chapter four

Forgetting

Key knowledge and skills

This knowledge includes:

- strengths and limitations of psychological theories of forgetting:
  - retrieval failure theory including tip-of-the-tongue phenomenon
  - interference theory
  - motivated forgetting as informed by the work of Sigmund Freud including repression and suppression
  - decay theory
- manipulation and improvement of memory:
  - forgetting curve as informed by the work of Hermann Ebbinghaus
  - measures of retention including the relative sensitivity of recall, recognition and relearning
  - use of context-dependent cues and state-dependent cues
  - mnemonic devices including acronyms, acrostics, peg-word method, narrative chaining and method of loci
  - effect of misleading questions on eye-witness testimonies including the reconstructive nature of memory informed by the work of Elizabeth Loftus
- research methods and ethical principles associated with the study of memory, as outlined in the introduction to the unit.

These skills include the ability to:

- use research literature to demonstrate how psychological concepts and theories have developed over time
- process and interpret information, and make connections between psychological concepts and theories
- apply understandings to both familiar and new contexts
- evaluate the validity and reliability of psychology-related information and opinions presented in the public domain
- analyse issues relating to and implications of scientific and technological developments relevant to psychology.


FORGETTING
Theories of forgetting
Retrieval failure theory
Tip-of-the-tongue phenomenon
Interference theory
Proactive interference
Retroactive interference
Motivated forgetting
Repression
Suppression
Decay theory
The forgetting curve
Hermann Ebbinghaus
Measures of retention
Recall
Recognition
Relearning
Savings score
Enhancing memory retrieval
Cues
State-dependent cues
Context-dependent cues
Aiding memory retention
Mnemonic devices
Acronyms
Acrostics
Peg-word method
Narrative chaining
Method of loci
Eye-witness testimony
Elizabeth Loftus

The concept of forgetting

In chapter 3, we learnt that information stored for future use is held in long-term memory (LTM) on a relatively permanent basis. However, although information is stored in LTM, this does not mean you will not have difficulty accessing or retrieving it. When such difficulties occur, you are experiencing forgetting. In other words, when you forget something, the information is generally not lost forever – you just cannot find it when you want to. Psychologists use the term forgetting to describe an inability to retrieve information previously stored in LTM.

In his book *The Man Who Mistook His Wife for a Hat* (1985), neurologist Oliver Sacks (see Figure 4.1) offered insights into the world of individuals whose lives had been dramatically altered by extreme forms of physiological and psychological memory loss (see also 'A closer look: The experience of an extreme amnesiac', in chapter 3, page 111). Sacks described one patient, William T., as permanently 'on the boil': always excited, chattering and jabbering. William could no longer remember much of his past, so he constantly invented information to fit what he was saying. He was not consciously lying, but 'remade' himself every moment because of his memory loss. Although William had lost contact with reality and was convinced that his long-dead brother George was alive, he could still recognise his younger brother, Bob.

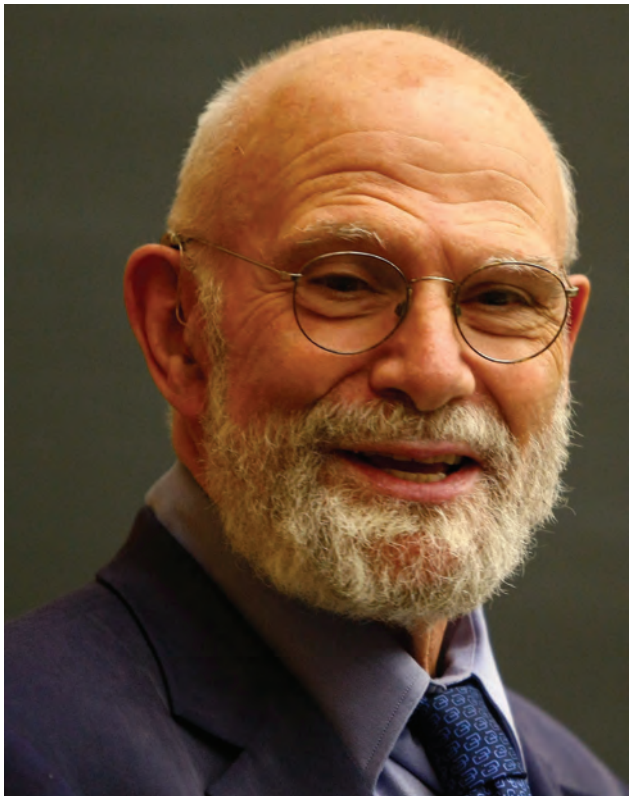


Figure 4.1 British neurologist and writer Oliver Sacks

Many of us may see forgetting as a negative experience, but what do you think would happen if you were unable to forget anything? (See Figure 4.2.) Sometimes being able to forget is advantageous. In his text *The Mind of a Mnemonist* (1968), neuropsychologist Alexander Luria described the case of Mr S., a man who could remember with incredible accuracy almost everything that had ever happened to him. Mr S. could also memorise, with equal ease, strings of digits, meaningless consonants, mathematical formulas and poems in foreign languages. As amazing as Mr S.'s memory might sound, it caused him great problems. He remembered so much he had difficulty separating important facts from trivia, or from fantasy. For example, if you asked him to read this chapter, he might remember every word. However, he might also recall all the images each word made him think of, and all the sights, sounds and feelings that occurred while he was reading. As a result, finding the answer for a specific question, writing a logical essay or even understanding a single sentence was very difficult for Mr S. Jill Price experiences similar difficulties, as shown in 'Videolink: The woman who can't forget'.

VIDEO
The woman who can't forget

Figure 4.2 What would your life be like if you could remember everything you had ever thought, imagined, seen, smelled, touched, tasted and heard?

Theories of forgetting

Forgetting is both frustrating and embarrassing: so why do we forget? Forgetting has a number of possible causes and purposes.

forgetting
The inability to retrieve information previously stored in LTM

We may be unable to retrieve information from LTM because we cannot find the right cues to trigger the memory. Sometimes when we recall information, we also experience interference from newly learnt or older information. Psychologists also believe that we are motivated to repress, or block out of consciousness, memories that are painful, threatening or embarrassing. There is also some evidence to show that memories that are not retrieved, 'used' or rehearsed will decay or become weaker over time (Schacter, 1999). We now consider these theories in more detail.

RETRIEVAL FAILURE THEORY

Have you ever looked back at your primary school photos and couldn't think of the names of some of your classmates, even though you *know* you know their names? Have you ever watched a movie and recognised an actor that you know you have seen in other movies, but couldn't think what those movies were? In these situations you know the memories are there but you just can't access them. The retrieval failure theory suggests that many memories are inaccessible because memory cues that were present when the memory was formed are not present at the time you are trying to retrieve them. In other words, the information is not lost; we simply cannot find the right cues to retrieve it.

For example, if you were asked, 'What were you doing on Monday afternoon of the third week in October two years ago?' you may exclaim, 'Come on – how should I know?' However, if you were reminded, 'That was the day your aunt won Tattslotto' or 'That was the day your brother broke his leg', you might immediately remember what you were doing at the time. The reminder provides a cue to the information you are searching for. A cue is any piece of information that helps you retrieve the required information from LTM. It acts as a hint or prompt, and helps to put information in context.

Students in one study on memory cues had the daunting task of trying to recall a list of 600 words. The students were asked to read the list but were not told they would later be tested on it. Instead, as they read the list, they were asked to write three other words closely related in meaning to each listed word. When the students were later tested, the related words each student supplied were used by the experimenter as cues to prompt memory of the original listed words. Using this process, the students recalled an astounding 90 per cent of the original word list (Mantyla, 1986).

Studies such as this suggest that the presence of appropriate cues enhances memory, and that the inability to access the correct retrieval cues inhibits our ability to access specific information, and increases the chances of forgetting.

Tip-of-the-tongue phenomenon

When trying to access long-term memories, it can often feel like the answer is on the 'tip of your tongue'. You know the answer is there, but it remains just out of reach. Not surprisingly, psychologists refer to this

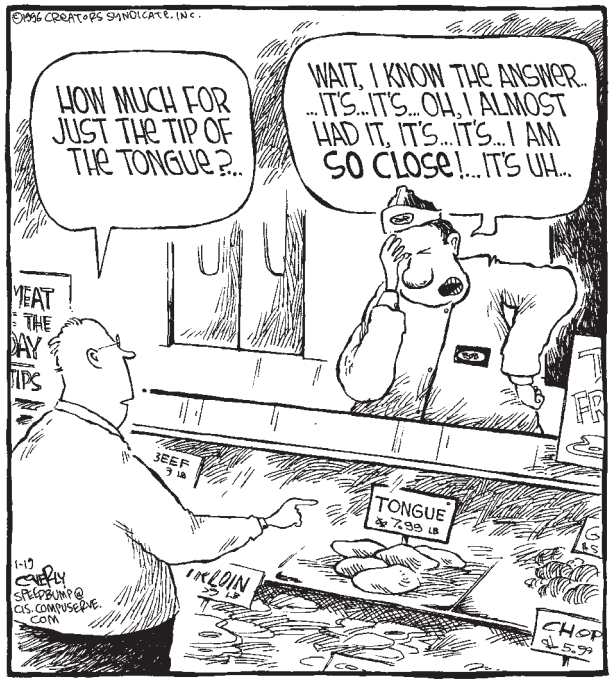


Figure 4.3 When we experience tip-of-the-tongue phenomenon we know that we know the information but we cannot access it; however, we can remember some things about the information we are trying to recall.

as the tip-of-the-tongue (TOT) phenomenon. When we experience TOT we have some information about the word we want – sometimes even the number of syllables or the word's first letter – but we cannot come up with the word itself (see Figure 4.3). Studies of the TOT phenomenon suggest that when we attempt to recall information, we do not necessarily access all of it at the one time. Instead, we may retrieve it in bits and pieces. 'Try it yourself 4.1' asks a series of questions that are well known for inducing a TOT experience.

TRY IT YOURSELF 4.1
Tip-of-the-tongue

Each of the following questions is well-known for creating a TOT experience. See if you can answer any of the questions. If you cannot, decide whether they create the TOT phenomenon for you. Do you remember something about the word you are trying to think of? Answers for these questions can be found in the back of the book.

1. What do you call a pen name that an author might use to conceal his or her identity?
2. What do you call a vessel or carafe used for holding and serving wine?
3. What do you call a metal stretcher with wheeled legs used for transporting patients?
4. What is the latticed arrangement of wood strips used in the garden for climbing plants?
5. What is the term used for keeping eggs warm until they hatch?

Source: Adapted from Tanenbaum, 2008.

In a TOT state, people are likely to recall words that resemble the word they are searching for. Brown and McNeill (1966) demonstrated the TOT phenomenon by asking participants to memorise a list of words that are generally not in everyone's vocabulary; for example, 'sampan', which is a wooden Chinese fishing boat. The words participants came up with when trying to recall the correct word sometimes resembled the word in meaning (for example, 'junk boat', 'houseboat'), but most often resemble it in sound (for example, 'Siam', 'sarong'). As a result of their study, Brown and McNeill believed that a word is stored in a specific location that contains information about its sound and its meaning. Therefore, we can retrieve words according to either characteristic. They also suggested that LTM contains a complexity of associations, or marked pathways, that are stored along with each word. These pathways lead to other, similar words, which is why we sometimes come up with a word that is almost, but not quite, the one we want.

Because words are stored according to both sound and meaning, Brown and McNeill concluded that phonetic and semantic features are needed for word retrieval. By remembering such features, you can eventually recall a word that is on the 'tip of your tongue'.

INTERFERENCE THEORY

Sometimes when we recall specific information from LTM, we experience difficulty because other memories get in the way of the one we are trying to recall. When this happens, we experience interference (see Figure 4.4). Interference theory refers to the tendency for existing memories, either new or old, to impair the retrieval of a required memory. For example, if you learnt to speak Italian in primary school and then in secondary school you learnt French, you might find it difficult to access the Italian words you once knew. Your knowledge of the French words interferes with retrieval of the Italian words.

Figure 4.4 If you park your car in a different place each day, you may experience forgetting due to interference. Your memory of your car's location today is confused with where you parked yesterday or the day before.

