

Discovering Psychology: Updated Edition

09 Remembering and Forgetting

- 1 01:00:15:19 >> ZIMBARDO: How can an artist accurately paint his home town from childhood memories, while another person forgets everything, even her name?
- 2 01:00:26:09 >> Things are so mixed up.
- 3 01:00:30:01 >> ZIMBARDO: Why are some things so difficult to remember, while others seem impossible to forget?
- 4 01:00:39:20 "Remembering and Forgetting," this time on *Discovering Psychology* .
- 5 01:01:16:13 >> The reason psychologists think that there's more than one type of memory is due to something called the serial position effect.
- 6 01:01:22:17 Now, you may have noticed the serial position effect for yourself when you try to memorize...
- 7 01:01:26:25 >> ZIMBARDO: If I'm going to profit from what I learn here today, I'm going to have to remember it.
- 8 01:01:31:03 The information, the sights, the sounds, and in some instances, even the smells and textures, somehow they have to be translated into codes that my brain can store, and that I can retrieve when I need to.
- 9 01:01:44:12 Images, ideas, language, and even my physical actions have to be represented in my memory and then retrieved to aid me when I need them.
- 10 01:01:53:03 Memory is so essential, in fact, that to many psychologists and neuroscientists, it's the royal pathway for studying the functions of the mind and the structures of the brain.
- 11 01:02:05:29 Experts estimate that the average human brain can store one hundred trillion bits of information, yet we are capable of forgetting even the simplest of things.
- 12 01:02:20:19 Research on forgetting makes us aware that memory is a complex psychological process, a dynamic one, that's influenced by many factors.

- 13 01:02:31:14 >> College, water.
- 14 01:02:40:19 That's all I can remember.
- 15 01:02:42:26 >> Mother.
- 16 01:02:44:04 >> Do you think of her as married to your father, mother?
- 17 01:02:46:10 >> Mother.
- 18 01:02:47:12 >> Do you think of her as married to Claudius, mother?
- 19 01:02:49:02 >> Mother.
- 20 01:02:50:07 >> What was she like...
- 21 01:02:51:11 >> ZIMBARDO: Your memory can be affected by how much you concentrate and how much you rehearse.
- 22 01:02:56:06 And it can also be affected by the context in which you learn something...
- 23 01:03:01:16 >> What do we call what was left over, Todd?
- 24 01:03:04:17 >> ZIMBARDO: ...and the context in which you recall it.
- 25 01:03:08:06 >> Carrie?
- 26 01:03:09:17 >> Five.
- 27 01:03:10:20 >> Good.
- 28 01:03:12:01 Six times five.
- 29 01:03:13:06 Very good, honey.
- 30 01:03:14:20 >> ZIMBARDO: And it can be affected by your motivation as well.
- 31 01:03:19:05 You can be motivated to remember or forget psychologically significant events, which become blended in your memory with your wishes, fears, and fantasies.
- 32 01:03:30:13 And finally, the state of your memory can be traced to your physical state and biological condition...
- 33 01:03:41:01 (*phone rings*) ...and also to interference from other events and experiences.

- 34 01:03:47:14 >> I understand.
- 35 01:03:48:10 Let me get back to you.
- 36 01:03:49:09 I'm trying to get something done for later on this morning, okay?
- 37 01:03:51:09 I'll get back to you.
- 38 01:03:52:06 Okay.
- 39 01:03:53:08 Bye-bye.
- 40 01:03:57:06 >> ZIMBARDO: Modern research into memory began a little over 100 years ago with a German psychologist named Hermann Ebbinghaus, who studied the memorization of syllables in a seemingly meaningless series.
- 41 01:04:11:08 By using them, Ebbinghaus hoped to obtain a pure, quantitative measure of memory, uncontaminated by previous learning.
- 42 01:04:21:17 First, he learned a list of the syllables.
- 43 01:04:25:00 Next, he tried to retain the list in his memory while distracting himself by learning other lists.
- 44 01:04:31:21 Then he would test his memory by seeing how many times he had to reread the list before relearning it perfectly.
- 45 01:04:39:26 As his original graph shows, the fewer times he had to go back to the list, the more information he had retained from his original effort.
- 46 01:04:49:22 It turned out that Ebbinghaus's memories showed an initial rapid loss followed by a gradually slower decline over the next month.
- 47 01:05:01:01 Why did Ebbinghaus's memories fade so quickly, even with all of his training and practice?
- 48 01:05:07:12 For starters, he had handicapped himself by attempting to get rid of the so-called complicating influence of meaning.
- 49 01:05:15:05 He had no links, no hooks to use to tie the new input, the syllables, to already stored information.
- 50 01:05:22:18 He had no context which could help him organize the unfamiliar in terms of the familiar.

