Introduction to short and long-term memory

What is memory?

… A cognitive (thinking) process.

… A way of retaining information.

… A number of connected stores.

… Actual information retained.

According to Reber (1985), possibly all of the above. Memory has not yet been defined as a single process or fact and several theories exist about its nature, character and structure.

Memory is generally thought to be made up of three parts:

1. Sensory Register (your senses)

2. Short-term memory

3. Long-term memory

Both short-term memory (STM) and long-term memory (LTM) are studied in terms of their ability to encode (make sense of) information, capacity (how much information) and duration (how long information can be stored).

Short-term memory - Encoding

Conrad (1964) suggested that short-term memory codes all information acoustically, that is, according to sound. Visual information is encoded (transformed) to its acoustic (sound/language) codes.

Shulman (1970) disagreed and thought that short-term memory also coded information visually and according to semantics (meaning).

Heyer and Barrett (1974) suggested that visual images that are difficult to acoustically code may also be stored briefly in short term memory.

Research into encoding in short term memory - Shulman (1970)

This research suggests that Conrad was incorrect in proposing that all encoding in short term memory was acoustic.

Shulman presented participants visually with lists of 10 words. Recall was then tested using cue or probe words which were one of three types.

Firstly, some of the probe words used were homonyms (words, which sound the same but, have different meanings, for example: ball and bawl).

Secondly, some probe words were synonyms (different words with same/similar meaning, for example: talk and speak).

Thirdly, some of the probe words used were identical to the ones on the original stimulus list.

Similar numbers of errors of recall from the stimulus list was made for homonym and synonym probes. This suggests that the semantic encoding (meaning) as well as acoustic encoding occurs in the short-term memory.

Both the Conrad and Shulman research were laboratory experiments. They therefore lack ecological validity due to controlled artificial environments. Participants were undergraduate students and therefore unrepresentative of the general population. They may have exhibited demand characteristics and experimenter bias may have occurred, as the experiment did not employ blind conditions.

The results may also have been influenced by individual differences or participant variables. The research has good reliability.

Capacity of short-term memory
Capacity refers to the amount of information that can be stored in the short-term memory.

Miller (1956) suggested that most people store about seven independent or discrete items in short term memory. These items may be numbers, letters or words, etc. Miller referred to each of these items as 'chunks'.

For example: 7 6 5 4 3 2 1 = Seven discrete chunks.

Miller further suggested that the capacity of the short-term memory may be enlarged by grouping items together by associations/links they have with each other.

For example: 1+1 2+2 3+3 4+4 5+5 6+6 7+7 = Seven discrete chunks but combined according to same numbers therefore increasing capacity of short-term memory. Items are chunked according to the meanings they have in long-term memory.

Miller therefore suggested that about seven chunks of information may be stored in short term memory whether in single or combined forms give or take one or two chunks, "The magical number seven plus or minus two"_____ 7 +/- 2.

Research into capacity in short term memory Miller (1956)
Participants were given 'sentences' of varying lengths that approximated 'true' English. They were asked to recall words in the correct order given in the sentence.

The more sense the sentence made, in terms of grammar, the better the recall. This suggests that the semantic (meaning) and grammatical structure, which is probably stored in LTM, is used to help increase amount of information stored in STM by combining items to create larger chunks.

Participants still recalled about seven pieces of information.

Criticisms of this laboratory experiment include ecological validity, demand characteristics, experimenter bias and participant variables/individual differences. The experiment has good reliability. The research is dated.

Research into capacity in short term memory Bower & Springton (1970)
Participants were presented with one of two letter sequences. The first sequence was made up of well-known groups of letters - for example; mfi, plc, aeb. The second sequence contained the same letters but not in the well-known order: imf, lcp, eba. The first sequence was better recalled suggesting that chunking according to meaning increases the capacity of the short-term memory.

Criticisms of this laboratory experiment are as above for Millers research.

Duration of short term memory

Brown & Peterson & Peterson (1959) devised a technique that prevents information from being continually repeated in the STM in order to test how long information will be retained. This continual repetition of information in order to hold on to it is referred to as Maintenance Rehearsal. Brown & Peterson suggested that the short-term memory can store information for approximately 15 to 30 seconds if maintenance rehearsal is prevented.

Reitman (1974) suggested that this short duration is due to displacement; as new information is coming into the short-term memory it is kicking out the previous information due to its limited capacity (7 +/- 2 chunks).

Peterson & Peterson suggest that information decays (fades away) rapidly in short term memory unless rehearsal of that information occurs.