In a study designed to investigate the effects of interference, one group of students was asked to memorise 20 lists of words over 20 days (one list each day). At the end of this period, the students were tested on the words, and were able to recall only 15 per cent of the last list they had memorised. However, a second group of students who learnt only one list over the 20-day period remembered 80 per cent of the words (Underwood, 1957).

More insight into the effects of interference on recall comes from a classic experiment by Jenkins and Dallenbach (1924) in which two groups of students learnt lists of nonsense syllables at the same time (we will examine the concept of *nonsense syllables* later in this chapter). After studying a set of information, students in Group A slept for eight hours and students in Group B went about their normal activities for eight hours. After this time period, each group was then tested several times, at differing intervals, on what they had learnt. The first test was conducted one hour after Group A woke up/one hour after Group B finished their normal activities. The next three tests were conducted another hour later, another two hours later and another four hours later.

Results showed that Group B remembered fewer items than Group A (see Figure 4.5). These results suggest that the students who stayed awake forgot

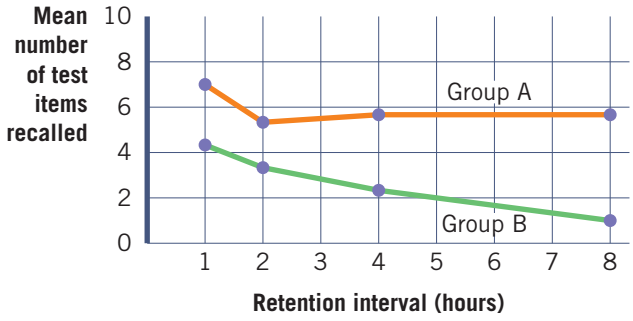


Figure 4.5 Graph of results in Jenkins and Dallenbach's (1924) experiment: They demonstrated that much forgetting can be attributed to interference.

retrieval failure theory
: A theory of forgetting that states that memories are inaccessible because retrieval cues that were present when the memory was formed are missing at the time of retrieval

cue
: A piece of information that helps you retrieve information from LTM

tip-of-the-tongue (TOT) phenomenon
: When we remember some information about the word/information we are trying to recall but we cannot remember the actual word/information needed

interference theory
: Theory of forgetting that refers to the tendency for other memories, either new or old, to impair the retrieval of a required memory

more than those who slept because they experienced interference from the competing information they had to process while engaged in normal activities. Group A did not experience this interference because they were asleep.

When investigating interference theory, it has been found that retrieval is most compromised when the interfering information is similar to what you are trying to recall. Imagine that an interest in art led you to study the French impressionist painters, and that you read a book about the techniques of Degas, Monet and Matisse. You may then be able to remember each painter's individual techniques accurately. However, if you then learnt about the techniques of three more French impressionists, and then three more, you might find accurate recall increasingly difficult, largely due to similar memories interfering with retrieval. This may have happened to you when you were trying to remember a lot of telephone numbers, shopping lists or maths formulas.

It is not clear if new memories alter existing memory traces or if they make it harder to 'locate' (retrieve) earlier memories. In any case, there is no doubt that interference is a major cause of forgetting (Johnson & Hasher, 1987).

Interference can occur in two forms, which we will now explore.

Retroactive interference

Retroactive interference (backward-acting) refers to the tendency for new information to obstruct the retrieval of previously learnt information (new interferes with retrieval of old). As we learnt in chapter 3, the prefix *retro* means 'moving/going backwards'. In this case, the interference goes backwards, causing difficulty with the retrieval of information learnt in the past. For example, learning new students' names typically interferes with a teacher's recall of previous students' names. Getting a new mobile phone number interferes with the ability to remember an old mobile number (see Figure 4.6). Learning a new language can make it difficult to retrieve a language you learnt in your childhood (especially if the two languages are similar).

Figure 4.6 Obtaining a new mobile phone number interferes with the ability to remember your old number.

One way to avoid the effects of retroactive interference is by reducing the number of interfering events; for example, by going to sleep shortly after you learn new information. If you want to maximise your chances of remembering information you studied for your VCE Psychology exam, you should have a rest from studying before you begin work on other subjects. Sleeping after studying can help you retain memories; but reading, writing or even watching TV may cause interference. The sleeping students in Jenkins and Dallenbach's (1924) experiment remembered more of what they had learnt because there was less retroactive interference for them than for the non-sleeping students. Further experiments (Fowler, Sullivan & Ekstrand, 1973) have confirmed that the hour before going to sleep is a good time to commit information to memory. These findings support consolidation theory, which you learnt about in chapter 3.

The effects of retroactive interference can also be seen in animals. 'Focus on research: Retroactive interference in honeybees' looks at this in greater detail.

FOCUS ON RESEARCH

Retroactive interference in honeybees

In an experiment conducted by Cheng & Wignall (2006) to test the effectiveness of retroactive interference, honeybees were taught two tasks.

In Task 1, the bees were taught to go to a particular painted target to receive sugar water. They were then tested on their memory of that task. In Task 2, the honeybees were taught to go to a different landmark to receive the sugar water. After learning Task 2, they were then tested on Task 1 again.

The first time the honeybees were tested on Task 1, they hit the target 48 per cent of the time. Performance on the second test of Task 1 showed that the honeybees only hit the target 23 per cent of the time. The performance on the second test was worse than the first test, thus illustrating a retroactive interference effect (caused by learning Task 2 in between trials of Task 1). It was concluded that honeybees held onto a memory and the interference effect arose from uncertainty about which of the two memories to rely on.

QUESTIONS

1. Write a possible operational hypothesis for this study.
2. Identify the independent variable and the dependent variable.
3. Identify the experimental design used in this experiment.
4. What is an advantage of this experimental design?

Proactive interference

Another form of interference is proactive interference (forward-acting), which occurs when previously learnt information obstructs the retrieval of newly learnt information (old interferes with retrieval of

new). The prefix *pro* means 'forward in time'. In this case the interference goes forwards, causing difficulty with the retrieval of information that has just been learnt.

For example, if someone gives you a telephone number, you may be able to recall it. But if two more people give you their numbers, each successive number will become more and more difficult to recall. Or, you may have learnt a dance routine that you have rehearsed for several weeks; however, when the instructor makes a change to the routine, you may find that you keep performing the old steps instead of the new (see Figure 4.7). Similarly, you may receive a new locker combination for the new school year; however, your old locker combination is the one you keep recalling when you go to your locker after class.

Figure 4.8 illustrates the processes of retroactive and proactive interference. 'Try it yourself 4.2' gives you an opportunity to discover whether the effects of proactive or retroactive interference are more likely to obstruct the information you are trying to recall.

Figure 4.7 Proactive interference occurs when your memory of old dance steps interferes with your ability to remember new dance steps.

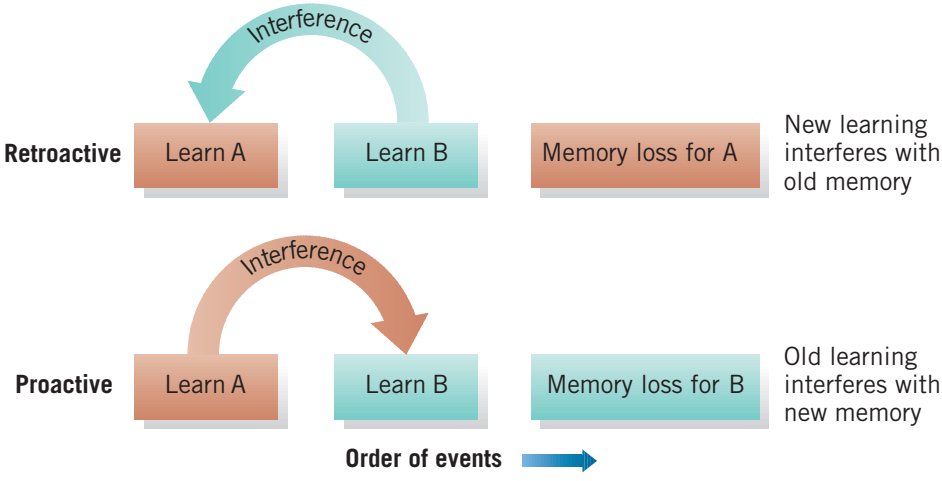


Figure 4.8 Retroactive and proactive interference – the order of learning and testing shows whether interference is proactive or retroactive

TRY IT YOURSELF 4.2

Proactive vs retroactive interference

You will need:

- a pen
- paper
- two groups of participants to test.

Construct two lists of names: List A and List B. Each list should include at least 12 names. Show List A and then List B to people that you know; friends, family or teachers. Then, ask them to recall as many names as they can from List A. This should cause *retroactive* interference. Write down the number of names they were able to recall and find an average of those numbers.

Repeat this task with a second group of participants. Show them List A and then List B, as done previously. This time ask them to recall List B. This should cause *proactive* interference. Write down the number of names recalled and find an average.

Continued

retroactive interference
The tendency for new information to obstruct the retrieval of previously learnt information

proactive interference
The tendency for previously learnt information to obstruct the retrieval of newly learnt information

QUESTIONS

1. Which condition caused the greatest amount of interference?
2. Was the effect of proactive interference more severe than retroactive interference or vice versa?
3. What can be concluded about forgetting from this investigation?

CHECK YOUR UNDERSTANDING 4.1

1. Forgetting refers to a(n) _____ to retrieve previously stored information.
2. According to retrieval failure theory, forgetting occurs because:
   - **A** the memory was painful or traumatic.
   - **B** the information was similar to old information previously learnt.
   - **C** the memory was never formed.
   - **D** there were insufficient cues to enable the memory to be accessed.
3. When we remember some information about a word we are trying to retrieve but can't access the word itself, this is known as the _____ phenomenon.
4. Indicate whether the following scenarios are examples of proactive interference (P) or retroactive interference (R).
   - **a** Being unable to remember your new mobile phone number because your old one keeps interfering.
   - **b** Being unable to remember the new game plan in Rugby match, and continuing to make plays according to the old game plan.
   - **c** Being unable to recall the Biology homework you studied before studying for Chemistry.
   - **d** Being unable to remember your Grade 4 teacher's name because you have had many teachers since then.
   - **e** Being unable to remember who played in the 2007 AFL Grand Final after watching the more recent finals.
5. Which of the following factors can make the effects of interference more severe?
   - **A** How hard the information is to learn
   - **B** How similar the information is
   - **C** The time it takes to learn information
   - **D** The age at which you learn information

MOTIVATED FORGETTING

Many years ago, one of the most famous psychologists of all time, psychoanalyst Sigmund Freud, suggested that we 'forget' information because it is threatening to us in some way. Freud believed that the conscious mind often deals with unpleasant, dangerous or traumatic information by pushing it out of conscious awareness, into the unconscious mind (see Figure 4.9). Freud believed that at any moment our unconscious mind is full of thoughts, feelings and emotions that we are not aware of. These unconscious thoughts may manifest in our dreams or even as an automatic response to a situation that occurs without thinking, also known as a 'Freudian slip'. Freudian theory views our consciousness as an iceberg: the part of the iceberg sitting above the water is small, and it represents our conscious awareness; the larger part of the iceberg is submerged, and represents our preconscious and unconscious.

Figure 4.9 Psychoanalyst Sigmund Freud suggested that motivated forgetting can occur for memories that are painful or traumatic. This accident victim may 'forget' the circumstances surrounding the accident because they are too traumatic to deal with.

Blocking traumatic or painful information from our conscious mind acts as a defence mechanism. We are protected from thoughts that may cause us grief and distress, which therefore allows us to continue to cope with day-to-day activities without reliving the pain of the event.

This form of forgetting is known as motivated forgetting. Motivated forgetting refers to the forgetting of LTMs that occurs because of a conscious or unconscious desire to block painful or traumatic memories from entering our conscious awareness. Supporters of the theory of motivated forgetting suggest that this type of forgetting can occur in two forms, which we will now explore.

Repression

Take a moment to reflect on events of the last few years of your life. What kinds of things come most easily to mind? Many people remember happy, positive events better than they remember disappointments and irritations (Linton, 1979). A clinical psychologist would say that this tendency demonstrates repression. Repression is a form of motivated forgetting that occurs unconsciously, or without your awareness. An example of repression is

that of returned soldiers who do not remember some of the horrors they witnessed during combat (Karon & Widener, 1997; 1998).

