Cognitive psychology

Models of memory

Specification content

- *The multi-store model, including the concepts of encoding, capacity and duration. Strengths and weaknesses of the model*
- *The working memory model, including its strengths and weaknesses*

Short-term memory and long-term memory

Psychologists distinguish between **short-term memory** (STM) and **long-term memory** (LTM). STM cannot hold much information and has limited capacity, whereas LTM can hold an apparently unlimited amount of information and has a vast capacity. George Miller theorised that the capacity of STM is approximately 'seven plus or minus two' pieces of information, but that this capacity can be extended by chunking, or combining, small pieces of information. The table below shows some of the ways in which STM and LTM are different.

Comparison of short- and long-term memory

Comparison	Short-term memory (STM)	Long-term memory (LTM)
Capacity	Limited (7 ± 2 chunks)	Potentially unlimited
Duration	Short (seconds only)	Possibly lifelong
Encoding	Acoustic (sound)	Semantic (meaning)

A study of encoding in STM and LTM (Baddeley 1966)

Aims: To show that STM is largely based on acoustic code; to find out whether LTM is also acoustically encoded, and to find out whether STM or LTM is semantically encoded.

Procedures: Participants were given four sets of words to recall: (1) acoustically similar (e.g. cap, can, map); (2) acoustically dissimilar (e.g. pit, cow, pen); (3) semantically similar (e.g. big, huge, large); (4) semantically dissimilar (e.g. good, hot, safe). One group was asked to recall words immediately (from STM) and a second group was asked to recall words after a delay of 20 minutes (from LTM).

Findings: The immediate recall (STM) group remembered fewer acoustically similar than acoustically dissimilar words. The delayed recall (LTM) group

showed no significant difference when remembering acoustically encoded words but differences in semantically encoded words.

Conclusions: Findings suggest acoustic encoding in STM but semantic encoding in LTM.

Criticisms: Control in laboratory experiments facilitates the identification of cause-and-effect relationships, thus the findings have high internal validity. However, laboratory experiments into memory only involve memory of facts rather than memory of experiences, thus because the findings apply only to limited aspects of memory, they have low external validity.

A study of capacity in STM (Jacobs 1987)

Aim: To research the capacity of STM.

Procedures: Participants were presented with strings of letters or digits and were asked to repeat them back in the same order. The length of the string was increased, from three to four, five, six etc., until the participant was unable to repeat the sequence accurately.

Findings: On average, participants recalled nine digits and seven letters. The average recall increased with age.

Conclusions: STM has a limited storage capacity of between five and nine items, but learned memory techniques (e.g. chunking) may increase capacity as people get older.

Criticisms: The research is artificial. In real-life settings people do not usually need to remember strings of meaningless numbers or letters, and the research therefore has low ecological validity. If the information to be remembered has more meaning, it might be remembered better.

A study of duration in LTM (Bahrick et al. 1975)

Aim: To study very long-term memories in a real-life setting.

Procedures: There were three tasks: (1) In a free recall test, 392 people were asked to list the names of their ex-classmates. (2) In a photo recognition task, participants were shown photographs of their ex-classmates and asked if they could remember the names. (3) In a name recognition task, participants were given names of their ex-classmates and asked to find the matching photographs.

Findings: Within 15 years of leaving school, participants could recognise 90% of the faces and names. Within 48 years of leaving school, participants could recognise 75% of the faces and names. Free recall memory had declined more than photo and name recognition memory.

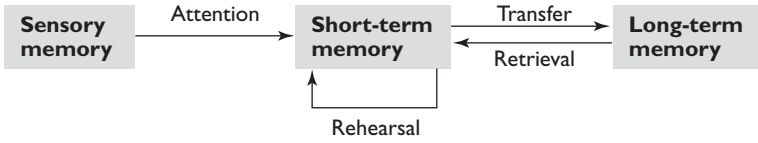
Conclusions: The study shows evidence of very long-term memories in a real-life setting. Since recognition was more accurate than free recall, there may be information stored in memory that can be accessed only when we are given an appropriate cue.

Criticisms: This study was undertaken in a real-life setting and the memories were meaningful to the participants, so it has high ecological validity. It is also has application in real life: for example, carers could show elderly people photographs of their friends and colleagues in the Second World War in order to engage them in conversation.