- 51 01:05:28:06 In getting rid of meaningful memories, Ebbinghaus unwittingly stripped himself of one of the most powerful strategies of the human mind: discovering meaning, order, and organization in the information it encounters.
- 52 01:05:44:13 Decades of research followed in which many basic principles of memory were discovered using subjects who tried to recall nonsense syllables presented at precisely-controlled intervals.
- 53 01:05:59:28 Other researchers analyze the memories of animals in learning mazes or making discriminations among possible choices.
- 54 01:06:10:21 But this line of research was changed dramatically in the '60s with the advent of the computer.
- 55 01:06:16:29 For the first time, psychologists could create a working model of the mechanisms of memory.
- 56 01:06:23:03 This new approach depicted the mind as an information processor, like the computer.
- 57 01:06:28:16 The information can be any knowledge received, processed, and understood by an individual.
- 58 01:06:35:27 The complexity of memory could now be dissected into its component processes.
- 59 01:06:43:02 First, input must be encoded, put into memory codes that can be registered by the brain.
- 60 01:06:49:24 Then it must be stored and retained for some period of time, ranging from a moment to a lifetime.
- 61 01:06:57:18 And finally, it must be retrieved on demand when it's needed.
- 62 01:07:02:16 There are also two kinds of memory.
- 63 01:07:05:26 Long-term memory is the storehouse of everything you know about the world and yourself, and is essentially unlimited.
- 64 01:07:13:00 In theory, anything you have experienced which is stored in long-term memory is available for later recall.
- 65 01:07:22:25 To understand the process of retrieval, try picturing your long-term memory as your own private library.

- 66 01:07:29:27 But instead of information stored in books, some researchers believe it is stored and represented in the form of networks.
- 67 01:07:38:04 In these associative networks, each piece of information or concept is linked to a family of others that share some common properties.
- 68 01:07:47:10 Activating any of the concepts in the network activates the others associated with them.
- 69 01:07:53:24 This activation process spreads automatically and rapidly not only within networks, but also across to others that are linked in any way meaningful to the individual.
- 70 01:08:05:27 In order for me to become consciously aware of the outcome of this activation process, in order for me to identify and understand what's going on around me, something more than long-term memory is needed.
- 71 01:08:18:09 That's because long-term memory is like a passive storehouse of information, and not an active information dispatcher.
- 72 01:08:26:06 So we need a second memory system -- we need a short-term memory.
- 73 01:08:33:16 Short-term memory is the transient working memory that holds all the knowledge currently in use.
- 74 01:08:42:01 All new information -- those things we're paying attention to right now -- must first pass through this narrow channel.
- 75 01:08:51:09 And the information we retrieve from our long-term memory must also pass through here for inspection.
- 76 01:08:57:02 But short-term memory has two major limitations.
- 77 01:09:00:11 First, only a small amount of information can be held there.
- 78 01:09:04:18 And second, the information can only be held for a short amount of time.
- 79 01:09:10:07 It fades as soon as we shift our attention elsewhere.
- 80 01:09:14:27 The new always pushes out the old.
- 81 01:09:18:12 Still, our short-term working memory is an essential part of our psychological present.