Freud proposed that our memory systems repress painful information or memories in order to protect our personal view and understanding of ourselves, and to minimise anxiety. But the submerged memory lingers, said Freud, and may be retrieved spontaneously by some later cue or with patience and effort during psychotherapy. One reported case involved a woman with an intense, unexplained fear of running water. One day her aunt solved the mystery when she whispered to the woman, 'I have never told'. These words cued the woman's memory of an incident when, as a disobedient young child, she wandered away from a family picnic and became trapped under a waterfall – until being rescued by her aunt, who promised not to tell her parents (Kihlstrom, 1990).

'Forgetting' past failures, upsetting childhood events, the names of people you dislike or appointments you do not want to keep may indicate repression. People prone to repression tend to be hypersensitive to emotional events (Mendolia, Moore & Tesser, 1996). Clinicians consider true repression an unconscious event, so when a memory is repressed, we may have no knowledge that forgetting has even occurred.

Psychologists Kenneth Bowers and Peter Farvolden (1996) believe, as did Freud, that repression is a form of avoidance. Avoidance behaviour is learnt and repeated because it successfully enables someone to evade information that is unpleasant or distressing. If someone has experienced a painful emotional event, they will probably avoid all thoughts associated with it, which in turn tends to keep cues out of mind that might trigger the painful memory.

Suppression

If you were *deliberately* to try to forget a test you had failed, would you be repressing it? No: repression occurs unconsciously. An active, conscious attempt to put something out of awareness is known as suppression. By not thinking about a failed test, you have merely suppressed a memory. If you chose to, you would be able to remember the test. Imagine that you trip up the stairs beside the stage while receiving an award in front of a large crowd (see Figure 4.10). Later, when your friends want to relive your embarrassing moment, you continually ask them to not mention it as you try to push it from your awareness. This active attempt to forget the incident is an example of suppression.

Limitations of the theory of motivated forgetting

A number of clinical case studies – in which psychologists intensively investigate and document the behaviour of a single person – lend support to the theory of motivated forgetting. There are well-documented cases of memory-loss for highly stressful events such as car accidents and crimes (Squire, 1987). Yet one major limitation of the theory is that there might be other reasons for documented cases of memory loss, such as a blow to the head. It may even be that in some cases unpleasant events disrupt the biological process of consolidation in LTM (see chapter 3) rather than causing the memory to be 'buried'.

Figure 4.10 Motivated forgetting can be a conscious process of blocking an embarrassing memory such as tripping in front of a crowd.

Although repression and suppression are essentially defence mechanisms, they are not necessarily advantageous to us. Remembering traumatic memories may help us to learn from the experiences, and therefore blocking them from conscious awareness does not enhance an individual's chances of adapting to and surviving in new situations and environments.

Motivated forgetting and repressed memories have also received 'bad press' due to the emergence of seemingly repressed memories that are actually 'implanted' or false memories. Many stories have surfaced regarding individuals reportedly 'remembering' repressed memories and using them

motivated forgetting
: A theory of forgetting that states that forgetting of LTMs occurs because of a conscious or unconscious desire to block painful or traumatic memories from entering our conscious awareness

repression
: A form of motivated forgetting, where an individual unconsciously blocks painful or traumatic memories from entering conscious awareness

suppression
: A form of motivated forgetting, where an individual consciously/deliberately blocks painful or traumatic memories from entering conscious awareness

[ISBN 9780170182966]

as evidence in court; these memories have later been found to be false. Often these 'repressed memories' are implanted during hypnosis sessions; however, we must remember that not all repressed memories are false. 'Videolink: False memories' investigates one such case.

VIDEO
False memories

DECAY THEORY

Decay theory assumes that when learning occurs, a physical change takes place in the brain. That is, a memory trace (a physical or chemical trace of the event) forms to contain the stored information (see chapter 3). Decay theory attributes forgetting to the gradual fading or disintegrating of these memory traces over time, due to the fact that they are not reactivated or used.

Decay theory is useful in explaining some of our forgetting. There are many events experienced over a lifetime that are forgotten. They are not traumatic, nor have they been interfered with, but when provided with ample cues, some memories are still unable to be accessed. This suggests that memories that are not used or revisited simply cease to be required and the memory trace is no longer necessary.

Decay also appears to be a factor in information loss from sensory memory and STM. Both sensory memory and STM can only store information for a limited time (up to 3 or 4 seconds for sensory memory, and up to 18 or 20 seconds for STM without rehearsal). After this time, the information fades and is replaced by newer information.

Limitations of decay theory

The decay theory does not seem to account for our ability to recover some seemingly forgotten memories that have not been used for a long period of time; that is, why some unused memories fade, while other unused memories are carried for life. Such recovery can happen through relearning information or when a retrieval cue suddenly triggers a memory that has not surfaced for years.

Another contradiction will be recognised by anyone who has spent time with the elderly. People who suffer the effects of senility may become so forgetful that they can hardly remember what happened a week ago, yet at the same time they may have vivid memories of trivial and seemingly long-forgotten events from the past. In short, the decay theory offers no more than a partial explanation of LTM forgetting.

The greatest difficulty with supporting a theory such as decay theory is attempting to prove the existence of a memory trace. 'A closer look: In search of the memory trace' looks at evidence in the science world that has sought to support the idea that a memory trace does in fact exist. Table 4.1 compares the four theories of forgetting.

Table 4.1 Comparing the theories of forgetting

THEORY OF FORGETTING	EXPLANATION	OTHER INFORMATION
Retrieval failure theory	Forgetting occurs due to a lack of the presence of the correct cues to access the memory	You may remember something about what you are trying to recall but not the actual word or information (tip-of-the-tongue phenomenon)
Interference theory	Forgetting occurs because other information blocks the retrieval of the information you are trying to recall	Previously learnt information may interfere with the recall of newly learnt information (proactive interference) or new information may interfere with the retrieval of existing information (retroactive interference)
Motivated forgetting	Forgetting occurs because memories that are painful or traumatic are blocked from entering conscious awareness	The blocking of painful memories may be unconscious (repression) or conscious (suppression)
Decay theory	Forgetting occurs as a result of a memory trace fading due to disuse over time	Does not explain why some memories formed long ago can still be recalled

A CLOSER LOOK

In search of the memory trace

For many years, neuroscientists have searched for evidence in support of a physiological basis for memory. James McConnell rocked the science world in 1962 when he reported that he had chemically transferred a specific memory from one flatworm to another. McConnell created a conditioned reflex (a learned automatic response to a stimulus – in this case, contraction in response to light) in flatworms and then transferred RNA (a basic molecular constituent of all living cells) from trained worms to untrained worms. The untrained worms showed evidence of 'remembering' the conditioned reflex. The initial excitement caused by McConnell's 'discovery' was short lived, however, as the RNA transfer studies proved difficult to replicate (Gaito, 1976).

Similarly, Wilder Penfield's 1963 research using electrical stimulation of the brain (ESB) during surgery led to the suggestion that the cortex retains exact 'tape-recordings' of past experiences (Penfield & Perot, 1963).

At the time, scientists believed this was a major advance; ultimately, it was not. The 'memories' activated by ESB often included factual impossibilities and dream-like elements of fantasy. These ESB-induced recollections were apparently hallucinations, dreams or loose reconstructions of events rather than exact replays of the past (Squire, 1987).

Today, scientists are still searching for the chemical code for memory (see 'A closer look: First image of memories being made' in chapter 3, page 103), and trying to identify psychological factors that may contribute to inaccurate traces when they are identified.

CHECK YOUR UNDERSTANDING 4.2

1 According to motivated forgetting theory, the unconscious blocking of traumatic events from your consciousness is known as _____; whereas the conscious blocking of these events is known as _____.

2 Which of the following statements regarding motivated forgetting is false?

- **A** It acts as a defence mechanism
- **B** It was investigated by Sigmund Freud
- **C** It allows individuals to cope with day-to-day living more easily
- **D** Repressed memories can never be retrieved

3 For each of the following statements, indicate if they are true (T) or false (F) with regard to the decay theory.

- **a** Memories fade due to misuse.
- **b** All memories that occurred a long time ago fade.
- **c** When a memory is learnt, a memory trace is formed.
- **d** Memories that have not been accessed for a long time are susceptible to decay.

4 Which of the following explanations is a criticism of decay theory?

- **A** Memories formed long ago can still be remembered.
- **B** Memories formed recently can still be remembered.
- **C** New memories can be formed when we are old.
- **D** New memories can be formed when we are young.

5 Match each term with its definition.

a	Interference theory	**i**	Memories that are painful or traumatic are blocked from entering conscious awareness
b	Decay theory	**ii**	The inability to access the correct cues to trigger the memory
c	Motivated forgetting	**iii**	Other information blocks the retrieval of the information you are trying to recall
d	Retrieval failure theory	**iv**	A memory trace fades due to disuse over time

The forgetting curve

Although a number of theories differ in their explanations of forgetting, generally psychologists agree on the typical *pattern* of forgetting new information. Many experiments have tested the rate and amount of forgetting that occurs, and results are usually presented in a forgetting curve. The forgetting curve is a graph that shows the typical rate (how fast) and amount (how much) of forgetting that occurs after varying lengths of time.

In a well-known set of experiments to test the rate and amount of forgetting for new information, memory researcher Hermann Ebbinghaus (1885) tested his own memory after learning. To do this, Ebbinghaus memorised nonsense syllables – meaningless sequences of three letters consisting of two consonants and a vowel, in any order, so that they are not always pronounceable (for example, 'BEX', 'CFE', 'WOL' and 'OZG'). Using nonsense syllables is an effective testing method because such syllables are not associated with prior learning, as long as the nonsense syllables are truly meaningless to the person being tested. The importance of using meaningless words can be illustrated by a simple test. If you were given limited time to memorise nonsense syllables such as 'VIC' and 'TAS', you would easily remember them because you have already learnt them as the abbreviations for two Australian states. However, if you were asked to memorise a list of syllables such as 'WEP', 'GXO' and 'BUQ', you would probably find it harder to recall them because they have no meaning.

Ebbinghaus waited various lengths of time before testing himself – from minutes to days, weeks and months. He found that after 20 minutes he remembered fewer than 60 per cent of the syllables he had learnt, and after about an hour he remembered slightly more than 40 per cent. After the initial sharp decline, however, his rate of forgetting began to slow. After nine hours he still remembered approximately 38 per cent of what he had learnt, and after

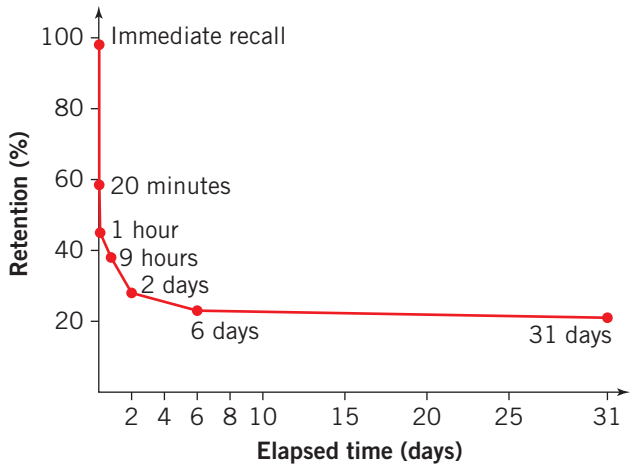
decay theory
A theory of forgetting that states that forgetting occurs due to the gradual fading of memory traces over time due to disuse

forgetting curve
A graph that displays the rate and amount of information that is lost, or forgotten, over time

nonsense syllables
Meaningless sets of three letters that are strung together – usually consisting of two consonants and a vowel, in any order

[ISBN 9780170182966]

two days approximately 28 per cent. A month later, he recalled 21 per cent of the items on the list. Ebbinghaus then plotted a forgetting curve to show his results (see Figure 4.11).



Source: Adapted from Ebbinghaus, 1885

Figure 4.11 Ebbinghaus' forgetting curve shows the rate and amount of information lost over time.