Research into Duration in STM: The Brown-Peterson Technique (1959)
This experiment involving remembering sequences of letters whilst counting backwards shows that in the absence of rehearsal, the short-term memory can only hold on to information for about 15 to 30 seconds. This illustrates what Brown & Peterson referred to as a Distractor Task or Interpolated Task and should have prevented you from rehearsing the information - the trigrams.

Brown & Peterson suggested that where information is continually rehearsed, it can be stored in the short-term memory indefinitely, but is lost as soon as interference blocks rehearsal. Ever been given a telephone number and had to keep repeating it avoiding all distractions until you wrote it down to prevent forgetting it? Then you were experiencing Maintenance Rehearsal.

Long-term memory - Capacity
Capacity (amount of information which may be stored) of the long-term memory is unknown. It is impossible to measure and may be limitless. The brains ability to store information is greater than the world's most powerful computer memory.

Duration in long-term memory
Information is thought to be stored permanently - for your entire lifetime. It is now thought possible that some memories may be genetically inherited and therefore lasts longer than a lifetime. The issue with duration in long-term memory relates to recall and forgetting.

Encoding in LTM
Two types of encoding are thought to operate in LTM.

Research into semantic encoding in long-term memory - Baddeley (1966)
Baddeley presented participants with four lists to remember:

List 1: man   map   can   cap

List 2: try   pig   hut   pen

List 3: great   big   huge   wide

List 4: run easy tug end

Participants had to recall as many words as possible immediately after presentation of lists and then try again 20 minutes later.

Baddeley found that the immediate recall was better for list 2 than for list 1 and with little difference in recall between lists 3 and 4.

List 1 contains similar sounding words and list 2 contains non-similar sounding words. When participants were then asked to recall words after twenty minutes they recalled list 4 better than list 3, list 4 contains words with non-similar meaning words and list 3 contains words with similar meanings.

There was little difference in recall for lists 1 and 2. This shows that the short-term memory tends to store information according to sounds rather than meaning and that the long-term memory tends to store information according to semantics (meaning) rather than simply sound.

Baddeley used a laboratory experiment and can therefore be criticised in terms of ecological validity, demand characteristics, participant variables/individual differences, experimenter bias and representativeness (Baddeley used undergraduate students as participants). Although it has good reliability.

The following table is a summary of what you have learnt about encoding, duration and capacity in the STM and LTM:

  Capacity:
 Duration:
 Encoding:

S

T

M
 Miller's

7 +/- 2 Chunks

The magical number seven plus or minus two.
 Brown & Peterson suggest 15 to 30 seconds
 Conrad suggested only acoustic process. Shulman suggested also visual and semantic processes.

L

T

M
 Unknown and impossible to measure. Maybe limitless.
 Relatively permanent. Relates to theories of recall and forgetting.
 Declarative and/or Procedural. Declarative may be Semantic and/or Episodic (Tulvig). Baddeley showed process was largely semantic.

Multistore Model - Atkinson and Shiffrin (1968)
Akinson and Shiffrin suggested that memory was comprised of three separate stores, the Sensory Memory Store, the short-term memory and the long-term memory. Each store had a specific and relatively inflexible function. Information is simply rehearsed in the STM and if rehearsed sufficiently is transferred to LTM. Information to be recalled from LTM passes back through STM producing the associated response.

Evidence for Multi-store Model:
1. Primacy - Recency Effect - Atkinson (1970): When presented with lists to remember we recall first and last items best. First items rehearsed into LTM and last items recalled from STM. Ones in middle less likely to be recalled. This is evidence for existence of several stores.

2. Brown - Peterson Technique: Suggests that if rehearsal of items is prevented then information does not enter LTM.

3. Amnesiacs caused by Korsakoffs Syndrome brought on by chronic alcoholism display sound STM functioning but impaired LTM. This suggests separate and distinct memory stores.

4. Shallice and Warrington (1970): Case study of K.F. who suffered brain damage because of motorbike accident. STM impaired but LTM intact.

Evidence against Multi-store Model:
1. De Groot (1966): Showed how expert chess players had phenomenal STM for chess positions as long as they fitted in with known rules. When pieces were randomly arranged their recall was no better than non-chess players therefore STM and LTM may not be so separate and distinct. Multi-store model is basic and limited in explaining such a complex phenomena as memory.