- 82 01:09:24:28 It links separate stimuli into episodes, and then into stories as we engage in conversations, work, read, play, and just take in the world.
- 83 01:09:36:11 Short-term memory does all this, yet it still cannot hold anything for more than about half a minute, and it can only store from five to nine items, with an average of seven.
- 84 01:09:47:26 So how can we get around these limitations of short-term memory?
- 85 01:09:52:20 First, our memories can be held for a longer time if we rehearse the new information carefully without distractions.
- 86 01:09:59:12 And second, more information can be held if we group items according to some pattern or something we're already familiar with.
- 87 01:10:07:10 This is a process called chunking.
- 88 01:10:10:02 A chunk can be a word, a meaningful phrase, or a number sequence.
- 89 01:10:14:05 And seven chunks can have a lot more information in them than seven items.
- 90 01:10:19:12 For instance, after I say the following sequence aloud, I want you to repeat it back to me number for number.
- 91 01:10:26:04 Here goes: 1-7-7-6-1-8-1-2-1-8- 6-1-1-9-1-4-1-9-4-1.
- 92 01:10:44:29 It's tough, isn't it?
- 93 01:10:46:24 Now I wonder how well you'd do if I read the sequence this way: 1776, 1812, 1861, 1914, 1941.
- 94 01:10:59:17 Instead of 20 numbers to remember, you have only five dates.
- 95 01:11:03:24 Instead of 20 bits, five chunks of familiar information from American history.
- 96 01:11:10:23 >> We learn new material by relating it, associating it, to old material.
- 97 01:11:16:10 >> ZIMBARDO: Gordon Bower, a Stanford psychologist, specializes in techniques which enhance memory, known as mnemonic training techniques.

- 98 01:11:26:04 >> Every memory problem can be broken down into several stages.
- 99 01:11:30:06 One has to do with storing the material originally -- that is, originally learning it when you're studying it.
- 100 01:11:38:09 And the other stage has to do with being able to retrieve it at the time you're being tested and asked for recall.
- 101 01:11:44:13 There are several techniques for improving one's memory, and one of these that's very effective is called the peg word, mnemonic.
- 102 01:11:52:15 And here the idea is to first learn a set of cues, or set of reminders, pegs they're called, which you will then use to associate with things that you are to remember.
- 103 01:12:06:14 So remember this: One is a bun.
- 104 01:12:08:28 >> ZIMBARDO: One is a bun.
- 105 01:12:10:11 >> Two is a shoe.
- 106 01:12:11:17 >> ZIMBARDO: Two is a shoe.
- 107 01:12:12:23 >> Three is a tree.
- 108 01:12:13:29 >> ZIMBARDO: Three is a tree.
- 109 01:12:15:00 >> Four is a door.
- 110 01:12:16:05 >> ZIMBARDO: Four is a door.
- 111 01:12:17:13 >> Five is a beehive.
- 112 01:12:19:00 >> ZIMBARDO: Five is a beehive.
- 113 01:12:20:12 >> All right.
- 114 01:12:21:27 These are the items of unrelated words I'd like you to remember.
- 115 01:12:24:26 Associate each item on the list with successive pegs.
- 116 01:12:28:03 First, or number one, is lamp.
- 117 01:12:30:09 >> ZIMBARDO: Lamp.
- 118 01:12:32:08 >> So associate that with bun.

- 119 01:12:33:26 >> ZIMBARDO: Bun.
- 120 01:12:35:16 Lamp is heating, the lamp is heating the bun.
- 121 01:12:39:04 >> Right.
- 122 01:12:40:19 Two is gloves.
- 123 01:12:43:02 >> ZIMBARDO: Two is shoe.
- 124 01:12:44:23 The gloves are covering the shoe.
- 125 01:12:47:12 >> Right.
- 126 01:12:48:24 Number three is fire.
- 127 01:12:49:29 >> ZIMBARDO: Okay.
- 128 01:12:51:05 Three is tree.
- 129 01:12:52:12 The tree is on fire.
- 130 01:12:53:12 >> Right.
- 131 01:12:54:18 Four is spoon.
- 132 01:12:55:22 >> ZIMBARDO: Four is door.
- 133 01:12:57:07 The spoon is opening the door.
- 134 01:12:59:04 >> Five is ashtray.
- 135 01:13:00:25 >> ZIMBARDO: Five is beehive.
- 136 01:13:03:04 The ashtray's in front of the beehive.
- 137 01:13:06:08 >> Okay, very good.
- 138 01:13:07:27 What was the third item in the list?
- 139 01:13:11:15 >> ZIMBARDO: Fire.
- 140 01:13:12:23 The tree is on fire.
- 141 01:13:14:12 >> I'd like you to go backwards through the list of items for me.
- 142 01:13:18:10 >> ZIMBARDO: Okay.
- 143 01:13:19:20 Five, beehive, ashtray.