Ebbinghaus' research indicated that most forgetting occurs immediately after memorisation. More than half of the information learnt is lost within the first hour after learning, but this rapid loss is then followed by a slow decline over the next 20–30 days until the decline reaches a plateau. The message is this: when we learn something new, we often forget much of it quite quickly. Fortunately, we remember at least a portion of it for a long time.

RATE AND AMOUNT OF FORGETTING

The general pattern (curve) of forgetting represented in the forgetting curve is generally the same for a variety of materials, under varying conditions. However, the actual *rate* and *amount* of forgetting can vary. Results from one memory test conducted with university psychology students showed that, after three years, students had forgotten approximately 30 per cent of the facts they had learnt. After that, little forgetting occurred (Conway, Cohen & Stanhope, 1992). It is also generally accepted that semantic memories (memories of facts and academic knowledge) are very long-lasting (Bower, 1990).

As you learnt in chapter 3, memory researchers have also established that the more meaningful the information, the better it will be committed to memory. It follows, then, that the more meaningful the information, the longer it takes to forget it. 'Try it yourself 4.3' contains an activity on meaningfulness and memory to enhance your knowledge of this concept.

How well we initially encode information also influences the rate and amount of forgetting. Information that is well-learnt is retained longer, and the retention rate for information encoded carefully is about the same regardless of how difficult the information is. That is, easily learnt material does not appear to be retained longer than material that is difficult to learn. Also, slow learners and fast learners both tend to forget at about the same rate.

TRY IT YOURSELF 4.3

The effect of meaningfulness on memory

You will need:

- a pen
- paper
- a stopwatch.

Each of these activities should be done on three separate days, to account for possible interference effects.

1. Day 1: Allow yourself 30 seconds to memorise the following list of words. When your time is up, immediately write down as many of the items you can remember, in any order. One hour after you have memorised the list, try again to write down as many items as you can (don't cheat by looking at the words you wrote down earlier!). Four hours later, again write as many words as you can remember. Record your results.

   PAM CAN RUN AND HOP BUT NOT SIT FOR YOU

2. Day 2: Repeat the instructions for Day 1, this time using the list of words below.

   TOP FIX HAT LAD JAM MOP DIG CRY POT GAP

3. Day 3: Repeat the instructions for Day 1, this time using the list below.

   GYT JRP ZQM BJV PTF DXH KQJ XNW RGP LBT

4. Plot your results for each test on a forgetting curve.

QUESTIONS

1. Compare your results from the three lists.
2. Which items were easiest to recall? Which items were most difficult to recall?
3. What conclusions about memory and the meaningfulness of information can you draw from your results?
4. What conclusions can you draw about your own rate of forgetting?

CRITICISMS OF EBBINGHAUS' FORGETTING CURVE

Ebbinghaus' forgetting curve has been criticised for being too dramatic. More recent findings have shown that when the information is meaningful, forgetting occurs more slowly.

Ebbinghaus also did not account for the effect of proactive interference on recall abilities. Once one syllable was presented it was followed by another similar syllable. We have learnt that recall can be adversely affected by similar information interfering with its retrieval. So when recalling the syllables, proactive interference may have occurred. When learning meaningful information, the content is less similar and therefore the effect of interference is reduced.

Ebbinghaus' work involved him retrieving a list of syllables that he tried to commit to memory, but there are other ways to measure if the information he had learnt was actually retained. He could have been given cues or prompts – such as the first letter of each syllable – or he could have been shown a list of syllables and asked to recognise which ones he saw. These different techniques are referred to as measures of retention.

Measures of retention

As explained earlier, forgetting assumes that the memories are not lost but just unable to be retrieved at that moment. Using cues is one technique that can help to retrieve a particular memory. There are different ways to utilise cues to assess whether retention has taken place; that is, whether the memory is actually still in LTM. These measures of memory retention are known as *recall*, *recognition* and *relearning*.

RECALL

What is the name of the first song on your favourite CD? Who wrote Hamlet? Who won the AFL Premiership last year (see Figure 4.12)? If you can answer these questions, you are demonstrating recall. To recall means to supply or reproduce facts or information that is stored in LTM, using few or no cues for assistance.

Tests of recall present you with minimal cues – usually only the question you are being asked – and often require that you recall something verbatim (word for word). If you study a poem until you can recite it without looking, then each time you recite it you will be recalling it. If you complete a fill-in-the-blanks question, you are using recall. When you answer an essay question without any assistance from your notes or texts, you are also using recall.

There are three different methods of recall – free recall, serial recall and cued recall – and any of them can be used when retrieving information.

Free recall requires that you reproduce information from your memory in any order, without the use of specific cues. If you tried to remember the songs on your favourite CD using free recall, then you would recite these titles in any order, rather than in the order they appear on the CD.

Figure 4.12 Remembering who won an AFL Premiership in a particular year is an example of recall.

Serial recall occurs when you reproduce information from memory in the order in which it was originally presented, without the use of specific cues. If you were asked to remember the songs on your favourite CD in the order they are listed, you would be using serial recall.

If cues are supplied, such as the first word of each song title on your favourite CD, then you would be using *cued recall* to access your memory of the CD contents. Cued recall is when you reproduce information from memory, but you are given cues or prompts to assist recall.

Earlier, when we examined retrieval failure theory, we were introduced to the benefit of providing a cue to help access a memory. Because recall involves the use of very few memory cues, it is usually the least effective at producing information when compared to the other measures of retention (recognition and relearning). It is therefore considered the least sensitive measure of retention.

recall
A measure of retention that involves retrieving stored information using few or no cues for assistance

free recall
Recalling information from memory in any order with no cues for assistance

serial recall
Recalling information from memory in the order or sequence in which it was learnt, with no cues for assistance

cued recall
Recalling information from memory with some cues or hints for assistance

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Of the *types of recall*, cued recall is the most sensitive measure of retention, followed by free recall and then serial recall. 'Try it yourself 4.4' allows you to investigate the relative sensitivity of the three types of recall.

TRY IT YOURSELF 4.4
The relative sensitivity of different types of recall

You will need:

- pen
- paper
- a word list (featuring 10 three-letter words)
- three groups of participants (or one group of participants, but you will need three different word lists).

1 Read the word list to your first group of participants. Ask them to write down the words from the list in the order in which they were read. This will assess the sensitivity of serial recall.

2 Read the word list to your second group of participants. Ask them to write down as many words as they can recall in any order. This will assess the sensitivity of free recall.

3 Read the word list to your third group of participants. Ask them to recall as many words as possible in any order, but provide them with the first letter of each word to be recalled. This will assess the sensitivity of cued recall.

QUESTIONS

1 Find the average number of correct responses for each group.

2 Which group achieved the highest number? Was this expected?

3 From your results, which is the least and the most sensitive measure of recall?

CHECK YOUR UNDERSTANDING 4.3

1 Ebbinghaus used nonsense syllables in his research investigating memory. Which of the following statements regarding nonsense syllables is correct?

A A nonsense syllable is not always pronounceable.

B A nonsense syllable is meaningful.

C A nonsense syllable cannot include consonants.

D A nonsense syllable cannot include vowels.

2 The forgetting curve measures the _____ and _____ of forgetting over time.

3 Which of the following statements best describes Ebbinghaus' forgetting curve?

A Information is lost slowly at first and then rapidly declines.

B Information is lost rapidly at first and then slowly declines until it reaches a plateau.

C Information is lost rapidly at first and then slowly declines until there is no memory left.

D Information is rapidly forgotten over time.

4 Different techniques used to assess whether information has been stored in memory are referred to as measures of _____.

5 Indicate whether the following tasks would involve free recall (F), serial recall (S) or cued recall (C).

a Recalling the names of the last five prime ministers in chronological order.

b Recalling which towns in Victoria you have visited while looking at a map that is not labelled.

c Recalling the order in which AFL teams finished on the ladder last season.

d Recalling the names of four psychologists you learnt about in Units 1 & 2 Psychology.

e Recalling your lines for a school play.

f Recalling your lines for a school play after receiving the first word of each line from a prompt.

RECOGNITION

Try to write down the names of all the people that were in your English class last year. While you might be able to remember a few, you are probably surprised by how many you have forgotten. However, to really test your memory of your classmates we could use a test of recognition – a more sensitive test than recall.

As a test of memory, recognition involves identifying the correct answer from a list of possible alternatives. For example, in order to remember who was in your English class last year, you might be asked to choose names from a list of all people in your year level. Because you would only have to recognise names rather than recall them from your LTM, you would probably find that you remembered a lot more students in your English class than you thought. Another test of recognition may involve taking a multiple-choice test on facts and ideas that are related to a topic you studied (see Figure 4.13). You have probably had the experience of being unable to answer a question, yet when you have been told the answer, you realised you knew it all along. This is another example of recognition.

Recognition memory can be amazingly accurate for illustrations, paintings, photographs and other visual stimuli. One investigator showed

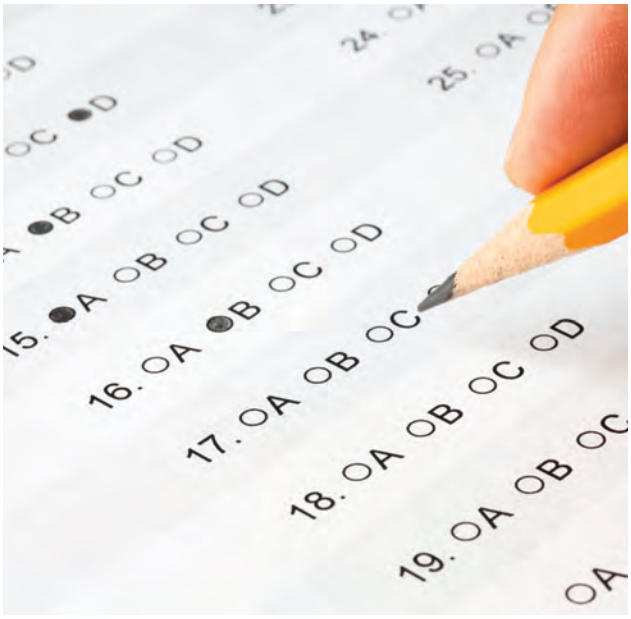


Figure 4.13 A good method of testing long-term memory using recognition is through the use of multiple-choice tests.

Figure 4.14 Some people report that they never forget a face – this highlights the effectiveness of recognition.

people 2560 photographs at a rate of one every 10 seconds. Each person was then shown 280 pairs of photographs. One photograph in each pair was from the first set shown, and the other in the pair was similar but had not been shown in the original set of photographs. Subjects could tell with 85–95 per cent accuracy which photograph they had seen before (Haber, 1970). This finding may explain why, when shown a photograph of a group of people, you may be certain that you know a particular person even though you cannot recall their name.

Recognition is a more sensitive measure of retention than recall because it is a superior measure – it is more successful than recall. Even patients suffering from amnesia (see chapter 3) can recognise words they have learnt but cannot recall them (Graf, Squire & Mandler, 1984). When you hear someone say, 'I may forget a name, but I never forget a face', they are also saying that recognition is a more effective retrieval method than recall (see Figure 4.14).

Why is recognition superior to recall? Recognition tests of memory are 'easier' because they provide retrieval cues that serve as prompts or reminders of information that could not otherwise be recalled. In other words, it is easier to retrieve 'correct' information because it is presented among incorrect alternatives. Thus, recognition is usually superior to recall because recognition accesses memories or information that recall cannot access. 'A closer look: The effect of distracters' explores some limitations with using recognition as a form of recall.

A CLOSER LOOK

The effect of distracters

Is recognition *always* superior to recall? It depends greatly on the type of distracters used. Distracters are false items that are included with the items to be recognised. If a distracter is very similar to a correct item, recognition may be poor or unreliable. So watch out for multiple-choice questions on your exam that contain a lot of similar-sounding answers – it is likely that they contain distracters to test your understanding of the course.

A reverse problem sometimes occurs when only one choice looks like it could be correct. This can produce a *false positive*, or a false sense of recognition. A false positive is an incorrect sense of recognition that occurs when you are presented with a group of incorrect items and you identify one as correct. The selection appears correct because it resembles the correct item more than the other items do.

