P: Hi, how are you? You had quite a day today, didn't you? You got Watergate on the way, didn't you?

D: We tried.

H: How did it all end up?

D: Ah, I think we can say well, at this point. The press is playing it just as we expected.

H: Whitewash?

D: No, not yet-the story right now-

P: It is a big story.

H: Five indicted plus the WH former guy and all that.

D: Plus two White House fellows.

H: That is good; that takes the edge off whitewash, really. That was the thing Mitchell kept saying, that to people in the country Liddy and Hunt were big men. Maybe that is good.

P: How did MacGregor handle himself-

D: I think very well. He had a good statement, which said that the Grand Jury had met and that it was now time to realize that some apologies may be due.

H: Fat chance.

D: Get the damn (inaudible)

H: We can't do that—

P: Just remember, all the trouble we're taking, well have a chance to get back one day.

How are you doing on your other investigation? (Presidential Transcripts, p. 32)

Assessing Dean's Memory

“If history has ever proven anything, it surely proves that Dean remembered those conversations and told the truth about them. I will not quarrel with that assessment here, but we shall see that ‘truth,’ ‘accuracy,’ and ‘memory’ are not simple notions. Dean’s testimony was by no means always accurate. Yet even when he was wrong, there was a sense in which he was always telling the truth . . .” (Neisser, 1981)



Elizabeth Loftus on Eye-Witness Testimony



Shown subjects a video in which there was a car accident at a stop sign

- Half the subjects later asked a question about a yield sign (“how fast was the blue car going when it went past the yield sign?”)
- Those who heard the misleading question were more likely to later remember the video as having a yield sign (85% versus 38%).

In other studies, people “recalled” a conspicuous barn in a bucolic scene that contained no buildings at all, broken glass and tape recorders that were not in the scenes they viewed, a white instead of a blue vehicle in a crime scene, and Minnie Mouse when they actually saw Mickey Mouse.

Constructing False Memories of One's Childhood

Loftus and Pickrell asked 24 subjects, 18 to 53, to try to remember childhood events provided by a parent, an older sibling or another close relative.

Three paragraphs related events that had actually happened to the subject

A fourth paragraph related an event of being lost in a mall that had not occurred but was constructed using information about a plausible shopping trip provided by a relative. The relative also verified that the participant had not in fact been lost at about the age of five

The false event involved being lost for an extended period, crying, aid and comfort by an elderly woman and, finally, reunion with the family.

68% recall of the true memories, 29% of subjects remembered the false memory

Hyman Study

In recollection study subjects given one false event amongst several real ones

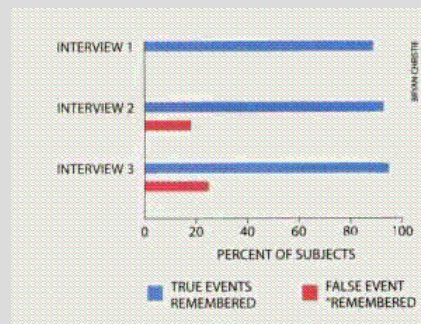
overnight hospitalization for a high fever and a possible ear infection

birthday party with pizza and a clown

No recall of false event on first interview

20% recalled something of the false event on second interview

One person remembered a male doctor, a female nurse and a friend from church who came to visit at the hospital.



Using Imagery to Create False Memories

Nicholas Spanos led students to believe that they had well-coordinated eye movements and visual exploration skills because the hospital in which they were born placed colored mobiles over their cribs

Half of the participants were hypnotized—
46% false recall

Half encouraged to construct images—
56% false recall

Others afterwards “recalled” other events from the hospital



Testimony of others leads to false memory

Saul M. Kassin arranged for some students to be falsely accused by a confederate of damaging a computer by pressing the wrong key

Many signed a confession

Internalized guilt

Confabulated other details

Piaget's False Memory

“One of my earliest memories goes back to when I was two years old. I can picture the scene quite clearly... I'm sitting in a stroller my nurse is pushing along the Champs Elyses when suddenly a man attempts to kidnap me. I'm stuck in the carriage and cannot move so I see the nurse bravely coming between me and my potential kidnapper. The man gets away and the nurse ends up with the scars I can still clearly see on her face... When I was about fifteen years old my parents got a letter from my old nurse... She wanted to apologize for mistakes she had made in the past and wanted to return the watch my father had given her as a reward for her bravery... The fact of the matter was that she had made the whole thing up... As a child I had projected the story my parents had heard and believed into my own past as a kind of visual memory.”