The multi-store model of memory (Atkinson and Shiffrin 1968)

Models, or theories, of memory aim to explain how information is transferred from STM to LTM, and why sometimes it is not.

In their **multi-store model of memory**, Atkinson and Shiffrin suggest that memory comprises three separate stores: the sensory memory store, the STM and the LTM. Each store has a specific function, as shown in the diagram.



Multi-store model

In the multi-store model, information is rehearsed in STM and, if rehearsed enough, is transferred to LTM.

There are three stages of information processing in the multi-store model of memory:

Stage 1: information is perceived (seen, heard etc.)

Stage 2: the information is transferred to STM, where it is maintained by rehearsal (if it is not lost or replaced by new, incoming information).

Stage 3: the information is transferred to LTM.

Research evidence (Glanzer and Cunitz 1966)

Participants were asked to recall word lists. When words were recalled immediately, early and later words were more likely to be recalled (primacy and recency effect) due to STM and LTM effects. **Primacy effect** occurs because the first words are likely to have been transferred to LTM. **Recency effect** occurs because the last words in the list are still in STM. If there was a delay of 10 seconds or more before recall, there was only a primacy effect — only LTM was affected. This demonstrates a difference between STM and LTM.

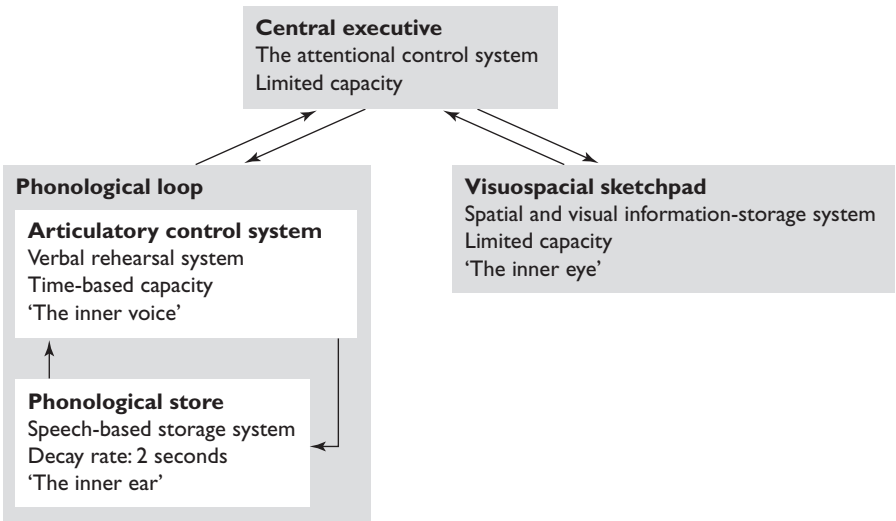
Evaluation

- A strength of the multi-store model is that it is simple and can be tested. Research evidence supports the idea that STM and LTM are qualitatively different types of memory. Moreover, we have all, from time to time, 'rehearsed' information and it seems to make sense that rehearsed information is more likely to be remembered.
- However, a weakness is that, in real life, memories are created in contexts rather different from laboratory-based 'free recall' experiments, so perhaps this model does not explain fully the complexities of human memory. In addition, the model suggests that memory is a passive process, whereas theories of reconstructive memory suggest that memory is an active process.

The working memory model of memory (Baddeley and Hitch 1974)

The Baddeley and Hitch model of working memory is more complex than the multi-store model, but it focuses solely on STM or, as Baddeley and Hitch call it, **working memory**. They propose a multi-store model of STM. In their model, STM is an active processor in which the central executive 'attends to and works on' either speech-based information passed to it from the articulatory–phonological loop or visually coded information passed to it by the visual system. The three components of this model are as follows:

- The **central executive** processes information from all sensory routes; this process is 'attention-like', having limited capacity.
- The **articulatory–phonological loop** processes speech-based information. The phonological store focuses on speech perception (incoming speech) and the articulatory process focuses on speech production.
- The **visuospatial working area** (also known as the 'visuospatial scratchpad') is where spatial and visual information is processed.