Working Memory - Baddeley & Hitch (1974)
An alternative to the Multi-store Model. Emphasises workings of STM. It is a far more complex explanation of STM. Rather than the STM being a single inflexible store, Baddeley and Hitch suggested that the STM was made up of several subsystems, each having a specialised function. They suggested that these subsystems were involved in complex cognitions/thought processes, including analysis and judgements about information input. Baddeley and Hitch provide evidence for this by people being able to carry out more than one task at once where both tasks involve STM functions.

Levels of Processing Model Craik & Lockhart (1972)
This model of memory concentrates on the LTM and the semantic processing occurring there.

It presents another alternative to the Multi-store model, which suggests information is transferred to LTM through rehearsal (repetition).

This model suggests that the depth or level at which we process information determines its place in LTM and also how well we recall that information.

So: the greater we think about information for whatever reason the more likely it will be remembered for longer.

Craik & Lockhart accepted Atkinson & Shiffrins separate stores but suggested that encoding and processing of information in LTM was more complex. They suggested that information could be processed or encoded at Shallow, Deeper and Deepest levels.

The deeper the processing the stronger and more durable the memory.

Craik & Lockhart suggested that semantic processing can operate at different depths of analysis, some being more complex than others which they referred to as Elaborate Semantic Processing. They used the laboratory experiment, which can be criticised in terms of validity and representativeness.

The variables identified may be difficult to operationalise as 'depth of processing' may be seen as a highly individual - deep for one person may be shallow to another. This makes generalisations difficult.

Bransford (1979) suggested that processing in LTM is even more complex than that proposed by Craik & Lockhart.

Forgetting in short-term memory - Decay in STM
Trace decay theory in STM relates to theories of Duration in STM.

The theory suggests STM can only hold information for between 15 and 30 seconds unless it is rehearsed Brown & Peterson (1959). After this time the information Decays (fades away). Waugh & Norman (1965) used the Serial Probe Technique to test the theory…

Participants were given a series of numbers to learn. They were then given one of the numbers and asked which number followed it. For example, participants were given the Probe word 7 and asked what followed it, the answer is 3.

The numbers were presented at different speeds therefore the faster the numbers presented the better the recall if Trace Decay theory is correct as the more likely the information is to remain in the STM.

The results did not support the theory. This research employed the laboratory experiment and its validity can therefore be questioned.

Displacement in STM
The idea of displacement in STM causing forgetting relates to the Capacity of STM as proposed by Miller (1956). It simply suggests that if the capacity of STM is limited to 7 plus or minus 2 items or chunks of information then STM is full then some of that information must be kicked out or displaced in order for new information to enter.

Retrieval Failure in LTM
This theory suggests that all information received is stored in LTM but that some information is difficult or impossible to access.

This idea is characterised by the Tip-of-the-Tongue Effect (TOT) where we know something but just cannot recall it. Retrieval of such information is thought to be dependent on three factors:

1. Firstly, Context-Dependent Retrieval suggests that recall of information depends on replicating the situation or context in which that information was originally encoded.

2. Secondly, State-Dependent Retrieval suggests that recall is improved if the individual is in the same physical and/or psychological state as when they first learnt the information.

3. Thirdly, recall may be by the presence of cues or probes, clues or associations.

Interference in LTM
This idea suggests that information in LTM may become confused or combined with other information during encoding thus distorting or disrupting memories.

Interference in LTM is thought to be either proactive where old memories disrupt new memories or retroactive where new memories disrupt old memories. Both Proactive and Retroactive Interference is

thought to be more likely to occur where the memories are similar - for example, confusing old and new telephone numbers.

McGeoch (1932) tested these ideas using laboratory experiments involving lists of single words or binary associations. The findings therefore can be criticised for their ecological validity including demand characteristics and representativeness thus making generalisations impossible.

Flashbulb Memories
Flashbulb memories involve the vivid recall of what individuals were doing when a major event occurred.

Source:
 Method:

Brown & Kulik (1977)
 Asked people a series of questions about 10 major events. Participants remembered where they were, what they were doing and the emotional impact it had. These memories may be seen as 'special' and are thought to involve special brain mechanisms.

Rubin & Kozin (1984)
 Showed that flashbulb memories are particularly powerful for personal events, such as love at first sight.

McCloskey (1988)
 Suggested that flashbulb memories are as prone to forgetting as ordinary memories.

Bohannon (1988)
 Suggested that flashbulb memories are not prone to forgetting when the event produced strong emotional reactions.

Repression (Freud)
Repression, according to Freud (1800s), is the unconscious forgetting of traumatic events, feelings, thoughts because they are too painful to remember.