Inducing False Memories in Children

Stephen Ceci:

In querying children about everyday events, also asked them about events which never occurred

“Recollect the time you got a finger caught in a mousetrap and had to go to the hospital to get the trap off”

Asked the children to think hard and try to visualize the event once every ten weeks

After ten weeks half the children had memories of one of the made up events, with elaboration

“My brother Colin was trying to get Blowtorch from me, and I wouldn't let him take it from me, so he pushed me into the wood pile where the mouse trap was. And then my finger got caught in it. And then we went to the hospital, and my mommy, daddy, and Colin, drove me there, to the hospital in our van, because it was far away. And the doctor put a bandage on this finger.”

I was certain, but I was wrong

By Jennifer Thompson

In 1984 I was a 22-year-old college student with a grade point average of 4.0, and I really wanted to do something with my life. One night someone broke into my apartment, put a knife to my throat and raped me.

During my ordeal, some of my determination took an urgent new direction. I studied every single detail on the rapist's face. I looked at his hairline; I looked for scars, for tattoos, for anything that would help me identify him. When and if I survived the attack, I was going to make sure that he was put in prison and he was going to rot.

When I went to the police department later that day, I worked on a composite sketch to the very best of my ability. I looked through hundreds of noses and eyes and eyebrows and hairlines and nostrils and lips. Several days later, looking at a series of police photos, I identified my attacker. I knew this was the man. I was completely confident. I was sure.

I was certain, but I was wrong

I picked the same man in a lineup. Again, I was sure. I knew it. I had picked the right guy, and he was going to go to jail. If there was the possibility of a death sentence, I wanted him to die. I wanted to flip the switch.

When the case went to trial in 1986, I stood up on the stand, put my hand on the Bible and swore to tell the truth. Based on my testimony, Ronald Junior Cotton was sentenced to prison for life. It was the happiest day of my life because I could begin to put it all behind me.

In 1987, the case was retried because an appellate court had overturned Ronald Cotton's conviction. During a pretrial hearing, I learned that another man had supposedly claimed to be my attacker and was bragging about it in the same prison wing where Ronald Cotton was being held. This man, Bobby Poole, was brought into court, and I was asked, "Ms. Thompson, have you ever seen this man?"

I was certain, but I was wrong

I answered: "I have never seen him in my life. I have no idea who he is."

Ronald Cotton was sentenced again to two life sentences. Ronald Cotton was never going to see light; he was never going to get out; he was never going to hurt another woman; he was never going to rape another woman.

In 1995, 11 years after I had first identified Ronald Cotton, I was asked to provide a blood sample so that DNA tests could be run on evidence from the rape. I agreed because I knew that Ronald Cotton had raped me and DNA was only going to confirm that. The test would allow me to move on once and for all.

I will never forget the day I learned about the DNA results. I was standing in my kitchen when the detective and the district attorney visited. They were good and decent people who were trying to do their jobs -- as I had done mine, as anyone would try to do the right thing. They told me: "Ronald Cotton didn't rape you. It was Bobby Poole."

I was certain, but I was wrong

The man I was so sure I had never seen in my life was the man who was inches from my throat, who raped me, who hurt me, who took my spirit away, who robbed me of my soul. And the man I had identified so emphatically on so many occasions was absolutely innocent.

Ronald Cotton was released from prison after serving 11 years. Bobby Poole pleaded guilty to raping me.

Ronald Cotton and I are the same age, so I knew what he had missed during those 11 years. My life had gone on. I had gotten married. I had graduated from college. I worked. I was a parent. Ronald Cotton hadn't gotten to do any of that.