For example, if a witness to a crime described a criminal as tall, blonde and young, and in the line-up there was only one suspect that was tall and blonde, or only one suspect was young, it is likely that the witness will identify that person simply because none of the other subjects fit those characteristics (not because the witness thinks that person actually committed the crime). A better method of identification is to have all of the distracters resemble the witness's description. Also, witnesses should be warned that the culprit may not be present at the

Continued

recognition
: A measure of retention that involves identifying previously learnt information from a list or group of alternatives

distracter
: A false item, similar to the correct item, that is included with items to be recognised and can lead to unreliable identification

[ISBN 9780170182966]

line-up. This reduces false positives and increases accurate identifications (Wells et al., 1998) (see Figure 4.15). The most unreliable identifications occur when the witness is presented with only one person as a suspect. In that case, false identifications of look-alike innocent people are a real danger (Yarmey, Yarmey & Yarmey, 1996). This will be discussed in greater detail later in this chapter.

Figure 4.15 Police line-ups such as this rely on the sensitivity of recognition. False identifications are still possible if great care is not taken.

Figure 4.16 Can toddlers retain information they were exposed to when they were young? Relearning may be able to demonstrate the retention of early learning.

RELEARNING

The process of relearning refers to learning something that has been previously learnt, to measure the amount of information retained from the original learning. In a classic experiment, psychologist Harold Burtt (1941) read a short passage in Greek to his son. He did this each day when the boy was between 15 months and three years of age. At age eight, the boy was asked if he remembered the Greek passage. He showed no evidence of recall. He was then shown selections of the passage he had heard, and selections from other Greek passages. Could he recognise the one he had heard as an infant? No.

Had the psychologist stopped there, he might have concluded that his son retained no memory of the Greek he heard as a toddler. However, the psychologist then asked his son to memorise the original passage as well as others of equal difficulty. This time, the earlier learning became evident: the boy memorised the passage he heard in childhood 25 per cent faster than he memorised the others (Burtt, 1941).

Psychologists believe that relearning is typically the most sensitive measure of retention – more sensitive than recognition and recall; that is, it is the most successful. This is because you may have shown no evidence of remembering the information when asked to recall or recognise it, but by relearning and therefore revisiting the information, some evidence of retention may exist. You may be able to learn the revisited information faster, hence demonstrating some retention of original learning. Relearning allows you to access memory stores that cannot be accessed by other tests of retention.

Savings score

When we test a person using the relearning method, how do we know how much of the original learning was retained? Traditionally, relearning is measured by a savings score. A savings score calculates the percentage of information retained from original learning. It does this by subtracting the time or number of trials it takes to relearn the information on the second occasion from the time or number of trials taken to originally learn the information. This figure is then divided by the time or number of trials taken to originally learn the information, and multiplied by 100 to convert the amount to a percentage. The formula for calculating the savings score is below.

$$\text{Savings score} = \frac{(\text{time/trials for original learning} - \text{time/trials for relearning})}{\text{time/trials for original learning}} \times 100$$

Let us say it takes you one hour to learn the 50 states of America. In two years' time, you relearn the information. When relearning, it only takes you half an hour. Using the savings score, you can figure out how much information has been retained:

$$\text{Savings score} = \frac{60\ (\text{mins}) - 30\ (\text{mins})}{60\ (\text{mins})} \times 100$$
$$= \frac{30}{60} \times 100$$
$$= 50\%$$

The savings score may not be needed to perform every calculation. As with the example above, it can be seen without doing the equation that the information was learnt in half the time; therefore, 50 per cent of the original information must have been retained. If it took a child 20 attempts to learn

to tie their shoelaces on Monday and then on Tuesday, after relearning, it only took them five attempts, it can be seen without necessarily having to do the calculations that the skill was learnt in one quarter of the time; therefore, 75 per cent of the original learning must have been saved (see Figure 4.17).

Figure 4.17 The savings score can demonstrate how much information has been retained from originally learning how to tie shoelaces upon relearning the skill.

CHECK YOUR UNDERSTANDING 4.4

1 Reproducing information using few or no cues is known as _____, whereas selecting the correct answer from a list of possible alternatives is known as _____.

2 In recognition tasks, the presence of distracters can often lead to:
- **A** more accurate recognition.
- **B** less accurate recognition.
- **C** slower recognition.
- **D** faster recognition.

3 When we learn information we have learnt previously, this is referred to as _____.
To calculate the amount of information retained from original learning you will need to use the _____.

4 It originally took Ben four lessons to learn how to count to 20 in French last semester. When he returned to class after the school holidays he seemed to forget everything. He then re-learnt all of the numbers in his first lesson. How much information did Ben save (what was his saving score)?
- **A** 0%
- **B** 25%
- **C** 50%
- **D** 75%

5 Rank the following measures of retention from most sensitive (1) to least sensitive (5)
- **a** Free recall
- **b** Recognition
- **c** Serial recall
- **d** Relearning
- **e** Cued recall

Enhancing memory retrieval

RETRIEVAL CUES: CONTEXT- AND STATE-DEPENDENT CUES

We have already learnt the importance of cues when trying to retrieve information from memory. Psychologists suggest that one of the most effective ways of improving retrieval from LTM is to recreate the conditions – both physical and psychological – that were present when the memory was formed (see Figure 4.18). This is based on the belief that the best memory (retrieval) cues are those that were present during encoding (Reed, 1996). The encoding specificity principle suggests that the more closely the retrieval cues match the original learning conditions, the greater the chance of recalling the information (Tulving, 1983). We will now explore the two types of retrieval cues that act as retrieval prompts.

Figure 4.18 Actors are able to remember large amounts of complex information for many months while filming a movie, even when learning newer roles during this period. They remember their lines best when they are able to move and gesture in the same way they did when they were rehearsing. Their movements supply cues that aid recall.

Context-dependent cues

Our physical surroundings during learning provide many useful external cues that may aid retrieval at a later time. These surroundings act

relearning
: A measure of retention that involves learning information that has been previously learnt and stored in LTM as a means of assessing whether any information was retained from the original learning

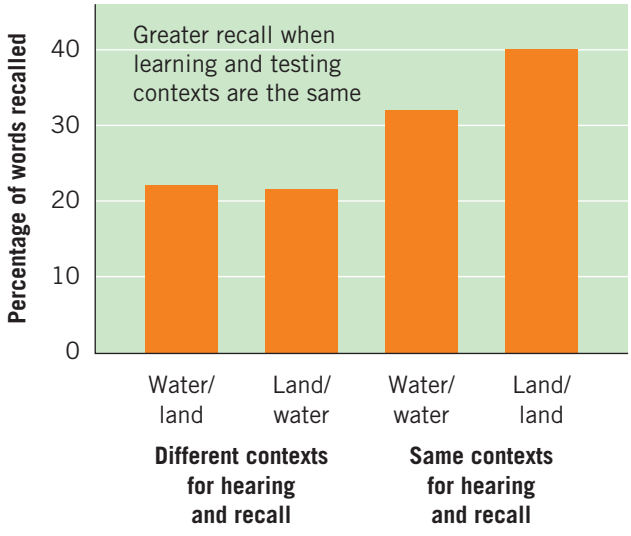
savings score
: A formula that calculates the percentage of information retained from original learning after relearning has occurred

encoding specificity principle
: The theory that the more closely retrieval cues match the original learning conditions, the greater the chance of recalling the information

[ISBN 9780170182966]

as context-dependent cues. Context-dependent cues aid retrieval by recalling information in the same place or setting in which the information was learnt; therefore, physical landmarks, sounds and smells act as cues for retrieving the memory. When we form a memory, it is stored in an organised manner, as demonstrated by the semantic network theory (see chapter 3); therefore, the physical surroundings help to put the memory in context.

Research conducted by Godden and Baddeley (1975) investigated the effect of context-dependent cues on retrieval. They had scuba divers listen to a list of words in two different settings. Divers learnt their list either three metres underwater or sitting on the beach. As Figure 4.19 illustrates, the divers recalled more words when they were tested in the same setting as they learnt the information. You have probably experienced similar context effects. If you have ever revisited your primary school or the beach where you spent your favourite childhood holidays, you have probably been flooded with memories because of the retrieval cues present in the environment.



Source: Adapted from Godden & Baddeley, 1975; from Myers, 2001, p. 336.

Figure 4.19 The effect of context-dependent cues on memory. Words that are heard underwater are best recalled underwater and words heard on land are best recalled on land.

Obviously, when attempting to recall information, returning to the appropriate physical environment where the memory was formed is not always possible. However, if you use visual imagery in order to 'recreate' the physical environment where memory formation occurred, then many parts of the image will provide the context cues you need.

Apart from helping you to remember, context cues can also help you pass exams. For example, memory will be best if you study in the same room where you will be tested. Because this is often impossible, while you are studying try to visualise the room where you will be tested. Alternatively, when you are sitting your exam, try to visualise the setting you were in when you studied the exam material (see Figure 4.20).

Figure 4.20 Using your imagination to recreate the context in which you studied can enhance your chances of recall. Alternatively, study where you will sit your exam.

State-dependent cues

Do you ever hear people joke that they lost their keys or wallet when drinking and that they will need to get drunk again if they are ever going to find them? Although this tale is often told for a laugh, it is not too far-fetched. The bodily state that exists during learning can be a strong cue for later memory retrieval, an effect known as state-dependent learning (Neath, 1998). State-dependent cues are retrieval cues associated with your internal physiological and/or psychological state at the time the memory was formed. Therefore, it is easier to access a memory when you are in the same state you were in when you learnt it.

Being very thirsty, for example, might prompt you to remember events that took place on another occasion when you were thirsty. Thirst is a physiological state, but a similar effect applies to emotional and psychological states (Eich, 1995). For example, Gordon Bower (1981) found that people who learnt a list of words while in a happy mood recalled the words better when they were happy again; people who learnt while they felt sad remembered best when they were sad. Similarly, if you are in a happy mood, you are more likely to remember recent happy events (Salovey & Stinger, 1989) than if you are in a bad mood, when you will tend to recall unpleasant memories (Eich, Rachman & Lopatka, 1990). Such links between emotional cues and memory retrieval could explain why couples who frequently quarrel often end up remembering – and rehashing – old arguments.

Research into the effects of drugs such as alcohol, caffeine, marijuana and nicotine also suggest that being under the influence of a particular drug aids recall of information stored when previously under the influence of that same drug (Roediger, 1992; Baddeley, 1990). To test this proposition, Goodwin, Powell, Bremer, Hoine and Stern (1969) conducted a recall experiment using alcohol. Their results showed that heavy drinkers who hide alcohol or money when they are intoxicated experience more accurate recall of where the alcohol or money was hidden when they are intoxicated again, rather than when they are sober.

Using hypnosis as a means to improve recall is another way that state-dependent cues are utilised. By placing an individual under hypnosis, the individual attempts to access the psychological state they were in when a memory was formed and then attempts to recover previously repressed memories. However, as we learnt earlier, memories recovered under hypnosis may not necessarily be reliable. 'A closer look: Hypnosis, imagination and memory' investigates this concept more closely.

Context- and state-dependent cues can work well together. In an exam situation, for example, recreating (or imagining) the physical *and* psychological state in which you studied can enhance retrieval of the information you studied (Jerabek & Standing, 1992).

A CLOSER LOOK

Hypnosis, imagination and memory

We sometimes hear stories of someone being able to remember information under hypnosis that they could not recall when in a state of normal consciousness. Does this mean that hypnosis can improve memory? Read on and judge for yourself.

Research has shown that a hypnotised person is more likely than a person in a state of normal waking consciousness to use imagination to fill in gaps in memory. Also, when hypnotised people are given false information, they tend to weave it into their memories (Sheehan & Statham, 1989).

Why, then, can some people remember more when they are under hypnosis? While it is true that hypnosis sometimes uncovers new information (Schreiber & Schreiber, 1999), there is no sure way to tell which memories are actually true and which are false (Perry et al., 1996).

Even when a memory is completely false, the hypnotised person's confidence in it can be unshakeable (Burgess & Kirsch, 1999). Most telling of all is that hypnosis increases the number of false memories more than it does true ones. Of the new memories produced by hypnotised subjects in one experiment, 80 per cent were incorrect (Dywan & Bowers, 1983).

Overall, it can be concluded that hypnosis does not greatly improve memory (Burgess & Kirsch, 1999). Clearly, hypnosis is not the 'magic bullet' against forgetting that some police investigators once thought it might be (Kebbell & Wagstaff, 1998).