- 144 01:13:21:03 >> Right.
- 145 01:13:22:18 >> ZIMBARDO: Four, door, spoon.
- 146 01:13:23:22 >> Right.
- 147 01:13:25:13 >> ZIMBARDO: Three, tree, fire.
- 148 01:13:27:01 >> Right.
- 149 01:13:28:12 >> ZIMBARDO: Two, shoe, glove.
- 150 01:13:29:26 One, lamp... one, bun, lamp.
- 151 01:13:32:10 >> Right.
- 152 01:13:33:17 You got them all right.
- 153 01:13:34:25 >> ZIMBARDO: Whew!
- 154 01:13:36:09 >> Good.
- 155 01:13:37:21 Now, you can see how there's a dovetailing between the storage procedure, the learning procedure, and the retrieval plan.
- 156 01:13:45:11 And most mnemonics have that kind of nice dovetailing.
- 157 01:13:48:23 >> ZIMBARDO: Sigmund Freud was the first to recognize that what we remember, and what we choose to forget, can help maintain our sense of integrity and self- esteem.
- 158 01:14:00:21 Freud labeled the process repression, in which the ego is defended against unacceptable thoughts and information by pushing them out of awareness -- by repressing them and storing them in the realm of the unconscious.
- 159 01:14:15:21 But some of them, says Freud, will struggle free and show up in disguised form: in dreams, slips of the tongue, and symptoms of mental distress.
- 160 01:14:25:13 Some memories are made more meaningful to us by what's called the constructive process of remembering.
- 161 01:14:32:24 To make new information fit better with what we already know and believe, we accentuate some details, eliminate some, and reinterpret others.
- 162 01:14:43:27 In this way, we construct consistent themes and coherent

stories even from information that is inconsistent and ambiguous.

- 163 01:14:54:09 These two processes form a central principle of memory: how and what you remember is determined by who you are and what you already know.
- 164 01:15:06:28 There's an awful lot of people and information to take in here on any given day.
- 165 01:15:11:09 But how much of it will I remember?
- 166 01:15:13:26 As we've seen, the answer is going to depend not only on how much I concentrate, and how many distractions there are, but also on who I am and what I already know.
- 167 01:15:23:00 But how will all these factors translate into the actual functioning of my memory?
- 168 01:15:27:26 Well, the answer has to do with something called schemas.
- 169 01:15:31:06 Schemas are frameworks of our basic ideas and preconceptions about people, objects, and situations.
- 170 01:15:38:06 All the new information we learn is organized by relating it to existing schemas, and many of our constructions of memory and distortions arise as we try to fit new information into old schemas.
- 171 01:15:52:24 How much would you be able to recall about what is in this office?
- 172 01:15:57:19 In an experiment to demonstrate the power of schemas, subjects spent a few minutes in this room.
- 173 01:16:04:01 Later they were questioned about its contents.
- 174 01:16:07:13 The subjects' recall was strongly influenced by their schema of what a typical office contains.
- 175 01:16:14:08 They correctly recalled items that matched those of the office schema, did less well recalling items that weren't part of the schema, and falsely remembered items that are usually in "" offices but aren't in this one.
- 176 01:16:30:15 Schemas also influence our perception and understanding of the world.