Mr. Cotton and I have now crossed the boundaries of both the terrible way we came together and our racial difference (he is black and I am white) and have become friends. Although he is now moving on with his own life, I live with constant anguish that my profound mistake cost him so dearly. I cannot begin to imagine what would have happened had my mistaken identification occurred in a capital case. . . .

Jennifer Thompson and Ron Cotton



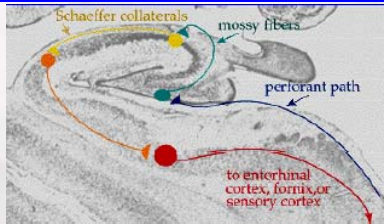
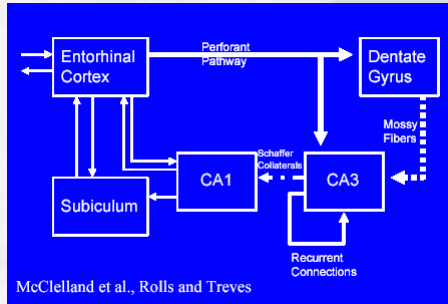
The man on the left, **Ron Cotton**, who spent 11 years in prison for the rape of Jennifer Thompson. The man on the right is the rapist Bobby Poole



Memory Consolidation and Reconsolidation

- The discovery of graded retrograde amnesia with HM was particularly intriguing
 - Why should he lose memories for approximately three years before the surgery?
 - Why should some of these memories be affected and not others?
- Memories are not permanently stored in the hippocampus but elsewhere (cortex)
 - It takes time to establish (**consolidate**) memories in cortex
- It also takes time (hours, not years) to establish memories in hippocampus
 - Chemical disruptions during this period eliminate memory
 - And, after recall, disruptions can eliminate memory
 - Memory **reconsolidation**

Hippocampal Architecture



- Convergence of sensory information from rest of cortex
- Overall loop (EC both input and output center):
Autoassociator?
- Recurrent connections esp. in CA3: Autoassociator?
- Sparse activations (especially in DG):
Pattern Separation?

Patients with Hippocampal Deficits Only

- RB: damage limited to CA1 fields bilaterally: moderate anterograde but minimal retrograde amnesia
- GD: damage restricted primarily to the CA1 fields: moderate anterograde but minimal retrograde amnesia
- LM: damage to all CA fields and dentate gyrus and some cells in entorhinal cortex: moderate anterograde AND graded retrograde amnesia

Alternative Hypothesis about Hippocampal Function: Place Memory

- Two systems for spatial navigation
 - Taxon System: egocentric and governed by local landmarks
 - Locale System: allocentric map (Tolman)
- Locale System lost with hippocampal lesions
 - Discovery of Place Cells in CA3 fields of the Hippocampus

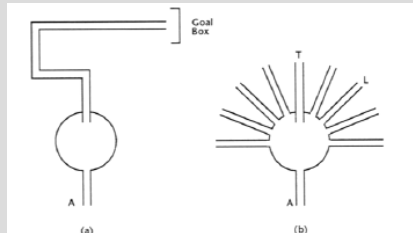


Figure 6.2. A Simplified Version of a Sunburst Maze Used by Tolman, Ritchie, and Kalish (1946). The rats were trained initially on the simple maze depicted in (a), taught to run through the central chamber from A, through the corridor, and to the goal box at the end. Subsequently, rats were released in a sunburst maze such as that illustrated in (b). Tolman, Ritchie, and Kalish reasoned that the path chosen in the second phase would reveal whether the rats had learned a specific route to follow or had learned the location of the goal. Rats uniformly took the direct route in the later trial.

Hippocampus and Amygdala

- Adjacent structures with different effects on memory
 - Damasio: conditioning fear response—linking an aversive stimulus (noise) with a non-aversive stimulus
 - Patient with amygdala damage failed to develop fear conditioning but remembered the episode
 - Patient with hippocampal damage—developed fear response but could not remember the episode
 - Double dissociation
- Patients with amygdala damage do not show memory enhancement for emotionally charged pictures
- Connectivity of amygdala to different levels of sensory processing equips it to perform emotional evaluation