CHECK YOUR UNDERSTANDING 4.5

1 The _____ _____ principle suggests that the more closely retrieval cues match the original learning conditions, the greater the chance of recall.

2 According to research into state- and context-dependent cues, which of the following techniques would most likely improve recall?

- **A** Sitting an exam in the classroom you usually learn in
- **B** Sitting an exam wearing your own clothes instead of a uniform
- **C** Sitting an exam early in the morning because you are more alert
- **D** Sitting an exam on your own because there are no distractions

3 Context-dependent cues aid retrieval by being in the same _____ you originally learnt in; state-dependent cues aid retrieval by being in the same _____ you originally learnt in.

4 Identify which of the following cues are state-dependent (S) and which are context-dependent (C).

- **a** Retracing your steps to find your keys
- **b** Taking deep breaths to relax in an exam like you do while studying
- **c** Sadness reminding you of other sad occasions
- **d** Remembering primary school memories when visiting your old school
- **e** Remembering how to get to the beach when arriving at an old holiday destination

5 When you form a mental picture of an item you wish to recall, this is known as visual:

- **A** association.
- **B** landscape.
- **C** plotting.
- **D** imagery.

context-dependent cues
Environmental cues in the specific context or environment where the memory was formed, which enhance the retrieval of memories formed in that context

imagery
Forming a mental representation, or mental picture, of an item or scene

state-dependent cues
Retrieval cues associated with your internal physiological or psychological state at the time the memory was formed, which enhance the retrieval of memories formed in that state

[ISBN 9780170182966]

Aiding memory retention

MNEMONIC DEVICES

Various 'memory experts' entertain people by memorising long lists of words, the names of everyone at a formal dinner, the order of all the cards in a deck, or other seemingly impossible amounts of information (see Figure 4.21). These tricks are not the result of a superior memory; rather, they are performed with the aid of mnemonic devices (Wilding & Valentine, 1994b).

Figure 4.21 Mnemonics can be used to remember the order in which cards have been pulled out of a deck.

A mnemonic device is any kind of system or technique that aids memory. For example, to remember the order of the four seasons, you can simply remember the word 'SAWS', and the season names will follow easily: Summer, Autumn, Winter and Spring. In some cases, the use of mnemonic devices increases recall tenfold (Patten, 1990). Mnemonic devices are particularly useful at the encoding stage of information processing. They also work best for remembering information that is to be memorised but not necessarily understood.

Mnemonic devices are useful because they allow us to retrieve information already stored in LTM. By linking new information to previously learnt information, mnemonics make retrieval easier because they enhance memory organisation. In this way, they help make meaningless information more meaningful, and therefore more memorable. Some simple mnemonic systems, such as rhymes and jingles, are so common that almost everyone knows them. For example, if you are trying to remember how many days are in a particular month, you may find the answer by reciting: 'Thirty days has September …' Mnemonics are effective because at the same time as information is encoded, retrieval cues that will make it easier to find the information are also encoded.

The superiority of mnemonic learning compared to *rote learning* (learning by simple repetition, usually applied to unfamiliar or meaningless information) has been demonstrated many times. For example, Gordon Bower (1973) asked students to study five different lists of 20 unrelated words. At the end of a short study session, subjects tried to recall all 100 items. Subjects using mnemonics remembered an average of 72 items, whereas members of a control group using rote learning remembered an average of only 28!

Many mnemonic strategies rely on imagery and mental association. According to Robinson-Riegler and McDaniel (1994), bizarre images can help improve immediate memory, and work best for simple information. Mental association involves creating meaningful connections between information to be learnt and information already stored in LTM. Mnemonic systems can be of practical value to you as a student. By practising mnemonics, you should be able to greatly improve your memory with little effort (Dretzke & Levin, 1996). We will now investigate several examples of mnemonic devices.

Watch 'Videolink: Mnemonic Wizards' to see mnemonic techniques in action at the US Memory Championships.

VIDEO
Mnemonic Wizards

Narrative chaining

Narrative chaining is a simple mnemonic strategy that links unrelated items to create a story-like sequence of events, also known as a narrative. Narrative chaining is particularly effective when we have to remember items of information that are not usually connected. The more unusual or exaggerated the link between the items, the easier it is to remember the information. It is also an effective technique for recalling information in a particular order.

Imagine you had to remember the following list of items: pig, cucumber, aeroplane, TV, saucer, ring, broom. By using narrative chaining to help you remember this information, you could organise the items into a story, such as: 'A pig was eating a cucumber while flying an aeroplane. He was frightened by a flying cup and saucer and crashed into a giant broom. The crash broke his TV and now his phone won't ring' (see Figure 4.22).

'Try it yourself 4.5' allows you to try this mnemonic technique for yourself.

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Figure 4.22 Narrative chaining is a useful mnemonic device to increase your chances of retrieving information from long-term memory.

TRY IT YOURSELF 4.5
Using mnemonics

Study the items in Figure 4.23. Using the mnemonic device of narrative chaining, construct a short story that includes all of the items. For an extra challenge, try to construct the story in the order the items appear in the photograph, from left to right.

Figure 4.23 Can you remember all of the items pictured?

Method of loci

A famous mnemonic system used first by the ancient Greeks is the method of loci, which involves committing a familiar location or sequence of locations to memory, and visually linking these locations with information that needs to be recalled. The locations act as retrieval cues that make it easier to retrieve the information when it is needed. When trying to recall the necessary information you could take either a physical or mental journey through each of the locations and then visualise the item that has been attached to the locations.

Orators and politicians of ancient times had to deliver long speeches. Since they did not have the advantages of technology (such as computers and tape recorders) that we enjoy today, they had to rely on their own memory. For this reason, they would often visit large buildings or temples, and as they walked through these places, they would note the floor plan and observe where specific objects were placed. Once this information was memorised, they visualised mental images of the information they needed to remember near specific objects in different rooms. Then when delivering a speech, they would imagine themselves walking through the fixed sequence of rooms in that particular building. By using associations they had earlier encoded, they would recall each point in their speech as they came to each object in a room.

VIDEO
Method of loci

See 'Videolink: Method of loci' to watch someone use the method of loci to explain how to solve a Rubik's cube blindfolded.

When creating your mnemonic using method of loci, locations such as your neighbourhood, the school grounds, or the layout of your house (see Figure 4.24) are probably the easiest to use. Remember, the number of objects or points located in the sequence must equal the number of items in your information list. Also, the method of loci works best when the items to be remembered are in a set order.

Acronyms

Another simple mnemonic device is the use of an acronym. An acronym involves using the first letter of each word to be remembered to create a pronounceable word or name. For example, 'sudden infant death syndrome' has become the acronym 'SIDS'. Other acronyms you are probably familiar with are ANZAC (Australian and New Zealand Army Corps) and QANTAS (Queensland and Northern Territory Aerial Service). When constructing an acronym, make sure the word is pronounceable; abbreviations such as AFL or IBM are not considered acronyms because the letters do not form a pronounceable word.

mnemonic device
: A system or technique that aids memory retention

mental association
: Creating a meaningful connection between information to be learnt and information already stored in memory

narrative chaining
: A mnemonic device that involves linking unrelated items to create a story-like sequence of events

method of loci
: A mnemonic device that involves visualising items to be recalled in a well-known series of locations, then taking a mental or physical journey through those locations to recall that information

acronym
: A mnemonic device involving constructing a pronounceable word using the first letter of each word of the information to be recalled

[ISBN 9780170182966]

ITEMS TO BE REMEMBERED

1 Dog	**10** Cup
2 Carrot	**11** Yellow
3 Scissors	**12** Hat
4 Mobile phone	**13** Shovel
5 Shoe	**14** 79
6 Bottle	**15** Sandwich
7 Flower	**16** Book
8 2004	**17** Car
9 Key-ring	**18** Purple

Figure 4.24 The method of loci: Imagining items to be remembered in particular rooms of a familiar house can aid recall of that information.

Acrostics

A similar technique to using acronyms is the use of acrostics. An acrostic involves making phrases or sentences from words that begin with the first letter of each word of the information to be recalled. For example, the names of the planets are often remembered by a phrase, such as 'My Very Elderly Mother Just Sits Up Near Pop' – the first letter of each word in that phrase corresponds with Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. (This phrase was developed before Pluto was declared a dwarf planet!) Or, if you have ever learnt a musical instrument, you may have learnt the lines on a stave by saying 'Every Good Boy Deserves Fruit' (see Figure 4.25).

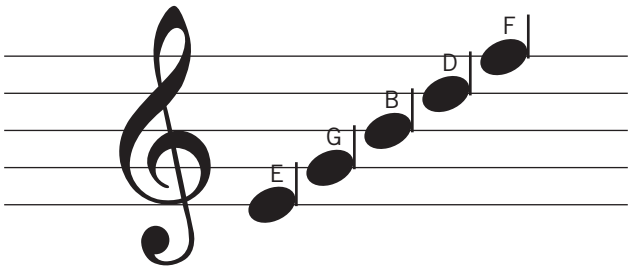


Figure 4.25 Music teachers can teach the lines on a stave by using the acrostic 'every good boy deserves fruit' to represent E G B D F.

Peg-word method

Another useful mnemonic device is the peg-word method. The peg-word method uses an easily-remembered rhyme to visually associate items to be remembered. The typical rhyme used in this method is: 'One is bun, two is shoe, three is tree, four is door, five is hive, six is sticks, seven is heaven, eight is gate, nine is vine, ten is hen.'

This rhyme can be used to remember a shopping list of (for example) bread, milk, carrots and washing powder. First, you must learn the rhyme. Then you visualise each item on your shopping list with the items in the rhyme. So, you may visually associate bread (the first item on your shopping list) with the first line of the rhyme by saying or imagining: 'one is bun – the bun is made of bread'. The second item is then assigned with the second line of the rhyme, and so on. For example: 'two is shoe – I spilt milk on my shoe', 'three is tree – there are carrots hanging from the tree' and 'four is door – using washing powder to wash the door' (see Figure 4.26).

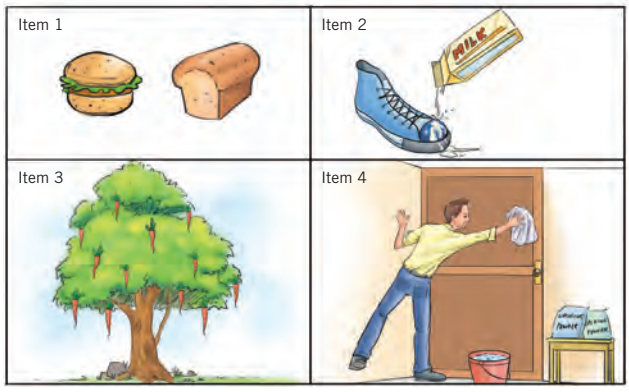


Figure 4.26 The peg-word method links a well-known rhyme to the information to be recalled.

In this way, the information to be recalled is 'pegged' to the rhyme. When recalling the information, you then recite the rhyme and the words that are associated with each line can be recalled.

The peg-word method can also be useful for remembering numbers. If you have to remember the locker code 3124 you can join the words tree (3), bun (1), shoe (2) and door (4) together in a story or sequence. For example, 'The tree was dropping buns, which I stepped on with my shoe, which I then left outside the door.'

There are many other mnemonic devices – such as songs and visual imagery – to help information to be encoded and therefore recalled more efficiently. Any technique that requires elaboration on the material to be learnt will enhance encoding and retrieval. Mnemonics clearly assist our recall of information in the short term, but may later prove more fragile than conventional memories over long periods of time. For this reason it is usually best to use mnemonics during the initial stages of learning (Carney & Levin, 1998), as mnemonics contribute very little to our long-term understanding.

What if the information we retrieve is incorrect? When information is encoded, it is done so according to our own perception of reality. This means that encoding is a personal experience and therefore subjective in nature. So, in light of this, how accurate is our memory? We will explore this question in the following pages.

CHECK YOUR UNDERSTANDING 4.6

1 A memory strategy or technique that is used to enhance memory is known as:
   - **A** a cue.
   - **B** a mnemonic device.
   - **C** a hint.
   - **D** a waste of time.