- 177 01:16:36:28 The San Francisco artist Franco Magnani painted this scene of the Italian town where he was born entirely from memory.
- 178 01:16:44:14 He hasn't seen the town since he left it some 30 years ago.
- 179 01:16:49:23 Now compare some of his other paintings with these recent photos of the town as it really is -- a town that has hardly changed.
- 180 01:16:59:17 Although many details are accurately recalled, some are distorted by a child's perspective -- by Magnani's boyhood schema.
- 181 01:17:09:00 At work here are the dual memory processes of remarkable accuracy and significant distortions.
- 182 01:17:19:10 Ongoing research about memory is leading psychologists to many discoveries about its nature.
- 183 01:17:25:14 But beyond theories about how memory works or doesn't work is the physical reality of the process.
- 184 01:17:32:12 When something is remembered, there's a corresponding physical change in the brain itself.
- 185 01:17:38:06 Memories make lasting alterations in the structure and functioning of the central nervous system.
- 186 01:17:46:03 Every bit of information you acquire in your lifetime is encoded in the neurons of the brain.
- 187 01:17:53:21 These memory traces, or engrams, make up the biological substrate of human memory.
- 188 01:18:00:03 One set of engrams forms the foundation of everything you know how to do -- the procedural knowledge behind every skilled action.
- 189 01:18:11:03 Another set embodies what you know -- your so-called semantic or declarative knowledge -- from the world of concepts, ideas, and things.
- 190 01:18:22:19 And yet another batch of engrams works in the service of your episodic memory -- your diary of personal experiences, each tagged with a time and a place, when and where it happened.
- 191 01:18:35:29 Functioning together, these engrams establish your

- individual, personal perspective on life.
- 192 01:18:43:02 But where exactly are these engrams?
- 193 01:18:45:24 What is the anatomy of memory?
- 194 01:18:50:01 The search for the engram began some 40 years ago with psychologist Karl Lashley.
- 195 01:18:56:07 Using rats as subjects, Lashley trained them to learn mazes, then removed portions of the cerebral cortex and retested their memories.
- 196 01:19:09:08 He found that memory suffered as more brain tissue was removed, but it didn't seem to matter what part of the cortex he took the tissue from.
- 197 01:19:16:27 Lashley concluded that memory was not localized in any specific area of the brain.
- 198 01:19:22:10 He may have been right for complex memories, but he was wrong about simple memories.
- 199 01:19:28:16 Others continued in the search for the elusive memory engram.
- 200 01:19:32:12 Among them was Richard Thompson of the University of Southern California.
- 201 01:19:37:25 Using rabbits as subjects, Thompson has succeeded in finding one of the memory engrams by tracing the circuitry of the brain involved in conditioning and remembering.
- 202 01:19:47:04 Thompson uses eyeblink classical conditioning.
- 203 01:19:51:03 A tone is synchronized with a slight puff of air to a rabbit's eye, which elicits a reflexive blink.
- 204 01:19:59:02 >> With a number of pairings of these two stimuli together, the animal develops a conditioned response, a learned response, a memory, if you will, so that it blinks to the tone before the air puff occurs.
- 205 01:20:11:22 After the animal has been trained, we will then make a very small lesion in the region that we think contains the memory trace.
- 206 01:20:20:02 And that very small lesion will abolish permanently the

memory for this conditioned response.

- 207 01:20:26:16 The memory traces for these learned responses that we study appear to be stored in very localized regions right here in this little structure within the cerebellum called the interpositus nucleus.
- 208 01:20:42:16 This is a recording of the eyelid response itself.
- 209 01:20:45:13 So time is going this way, tone comes on, and there's no response at all to the tone.
- 210 01:20:50:05 Air puff to the eye, a reflex eyeblink, eye closure.
- 211 01:20:53:11 Strictly a reflex before learning has occurred.
- 212 01:20:56:25 The tone comes on at this point in time, and you'll notice that there's a very well-developed eyelid closure response that peaks about the time of onset of the air puff.
- 213 01:21:06:15 There is then a reflex response to the air puff itself.
- 214 01:21:09:13 This is the conditioned response.
- 215 01:21:13:04 After the surgery, we can see that the memory for the learned response is completely obliterated.
- 216 01:21:20:16 All that's left is the reflex response -- the same response the animal gave at the beginning of training, before it had learned the conditioned response.
- 217 01:21:27:15 (*tone sounding*) So we feel that as we come to understand how the brain stores memories, we will be able to develop new techniques and new tools to deal with memory disorders.
- 218 01:21:39:22 So that's a very practical, and I think now, realizable, goal.
- 219 01:21:43:26 >> ZIMBARDO: Thompson's work was the basis for the research of Diana Woodruff-Pak at Temple University.
- 220 01:21:51:16 Woodruff-Pak has pioneered the use of eyeblink classical conditioning methods on humans as a means of detecting early onset dementia such as Alzheimers in older adults.
- 221 01:22:02:26 >> The idea that eye blink classical conditioning might detect Alzheimer's disease was derived from the animal model, the rabbit model.