The working memory model can be tested by the **interference task** technique. This technique is based on the assumption that the articulatory–phonological loop and the visuospatial scratchpad both have limited capacity to process information, so when participants are asked to perform two tasks, using the same system at the same time, their performance is affected. For instance, repeating 'the' silently while reading is difficult because both of these tasks use the articulatory–phonological loop, which has limited capacity; it cannot cope with both tasks, so the performance of one or the other will be affected.

Evaluation

Strengths

- It suggests that rehearsal is an optional process, which is more realistic than the multi-store model, especially since we do not rehearse everything that we remember.
- The model can explain how we can successfully do two tasks at the same time if the tasks involve different stores, but why we have trouble performing two tasks at the same time if the tasks involve the same stores.

Weaknesses

- Least is known about the precise function of the most important component, the central executive, and the suggestion that there may be a single central executive may be inaccurate.

Memory in everyday life

Specification content

- *Eyewitness testimony (EWT) and factors affecting the accuracy of EWT, including anxiety, age of witness*
- *Misleading information and the use of the cognitive interview*
- *Strategies for memory improvement*

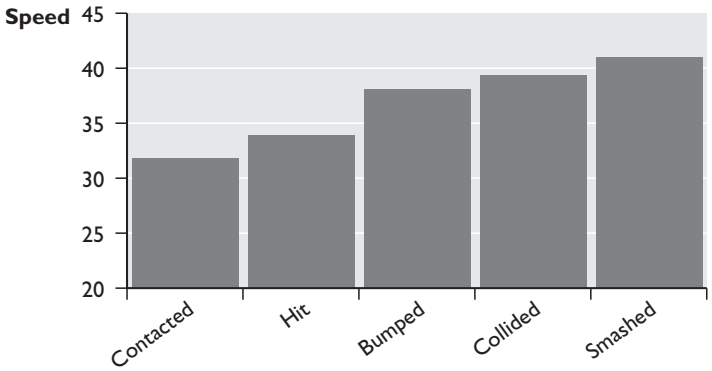
Research into eyewitness testimony (Loftus and Palmer 1974)

Loftus and Palmer conducted research into the accuracy of **eyewitness testimony** (EWT). In Experiment 1 they investigated the effect of **leading questions** on eyewitness accounts, and in Experiment 2 they investigated the effects that leading questions have on later memory of what happened. The leading question they asked was based on 'How fast were the cars going when they smashed into each other?' but the verb 'smashed' was varied to lead participants to perceive different speeds for the vehicles.

Experiment 1

Forty-five student participants viewed a short video of a car accident. The participants were divided into five groups of nine students. After watching the video, each group was given a questionnaire that included the leading question. However, a slightly

different version of the critical question was given to each group, in that the verb varied between 'smashed', 'collided', 'bumped', 'hit' and 'contacted'. As shown in the bar chart, the leading question affected the participants' perception of speed. The conclusion was that the way questions are worded may affect perception and recall.

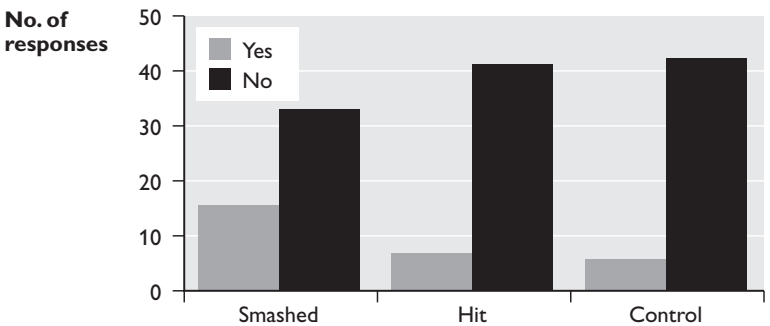


Experiment 1: estimated speed for verb used

Experiment 2

One hundred and fifty student participants (three groups of 50) viewed a short video of a car accident. Afterwards they were given a questionnaire. Again, the critical leading question was based on 'How fast were the cars going when they smashed into each other?' However, group 1 was asked the critical question containing the word 'hit', group 2 was asked it with the word 'smashed' and group 3 (the control group) was not asked the leading question.

A week later, the participants were asked to return and answer more questions, including 'Did you see any broken glass?' (there was no broken glass in the film clip). The findings are shown in the bar chart. Those participants who thought the car was travelling faster (the 'smashed' group) were more likely to report seeing broken glass. This suggests that their memory of a car travelling faster led them to 'invent' a memory in line with this expectation.