2 Narrative chaining involves linking _____ information into a _____ sequence of events.

3 The memory technique that visually associates items to be remembered with a well-known series of locations is known as:
   - **A** a state-dependent cue.
   - **B** narrative chaining.
   - **C** the method of loci.
   - **D** the peg-word method.

4 Indicate whether the following examples are an acronym (A) or not an acronym (N).
   - **a** NASA
   - **b** AFL
   - **c** RSPCA
   - **d** SAC
   - **e** NBA

5 An acrostic involves using the first letter of each word to be remembered to form a _____; whereas associating words to be remembered with a rhyme involving numbers is known as the _____.

Reconstructing memories

A common belief regarding memory is that it is a copying process. This belief suggests that the human brain handles the wealth of sensory information entering it from the external world in a similar way to tape recorders and cameras (Eysenck & Eysenck, 1994). However, psychologists know this is not the case. For example, the tip-of-the-tongue phenomenon suggests that memories do not always survive intact – sometimes only fragments of a word can be retrieved. The fallibility of memory was first investigated by Hermann Ebbinghaus and illustrated by the forgetting curve. However, it is not only the duration of memory that is limited; memory is also limited in its reconstruction.

Memory reconstruction involves remembering past events and features of these events and putting them together during memory recall. For example, you may be asked to recall your last birthday party. Certain features and fragments may come back to you, such as where it was held, who was there, what you were wearing and what happened. As all of these features and events are recalled, they are put together to reconstruct the memory of your last birthday. This seems easy enough to do, but the process of reconstructing memory may be harder than you think.

Research conducted by Sir Frederic Bartlett in 1932 illustrated just how problematic reconstructing memory was. Bartlett asked his English participants to read a North American Indian folktale called *The War of the Ghosts*, after which they had to try and recall the story. Bartlett found that when he asked participants to repeat the story they had read, they changed

acrostic
A mnemonic device that involves constructing a phrase or sentence from words that begin with the first letter of each word of the information to be recalled

peg-word method
A mnemonic device involving using a recognisable or easily-remembered rhyme to visually associate items to be remembered

memory reconstruction
Remembering past events and features of these events and putting them together during memory recall

it to fit their existing knowledge. They had fitted the story into their own experiences and it was this revised story that they recalled.

The participants' recall distorted the content and style of the original story. They shortened the story, and changed the phrases (and often words) to more familiar words and concepts than those used in the original story (e.g. they changed 'canoe' to 'boat') (Eysenck, 2004). 'A closer look: The War of the Ghosts' features the story they read and one participant's reconstruction of events in the story.

Bartlett's findings led him to propose the concept of schema – the preconceived idea of the world and the things in it, which is influenced by the cultural and historical contextualisation of memory (Hammond, 2003). This concept proposes that information is stored in a way that is personally meaningful and in line with our own culture and experiences of the world. For example, if you were raised on a farm, your schema of pigs might be 'brown, white or pink', 'harmless', 'useful for pork, ham and bacon', but if you were raised in the city and had little access to pigs, your schema of them might be 'pink', 'messy', 'smelly'.

A CLOSER LOOK

The War of the Ghosts

Following is the story of *The War of the Ghosts*, used by Sir Frederic Bartlett in his 1932 experiments.

One night two young men from Egulac went down to the river to hunt seals and while they were there it became foggy and calm. Then they heard war-cries, and they thought: 'Maybe this is a war-party'. They escaped to the shore, and hid behind a log. Now canoes came up, and they heard the noise of paddles, and saw one canoe coming up to them. There were five men in the canoe, and they said:

'What do you think? We wish to take you along. We are going up the river to make war on the people.'

One of the young men said, 'I have no arrows.'

'Arrows are in the canoe,' they said.

'I will not go along. I might be killed. My relatives do not know where I have gone. But you,' he said, turning to the other, 'may go with them.'

So one of the young men went, but the other returned home.

And the warriors went on up the river to a town on the other side of Kalama. The people came down to the water and they began to fight, and many were killed. But presently the young man heard one of the warriors say, 'Quick, let us go home: that Indian has been hit.' Now he thought: 'Oh, they are ghosts.' He did not feel sick, but they said he had been shot.

So the canoes went back to Egulac and the young man went ashore to his house and made a fire. And he told everybody and said: 'Behold, I accompanied the ghosts, and we went to fight. Many of our fellows were killed, and many of those who attacked us were killed. They said I was hit, and I did not feel sick.'

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

He was dead.

Bartlett, F. C. (1932) *Remembering*. Cambridge: Cambridge University Press.

Following is one subject's recall of the story two weeks later.

There were two ghosts. They were on a river. There was a canoe on the river with five men in it. There occurred a war of ghosts ... They started the war and several were wounded and some killed. One ghost was wounded but did not feel sick. He went back to the village in the canoe. The next morning he was sick and something black came out of his mouth, and they cried: 'He is dead' (Eysenck, 2004).

Another experiment that illustrates the impact that schemas have on memory reconstruction was conducted by Carmichael, Hogan and Walter (1932). The experimenters presented subjects the stimulus figure shown in the *middle* column of Figure 4.27. The experimenters then made remarks from a word list. For example, when presenting the fifth figure they would say either 'This drawing looks like eyeglasses' (using the word from word list 1) or 'This drawing looks like a dumbbell' (using the word from word list 2). Subjects were later asked to reconstruct the drawings they had seen. Based on the drawings they made, it was clear that subjects' drawings had been influenced by the words spoken by the experimenters as the original stimulus was shown. That is, participants presented with the fifth figure who heard the comment about the eyeglasses were likely to redraw the figure as a pair of eyeglasses. The participants presented with the same figure accompanied by the comment about the dumbbell were likely to redraw the figure as dumbbells. See the outside columns of Figure 4.27 for some examples of the redrawn figures. The research demonstrated that the experimenters had vocally provided schemas according to which the subjects organised their experiences and reconstructed their memories.

Findings such as these illustrate the number of factors that are at play when we reconstruct memories of personal events. Memory reconstruction can be influenced by our expectations, beliefs, experiences, ideals and mood, especially in times of high stress.

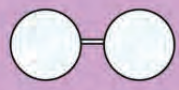
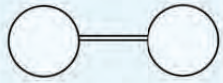
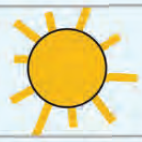
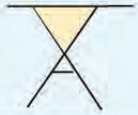
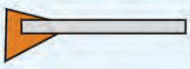
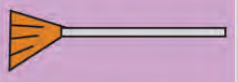
REPRODUCED FIGURE	WORD LIST 1	STIMULUS FIGURE	WORD LIST 2	REPRODUCED FIGURE
	Curtains in a window		Diamond in a Rectangle	
	Bottle		Stirrup	
	Crescent Moon		Letter C	
	Bee Hive		Hat	
	Eye Glasses		Dumbbells	
	Seven		Four	
	Ship's Wheel		Sun	
	Hour Glass		Table	
	Kidney Bean		Canoe	
	Pine Tree		Trowel	
	Gun		Broom	
2	Two	2	Eight	8

Figure 4.27 In an experiment by Carmichael, Hogan & Walter (1932) subjects were shown the stimulus figure (middle column) as the experimenter made remarks from one of the word lists (shown on either side of the middle column). The reproduced figures (shown in the outside columns) show that the remarks influenced the reconstructed memory.

[ISBN 9780170182966]

Payne, Nadel, Allen, Thomas and Jacobs (2002) investigated the effect that stress can have on memory reconstruction. They found evidence that, during times of stress, high levels of glucocorticoids are produced. Glucocorticoids are a group of steroid hormones involved in the metabolism of carbohydrates, fats and proteins, which have anti-inflammatory properties. High levels of glucocorticoids accompanying stress can impair the accuracy of episodic memories and lead to false memories. Memories of stressful events can be distorted – they may seem more severe or dramatic due to the heightened emotions experienced during this time. Stress can also reduce the attention we pay to certain stimuli, which leads our brain to fill in the gaps in memory and can lead to the formation of false memories.

Findings such as these have enormous implications for the accuracy of eye-witness testimony.

EYE-WITNESS TESTIMONY

Society relies on accurate accounts of an individual's memory through the use of eye-witness testimony. Eye-witness testimony requires people who have viewed an event (such as a crime or an accident) to give their personal account of the event. Police, judges, jurors and lawyers (among others) require that individuals' accounts of events are accurate – but how accurate is eye-witness testimony? See 'A closer look: Wrongful convictions' to read an article on recent examples of wrongful convictions due to inaccurate eye-witness testimony.

Figure 4.28 Eye-witness testimony is often relied upon during investigations of crimes that occur in public places.

A CLOSER LOOK

Wrongful convictions

The 1982 police line-up in which Ivan Henry was restrained in a police headlock was so obviously unfair that it would appear amusing were it not for the fact it was part of the evidence used to convict him of a series of rapes in Vancouver. One victim testified that she was 'pretty sure' that he was the person she remembered as her attacker.

He spent more than 26 years in prison before he was released on bail in 2009, following the release of information that pointed to another suspect as the actual perpetrator.

While his tainted line-up was an extreme circumstance, false identifications by well-meaning witnesses are not isolated occurrences. More than 75 per cent of convictions in the United States later overturned through DNA testing were a result of faulty eye-witness identification, according to data compiled by The Innocence Project, at the Cardozo School of Law in New York.

In 2009 James Bain was also freed after 35 years in prison in Florida, convicted of a rape that he did not commit. The conviction was based on a mistaken identification by the victim and Bain spent from ages 19 to 54 in prison, until he was cleared by DNA evidence.

In Canada, one of the best known instances of eyewitness evidence leading to a wrongful conviction was the case of Thomas Sophonow, who spent four years in prison before he was released and later cleared. The Sophonow Inquiry, conducted by Justice Peter Cory, included a number of recommendations in 2001 about how to conduct police line-ups to reduce the chance of eye-witness error.

Gradually, police departments across Canada are implementing those recommendations and starting to embrace more than two decades of research about witnesses and the frailties of memory.

Adapted from Kari, S. (2009). 'On Memory: Eyewitness errors costly.' *National Post* online. 22 December.

German psychologist Hugo Munsterberg was the first psychologist to question the accuracy of eye-witness testimonies. Munsterberg worried that innocent people were being imprisoned solely on the basis of what one or more witnesses said they remembered, because they may have actually remembered the event incorrectly (Eysenck & Eysenck, 1994). Research in this field has been conducted by Elizabeth Loftus. Loftus was particularly interested in the effect of leading questions, and the influence of the use of language during police questioning, in the reconstructive nature of memory.

An early study by Loftus (1975) asked participants to view a film of a car accident and then estimate the speed of the car that was involved. Half the participants were asked to estimate this speed as it 'passed the stop sign' and the other half were asked to estimate the speed as it 'passed the barn'.

As there was no barn present at any time in the film, this question was viewed as a leading question, because it involved presenting incorrect information as a means to create false memories.

A week later, all of the subjects were given a test on their memory of the accident. Seventeen per cent of the subjects who were originally asked about the barn claimed they saw a barn in the accident. Only three per cent of participants who were not asked the leading question claimed to have seen a barn (Davies & Houghton, 1991).

In a similar piece of research into leading questions, Loftus showed participants a scene and then asked them questions about it. The experimental group was asked, 'Did you see children getting on the school bus?' and the control group was not asked about the bus. There was in fact no school bus in the scene at all. A week later, participants in the experimental group were three to four times more likely to say there was a bus as compared with the control group (Gleitman, Fridlund & Reisberg, 1999). See 'Videolink: Eye-witness testimony' to view results from other studies by Loftus and her colleague John C. Palmer.

VIDEO
Eye-witness testimony

Loftus also investigated the *way* in which questions were asked and the *language used*. She found that observers were three times more likely to say they saw an item when asked, 'Did you see *the* [item]?' as opposed to, 'Did you see *a* [item]?' (Eysenck & Eysenck, 1994). Findings also demonstrated that when the cars in an accident were described as 'smashing' into each other, and participants were asked if there was broken glass in the scene, 32 per cent of witnesses claimed they saw broken glass. When the cars were described as 'hitting' each other, only 14 per cent reported seeing broken glass when asked. Of course there was no broken glass at the scene at all (Eysenck & Eysenck, 1994).