- 222 01:22:14:05 Scopolamine is a drug that impairs acetylcholine transmission.
- 223 01:22:20:28 Acetylcholine is really the memory neurotransmitter.
- 224 01:22:25:08 Alzheimer's Disease devastates the acetylcholine neurotransmitter system.
- 225 01:22:31:16 The reason that memory impairment is the number one system of Alzheimer's disease is probably this acetylcholine connection.
- 226 01:22:39:10 >> And you're going to feel some puffs of air in your eye that are going to make you blink.
- 227 01:22:43:16 I don't want you to try to blink.
- 228 01:22:46:01 >> So my hypothesis was that patients with Alzheimer's disease would have this disrupted hippocampus, this impairment of the acetylcholine, and would find it almost impossible to produce conditioned responses.
- 229 01:22:59:24 And that is the case.
- 230 01:23:02:08 We have what we think is a perfect case study for our hypothesis.
- 231 01:23:07:02 This individual started working with us as a good conditioner, and the first time we tested her, she had something like 50% condition responses, even though she was 89 years old.
- 232 01:23:20:11 We saw her again a couple of years later, and she had really dramatically slipped, and her eye-blink conditioning score was below 25% condition responses.
- 233 01:23:30:25 On the other hand, her scores on neuropsychological tests were normal, and continued to be normal for another five years.
- 234 01:23:39:24 So this was a case of an individual where eye-blink conditioning showed impairment five years before tests that would be of declarative memory showed impairment.
- 235 01:23:50:24 We were fortunate to have MRIs of this individual five years apart, and we showed about the time she had impaired eye-blink conditioning her medial temporal lobes were showing deterioration, and five years later the MRI showed major deterioration in medial temporal lobes.

- 236 01:24:13:18 It's critically important to detect Alzheimer's disease early, because even in the earliest stages when there are no clinical signs, neurons in the brain are dying.
- 237 01:24:27:10 So you want to catch the person as early as possible to preserve as much of their brain as you can.
- 238 01:24:35:09 If we could catch a person and keep their personality and their memory intact, this would be the ideal goal.
- 239 01:24:41:16 Of course even a greater goal, I guess, would be to prevent the disease entirely.
- 240 01:24:45:07 >> ZIMBARDO: Brain tissue atrophies.
- 241 01:24:47:25 As more of the cortex is lost, so are the memories, then the personality, and eventually life itself.
- 242 01:24:55:11 >> Don't you remember?
- 243 01:24:57:17 >> Things are so mixed up.
- 244 01:24:59:24 >> ZIMBARDO: Life without memory is life without a past, and a future.
- 245 01:25:05:07 Throughout this program we've looked at memory as the mind's most vital form of information processing.
- 246 01:25:11:09 But there are many other higher order mental processes that make us what we are.
- 247 01:25:15:17 Thinking, reasoning, planning, judging, deciding, problem solving.
- 248 01:25:21:07 And they're all in the domain of cognitive psychologists, who have transformed modern psychology.
- 249 01:25:27:28 The cognitive revolution, next time.
- 250 01:25:30:15 I'm Philip Zimbardo.
- 251 01:25:34:16 [Captioned by The Caption Center WGBH Educational Foundation]
- 252 01:26:09:24 >> *Funding for this program is provided by Annenberg/CPB to advance excellent teaching .*
- 253 01:26:20:29 >> *For information about this and other Annenberg/CPB programs, call 1-800-LEARNER and visit us at*

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