Experiment 2: response to 'Did you see any broken glass?'

The findings from these two experiments suggest that leading questions do have an effect on what eyewitnesses think they have seen.

Criticism: There is some evidence from real-life studies that recall is not affected by leading questions — perhaps because emotional arousal makes the original image stronger. However, the high levels of control in the laboratory experiment meant that it was possible to show clearly that EWT could be affected by the way questions were asked. The results have a useful application in real life — when the testimony of an eyewitness could lead to a person being convicted of a crime.

Eyewitness memory of a crime (Yuille and Cutshall 1986)

Aim: To examine eyewitness accounts of a real event.

Sample: 21 witnesses to a gun-shooting crime were interviewed by police. Four to five months after the incident, 20 witnesses were contacted and 13 agreed to be re-interviewed; 10 were male and 3 female and their ages ranged from 15 to 32.

Method: Case study of a real event (shooting). The initial police interviews were made available to the researchers and included a verbatim account of the event in the witness's words and their responses to a series of questions designed to clarify aspects of the event.

Research interviews were conducted 4–5 months after the event at a time and place chosen by the witness. Interviews were between 45 and 90 minutes long and followed the same procedures as the police interview: an account in the witness's own words followed by questions to clarify earlier points and solicit specific details. The questions included two misleading ones. One misleading question asked about a broken headlight: 6 of the witnesses were asked if they had seen 'the busted headlight' and the remainder were asked if they had seen 'a busted headlight' (there was no broken headlight). Another similar question was asked about a differently coloured panel on the car. These questions were chosen because, although the car was in full view of all the witnesses, the car did not play a major part in the event.

Scoring: The event was reconstructed from police evidence (photographs, confiscated weapons, witness descriptions etc.) and reports of other professionals attending the scene (ambulance men etc). Each detail recalled was awarded 1 point.

Results: The research interview elicited considerably more detail than the police interview:

- Police interview: number of details recalled 649.5
- Research interview: number of details recalled 1,056.5

Misleading questions had no effect.

Conclusion: This is a very different finding from most of the laboratory research conducted into EWT. There was a small amount of information reported that never happened (2.93% of action details reported to police, 3.23% in research interviews), but this is lower than is often reported by laboratory research.

Factors that may influence eye witness memory

- **Estimator and system variables.** These two main reasons for witness error were proposed by Wells (1978). **Estimator variables** are factors to do with the witness. They might include levels of stress and whether or not the criminal was carrying a weapon. **System variables** are factors where the justice system has some control, such as preventing the use of leading questions (e.g. Loftus and Palmer 1974).
- **Duration of event and time of day.** The longer we watch, the more likely we are to remember details. Witnesses also remember more when they see something during the day or at night, but twilight is not very good. It seems that people make more effort when it is dark because they know that viewing conditions are poor.
- **Violence distraction.** People have a better memory for non-violent events. Clifford and Scott (1978) showed their participants two short films, one violent and one not, and participants remembered more about the non-violent film.
- **The amount of time between an event and recall.** This will influence memory — the longer the time, the worse the recall. This is known as **trace-dependent forgetting**. Over time, the memory trace will disappear because when memory circuits are not activated for long periods, the connections between them may weaken to the point where the circuit is broken and the information is lost.
- **Emotion (stress).** Highly emotional events may be either more memorable or less memorable than everyday events. **Flashbulb memories** can be described as memories of emotional events that last for a lifetime. Christianson and Hubinette (1993) found that emotional involvement does increase the accuracy of memory. They interviewed 110 people who had witnessed a bank robbery. Witnesses who had been personally threatened during the crime, and who were more emotionally involved, had more accurate memories than the witnesses who said they were not very involved. However, Freud suggested that **repression** is the way we protect our ego (conscious mind) from unpleasant memories, and that unhappy or traumatic memories are more likely to be forgotten because we are unconsciously motivated to forget events that make us uncomfortable.

Improving the reliability of eyewitness testimony

The cognitive interview (Geiselman 1985)

The **cognitive interview** is a procedure used by the police to help eyewitnesses recall information more accurately. During the interview the witness is encouraged to:

- report every detail, no matter how seemingly trivial
- recreate the context of the event
- recall the event in different orders (in reverse, partially etc.)