Earlier in this chapter we discussed the influence of distracters on recognition tasks. This is highlighted in eye-witness testimonies and police line-ups, in that it is important to include in police line-ups people who look similar to each other and the suspect.

Due to the effect of leading questions on our construction of memory, it is easy to see why leading questions are not permissible in court cases. Such questions allow for a false memory to be implanted in the minds of jury members. Watch 'Videolink: When eyes deceive' to see the effect of leading statements on memory formation and the fallibility of eye-witness testimony. Read 'Focus on research: The power of eye-witness testimony' to examine the impact of eye-witness accounts on jurors.

VIDEO
When eyes deceive

FOCUS ON RESEARCH

The power of eye-witness testimony

We have learnt that eye-witness testimony is not always reliable. But do jurors know this? It is often argued that despite the known limitations of human memory, jurors often overestimate the validity of eye-witness testimony. To illustrate this point, in one study mock jurors were presented with a case of an armed robbery that resulted in two deaths (Loftus, 1974). Some of the mock jurors heard only circumstantial evidence of the crime, while the others heard eye-witness testimony as well as the circumstantial evidence. Of the jurors who heard only circumstantial evidence, only 18 per cent wanted to convict the defendant. However, of the jurors who heard the eye-witness testimony, 72 per cent wanted to convict the defendant. Even when the eye-witness had only 20/400 vision (which is not very good eyesight!), 68 per cent of jurors found the defendant guilty (Flowe, 1996).

QUESTIONS

1. Identify the independent variable in this study.
2. Identify the dependent variable in this study.
3. What is a possible conclusion for this study?

Ethical principles and the study of memory

As seen in chapter 9, the use of appropriate research skills and procedures in psychology research is of utmost importance. When conducting research into human forgetting and memory, it is crucial that researchers obtain *voluntary participation* and *informed consent* from all participants. Memory ability can also be a very personal subject and, as such, the importance of confidentiality is always heightened when individuals' abilities are being compared and measured. As with any experimentation, it is vital that participants are aware of their *right to withdraw* and their *right to debriefing*.

schema
A preconceived idea that represents an aspect of the world or the things in it, influenced by culture and experience

eye-witness testimony
A statement from an individual who has viewed an event (e.g. crime or accident), giving their personal account of that event

leading question
A question that features incorrect information as a means of implanting false memories

[ISBN 9780170182966]

CHECK YOUR UNDERSTANDING 4.7

1 The process of remembering events and features of events to recall a memory is referred to as memory _____.

2 Indicate whether the following statements are true (T) or false (F).

- **a** Memory is exactly like the image taken by a camera.
- **b** Memory is a personal experience.
- **c** Everyone encodes memories in a unique way.
- **d** Memories are always recalled in the same manner.
- **e** Once a memory is formed, it cannot be changed.

3 There are many factors that can impact on the accuracy of memories of autobiographical events. Two of these are _____ and _____.

4 Which of the following statements regarding eye-witness testimony is correct?

- **A** The memory accounts of witnesses improve over time.
- **B** Leading questions are more likely to lead to inaccurate recall.
- **C** Memories are not changed once they are formed.
- **D** Eye-witness testimony is always accurate.

5 Which of the following ethical considerations must be adhered to when studying memory?

- **A** Informed consent
- **B** Withdrawal rights
- **C** Voluntary participation
- **D** All of the above

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Chapter summary

WORDCHECK TEST YOURSELF

Theories of forgetting:

- Forgetting is an inability to retrieve previously stored information from long-term memory.
- *Retrieval failure theory* suggests that forgetting occurs because we cannot access the correct retrieval cues to access the required memory.
- *Interference theory* suggests that forgetting occurs when other information blocks our retrieval of specific information. There are two types of interference: proactive interference is when old memories block the retrieval of recently learnt information; retroactive interference is where new information blocks the retrieval of old memories.
- *Decay theory* suggests that forgetting occurs because memory traces deteriorate over time due to lack of use.
- *Motivated forgetting* suggests that forgetting occurs because we block painful or threatening memories from our conscious awareness. This may be due to repression (forgetting without conscious awareness) or suppression (conscious forgetting).

Ebbinghaus' forgetting curve:

- Ebbinghaus' forgetting curve shows the typical amount and rate of forgetting for newly learnt information over time.
- The forgetting curve shows that forgetting is most rapid immediately after learning, but then slows down until the amount of forgotten information plateaus.
- Hermann Ebbinghaus favoured the use of nonsense syllables in his memory experiments because these are not linked with prior knowledge or experience.
- Although the shape of the forgetting curve remains the same, forgetting is much slower for meaningful information.

Measures of retention:

- *Recall* is the least sensitive measure of retention and involves reproducing information using few to no cues. There are three types of recall: free recall (no cues), cued recall (some cues) and serial recall (ordered recall, no cues).
- *Recognition* is a more sensitive measure of retention than recall. It involves selecting the correct alternative from a list of possible alternatives.
- *Relearning* is the most sensitive measure of retention. It involves learning information that has been previously learnt, as a means of assessing whether any information was retained from original learning. This is calculated using the savings score.

Memory enhancement:

- Memory can be enhanced using appropriate cues. Context-dependent cues aid retrieval by recalling information in the same place or setting as that in which it was learnt; state-dependent cues aid retrieval by recalling information while in the same physical or psychological condition as that in which it was learnt.
- Mnemonic devices can also aid memory. Techniques include: narrative chaining (creating a story that sequentially links the words to be remembered), method of loci (using a well-known series of locations to visually associate with words to be remembered), acronyms (constructing a word using the first letter of each term to be recalled), acrostics (creating a sentence using the first letter of each word to be recalled) and peg-word method (using a specific rhyme to associate with words to be remembered).

Reconstructing memories:

- Memory reconstruction involves remembering past events and features of these events and putting them together during memory recall.
- Research conducted by Sir Frederic Bartlett found that individuals fit new memories into their existing knowledge and personal experiences (their schema), leading to inaccurate reconstruction of memory.
- Eye-witness testimony can be influenced by leading questions and language use.
- Research conducted by Elizabeth Loftus has found that when asked leading questions such as 'Did you see children get off a school bus?', participants were more likely to report seeing a school bus a week later compared to those who were not asked the leading question.
- There is also evidence to suggest that emotive language such as 'car smash' as opposed to 'car crash' will result in an increase of reported damage at the scene of a crime.

Apply your knowledge and skills

SECTION A: MULTIPLE-CHOICE QUESTIONS

1 Herman Ebbinghaus' forgetting curve demonstrates that forgetting is most rapid:

A one week after learning.
B immediately after learning.
C two hours after learning.
D four hours after learning.

2 Ebbinghaus chose to use nonsense syllables in his experiments to test forgetting because these:

A are easier to encode.
B provide more retrieval cues.
C are more meaningful.
D lack meaning.

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3 A stimulus used to aid recovery of information stored in memory is called a:

A retrieval cue.

B mnemonic device.

C form of elaboration.

D theory.

4 Trying to memorise the order of items on a shopping list by creating a story in which each item is included is an example of:

A the method of loci.

B an acronym.

C elaborative rehearsal.

D narrative chaining.

5 Melissa is conducting an experiment into memory. She separates her classmates into two groups. Both groups look at a list of 20 nonsense syllables for one minute. Participants in Group A then write down as many words as they can remember, while Group B is given a list of possible alternatives and participants are instructed to circle the words they had seen. In this experiment, Group A is using _____ to access their memory, while Group B is using _____.

A recognition; recall

B recall; recognition

C recognition; relearning

D relearning; recall

6 Refer to Question 5. Based on past research into the relative sensitivity of measures of retention, what is the likely outcome of the experiment?

A Group A will remember more nonsense syllables than Group B.

B Group B will remember more nonsense syllables than Group A.

C Group A and B will remember the same number of syllables.

D It will depend on the gender of participants as gender differences may affect the results.

7 People are more likely to remember information when they are in the same environment where the original learning occurred. This illustrates the role of _____ in retrieval.

A recall

B rehearsal

C state-dependent cues

D context-dependent cues

8 When newly formed memories block the retrieval of old memories, this is described as:

A retroactive interference.

B proactive interference.

C retrograde amnesia.

D anterograde amnesia.

9 What does the savings score calculate?

A The amount of information lost over time

B The amount of information retained over time

C The percentage of information retained over time

D The percentage of information still to be learnt

10 Kat is trying to learn a list of cities for her Geography test. She decides to place them in alphabetical order and attaches each city to be remembered to a letter of the alphabet. Kat is trying to avoid which type of forgetting?

A Motivated forgetting

B Retrieval failure theory

C Amnesia

D Interference theory

11 Theories regarding motivated forgetting are supported by which famous psychologist?

A Freud

B Piaget

C Hudspeth

D Pavlov

12 Recalling information in the order it was presented, but with no cues, is known as _____ recall, whereas recalling information in any order with no cues is known as _____ recall.

A serial; free

B ordered; cued

C cued; free

D free; serial

13 Kubra has been trying to learn the periodic table of elements for Chemistry. At first she tries reciting them over and over again but this does not seem to improve her performance. She then constructs a memory aid that allows her to link the first letter of each element with the first letter in each word of a sentence that she constructed. She finds this technique much more effective. When Kubra uses the first letter of each element to be remembered to form a sentence, this is an example of:

A method of loci.

B an acronym.

C an acrostic.

D narrative chaining.

14 Memories that are consciously blocked from our conscious awareness are known as _____ memories; whereas those that are unconsciously blocked are known as _____ memories.

A repressed; motivated

B repressed; Freudian

C suppressed; repressed

D motivated; repressed

15 When Lewis learnt French in Year 7, it took 12 classes in total for him to learn the basics of the language. Considering that it only took him three classes to learn the basics of the language recently, what percentage of information has Lewis saved?

A 25%

B 33%

C 67%

D 75%

SECTION B: SHORT-ANSWER QUESTIONS

1 What does the forgetting curve show?

2 One technique for improving memory involves the use of a well-learnt sequence of locations as a series of cues for the information to be recalled. Name this technique, and explain how you would use it to remember a list of items on a shopping list.

3 Explain why the peg-word method is an effective technique for remembering items in order.

4 How do state-dependent cues help improve memory? Provide an example to help support your explanation.

5 Write the formula for the savings score.

6 Provide one finding of Loftus' work on the accuracy of eye-witness testimony.

7 What do psychologists mean by the term 'forgetting'?

8 Name one factor that increases the amount of interference experienced when studying for different subjects one after another.

9 What are two criticisms of the decay theory?

10 What is a mnemonic device?

SECTION C: EXTENDED-RESPONSE QUESTION

What is forgetting? Discuss the different theories that seek to explain why forgetting occurs and identify any limitations that may apply to these theories. *This question is worth 10 marks.*

SECTION D: ASSESSMENT TASK

Visual presentation

Complete each of the following tasks to demonstrate your understanding of the concepts. You must use both written explanations *and* visual representations. You will need three A3 sheets of paper or card.

Task 1: Forgetting

1 Create a flow chart that shows how retroactive and proactive interference occurs. Include an example within your flow chart and remember to clearly label where the interference has occurred.

2 Draw a diagram to show how retrieval cue failure and tip-of-the-tongue phenomenon occur.

3 Draw a graph showing Ebbinghaus' forgetting curve for meaningless information (remember to label each of the axes). Plot another curve on the same set of axes to show the rate and amount of forgetting that would occur for more meaningful information. Explain why there is a difference between these two curves.

Task 2: Measure of retention

1 Write 10 nonsense syllables in the middle of an A3 page.

2 Design separate tasks that could be used to test the recall, recognition and relearning of these syllables. On your A3 page, write/explain these tasks as branches coming out from the middle of the page.

3 Label each of the tasks from *most sensitive* to *least sensitive* measures of retention. Explain why this is the case.

Task 3: Mnemonic devices

1 Divide your A3 paper into four quarters.

2 Find a magazine and cut out pictures of five items that are available for sale. Arrange these pictures on the centre of the page and paste them down.

3 Write the name of the following mnemonic devices in each corner of the page: acrostics, narrative chaining, method of loci and peg-word method.

4 Under each method, explain how you would use that mnemonic device to remember the five items you found in the magazine.

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