These memories are said to be repressed or 'pushed out' of consciousness into the unconscious and are very difficult to recall. These repressed memories may be the cause of mental abnormality as they express themselves in some other way.

Source:
 Findings:

Williams (1994)
 Examined records of young women who had been treated for sexual abuse as children and seventeen years later 38% of them had no conscious recall of the abuse.

Zimbardo (1995)
 Reported the case of Eileen. In 1989, Eileen suddenly remembered the reason for her childhood friend, Susan's, disappearance twenty years earlier. Eileen's father had raped and murdered her. Eileen had repressed this memory due to threats from her father and the understandable trauma it caused. Her father was sentenced to life imprisonment.

False Memory Syndrome - Pynoos & Nader (1989)
 Recall of so-called repressed memories may be false although real to the person remembering them.

Repression as a theory of forgetting is based on Case Study evidence and therefore is impossible to generalise from or replicate. Case studies are highly subjective and tend to personal and subjective interpretations.

Critical Issue: Eyewitness Testimony
Reconstructive Memory - Bartlett (1932)
Barlett's theory of Reconstructive Memory is crucial to an understanding of the reliability of eye witness testimony (EWT) as he suggested that recall is subject to personal interpretation dependent on our learnt or cultural norms and values - the way we make sense of our world.

In other words, we tend to see and in particular interpret and recall what we see according to what we expect and assume is 'normal' in a given situation.

Barlett referred to these complete mental pictures of how things are expected to be as Schemas. These schemas may, in part, be determined by social values and therefore prejudice.

Reconstructive Memory The work of Loftus in this area, (1974)
Loftus drew on the ideas of Barlett and conducted research, illustrating factors, which lead to inaccurate recall of eyewitness testimony. Loftus & Palmer conducted two laboratory experiments to illustrate this reconstrutive memory and how questioning techniques used by the police influences this.

Experiment One:

45 participants involved using an independent measures design.

Participants were shown films of traffic accidents.

They were then given a general account of what they had just seen and asked a series of questions about it.

The critical question asked was 'About how fast were the cars going when they HIT each other?'

Or the word 'HIT' was replaced by either 'SMASHED', 'COLLIDED', 'BUMPED' or 'CONTACTED'.

The results suggested that participants recall was influenced by the word used - the independent variable. The word 'smashed' led to the fastest speed estimate and the word 'contacted' the slowest.

Experiment Two:

The experiment above could be explained by response bias - pressure from interrogator or a change in participants recall of the event because of word used in question.

Loftus & Palmer conducted this experiment in order to test which explanation was accurate.

150 students were tested using independent measures design.

Participants were shown a short film of a traffic accident.

They were then given a general account of what they had seen. They were then divided into groups of 50.

The first group was asked 'How fast were the cars going when they hit each other?'

The second group were asked 'How fast were the cars going when they smashed into each other?'

The third group were not asked the question at all and acted as a control group.

One week later they were asked a series of questions about the road traffic accident, one of which was the critical question, 'Did you see any broken glass? Yes or No?'

There was no broken glass in the film itself. The results suggested that the word 'SMASHED' not only led to estimates of faster speeds but also increased the likelihood of the participants recalling seeing broken glass when none was in the film.

This research suggests that memory is easily distorted by questioning technique and information acquired after the event can merge with original memory causing inaccurate recall or reconstructive memory. The addition of false details to a memory of an event is referred to as conflabulation.

The Loftus & Palmer experiment can be criticised for lacking ecological validity.

Face Recognition
The work of Loftus & Palmer can be applied to face recognition. This area of EWT has however been studied directly to order to avoid false accusations.

Source:
 Findings:

Cohen (1966)
 Cross-Race Identification Bias: Showed how faces are not seen in isolation but that they are perceived or influenced both by the event itself and by people's schema, social norms and values and therefore stereotyped images. Cohen referred to this as. He suggested that people find it easier to identify people from their own race than people from a different race.

Young
 Showed how we are more likely to wrongly identify someone the less we know them.

Dood & Kirschenbaum (1973)
 Illustrate the problem of facial recognition by their Case Study of Ron Shatford.

Well (1993)
 Showed how the witness assumes the suspect to be present in an identity parade, which again may lead to false recognition.

Lindsay (1991)
 Suggested that suspects in an identity parade should be viewed one at a time rather in a line-up in order to avoid functional size (fair number of feasible suspects to chose from) and reduce possibility of mistaken identity.

Bull & Rumsey
 Proposed that we judge people to be criminal on their appearance.