- recall the event from other perspectives (imagining what someone in a different place may have seen)

While the interview is progressing, the police take care to:
- reduce the anxiety felt by witnesses
- minimise any distractions
- allow the witness to take his or her time
- avoid interruptions and leading questions

This type of interview has been found to achieve up to 35% improvement in the accuracy of recall, especially if the interview takes place shortly after the event.

Research evidence: the cognitive interview (Fisher et al. 1989)

Aim: To test the validity of the cognitive interview technique.

Procedures: 16 experienced police officers from Florida USA interviewed 47 witnesses or victims of shoplifting or mugging twice. Between the two interviews, 7 officers were trained to use the cognitive interview technique; the other 9 officers formed the control group. The independent variable was the type of interview, cognitive or standard, while the dependent variable was the number of accurately recorded facts elicited in the interview. The increase in the number of facts in the second interview was measured and two comparisons were made: (1) did the second interview gain more facts than the first interview? (2) did the cognitive interview gain more facts than the standard interview?

Findings: The cognitive interview gained 47% more facts than were gained in the first standard interview. There was no gain in facts in the second standard interview by the control group.

Conclusion: The cognitive interview is a useful technique for improving EWT.

Criticism: These were real officers and real witnesses, leading to high external validity. However, the control group officers were aware that they had not received training and this may have affected their motivation levels.

Strategies for memory improvement

Levels of processing theory (Craik and Lockhart 1972)

Craik and Lockhart theorise that whether or not we remember information depends on how it is processed. They describe three levels of processing:
- **iconic** — what information looks like (e.g. daughter)
- **acoustic** — what information sounds like ('doorter')
- **semantic** — what information means (female offspring)

In terms of levels of processing, iconic processing is shallow, acoustic processing is deeper and semantic processing is the deepest. Information that is processed deeply will be remembered better than shallowly processed information.

Based on Craik and Lockhart, one effective technique is known as **elaborative rehearsal**. An example of this might be to read the definition of a key term, study the definition of that term, and then read a more detailed description of what that term means. After repeating this process a few times, your recall of the information will be far better. Moreover, if you explain new concepts to others, this enhances your understanding and recall, so try to teach a friend what you are learning.

The organisation of memory (Collins and Quillian 1969)

Collins and Quillian proposed that concepts are stored hierarchically in our 'mental dictionary'. Relationships between concepts are represented within the hierarchy: for example, the concept of 'animal' would be stored at a node that is above 'bird', which would be stored above 'canary'. Connected to each category node are properties, such as 'has skin' and 'can move around' for 'animal'. Collins and Quillian predicted that the more closely situated on the hierarchy the concepts were, the faster they would activate each other: that is, people should be faster to say that the proposition 'Birds have feathers' is true than to say that 'Birds eat' is true.

If Collins and Quillian are correct, then when information is organised into clusters it is more likely to be remembered because each remembered concept will activate other related information. You can take advantage of this by grouping similar concepts and terms together, or make an outline of your notes and textbook readings to help group related concepts. Also by thinking about and establishing relationships between new ideas and previously existing memories, you can increase the likelihood of recalling the recently learned information.

Mnemonics

A **mnemonic** is a memory aid, often verbal, and sometimes in verse form, which can be used to remember lists. One common mnemonic device is to use an easily remembered word, phrase or rhyme, whose initials or other characteristics are associated with the list items. For instance, to remember the order of the colours in the spectrum (red, orange, yellow, green, blue, indigo, violet), 'Richard Of York Gave Battle In Vain' is popular. A mnemonic for approximating the digits of pi is 'May I have a large container of coffee?' because counting the letters in each word yields the sequence 3, 1, 4, 1, 5, 9, 2, 6.

Memory: glossary of terms

capacity: a measure of how much information can be stored in STM and LTM. Capacity of STM is thought to be 7 ± 2 chunks of information. LTM is thought to have unlimited capacity for many types of information.

cognitive interview: a procedure used by the police to help eyewitnesses recall information more accurately. During the interview the witness is encouraged to relax and recall everything they can remember, no matter how trivial the information appears. During recall the police do not ask questions or interrupt the witness.