Encoding in short term memory

Conrad (1964) suggested that short-term memory codes all information **acoustically**, that is, according to sound.

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

Research into encoding in short term memory - Conrad (1964)

Participants were presented with a list of consonants for about ¾ of a second.

Participants were then asked to recall what they had seen.

Conrad found that errors of recall were linked to letters, which had a similar sound.

Bs were mistaken for Ps, Vs were mistaken for Ps, Ss were mistaken for Ps

This suggests that visually presented information is encoded according to acoustics/sounds. Conrad referred to these errors as **Acoustic Confusion.**

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.**

Miller further suggested that grouping items together by associations/links they have with each other might enlarge the capacity of the 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, **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 illustrates what Brown & Peterson referred to as a **Distractor Task or Interpolated Task** and should have prevented rehearsing the information - the trigrams.

This experiment shows that in the absence of rehearsal the short-term memory can only hold on to information for about **15 to 30 seconds**.

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.

Brown & Peterson employed a laboratory experiment and therefore may be subject to the criticisms above.

Long-Term Memory

Capacity in long term memory

Capacity of the long-term memory is unknown. It is impossible to measure and may be limitless.

Duration in long term memory

Information is thought to be stored permanently – for your entire 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

	Capacity	Duration	Encoding
STM	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.
LTM	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 (Tulving). Baddeley showed process was largely semantic.

Models of Memory

Multistore Model - Atkinson and Shiffrin (1968)

Atkinson 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. This model is represented below as a diagram.

The Multi-store Model

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 (1974) provide evidence for this by people being able to carry out more than one task at once where both tasks involve STM functions.

According to Baddeley & Hitch your willing subjects should have done both tasks successfully.

However according to Miller and his 7 +/- 2 theory and Atkinson and Shiffrin the STM reached full capacity by attending to the letters only.

Therefore the STM is more complex and may have several subsystems that can operate simultaneously.

Baddeley & Hitch suggested the existence of several subsystems in STM but they studied the possibility of two in particular which a central controlling mechanism, which they termed the Central Executive, governed.

This fat controller is the boss and supervises and coordinates the other subsidiary systems. The central executive decides which information is attended to and which parts of the **working memory** to send that information to be dealt with.

The two subsystems studied were named the **Visuo-spatial Sketchpad** and the **Phonological/Articulatory Loop**.

The Visuo-spatial Sketchpad deals with what information looks like and how it is laid out - it deals with visual and spatial information.

The Phonological Loop holds spoken information for about 1.5 to 2 seconds. Written words must be converted to spoken words to enter phonological loop. The Articulatory loop rehearses the spoken/acoustic information from the phonological store and also converts written material to acoustic material so that the phonological loop can deal with it.

There is little empirical evidence to support the Working memory Model but the recognition of the complexity of the STM makes sound theoretical sense. However some brain damaged patients appear to suffer impairment to some functions of STM and not others (Shallice & Warrington '1974) therefore suggesting existence of several specialised systems within STM.

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.**

Craik and Lockhart 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.

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. 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**, which suggests that recall of information, depends on replicating the situation or context in which that information was originally encoded.

Godden & Baddeley (1975) provided evidence for this by asking participants to learn a list of words either on land or 15 ft underwater. They were better able to recall words if asked to do so in the setting in which they originally learnt them.

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.

Godwin (1969) investigated the effect of alcohol on recall and found individuals were better able to recall information learnt when drunk if they were drunk. Other drugs seem to affect memory similarly. Bower (1981) however found that the same principle applied to mood did not have such a convincing effect but only a tendency to produce **State-Dependent Retrieval.**

3. Thirdly, recall may be by the presence of cues or probes, clues or associations. This is referred to as **Cue-Dependent Retrieval**, Tulving & Pearlstone (1966).

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

Flashbulb Memories

Flashbulb memories involve the vivid recall of what individuals were doing when a major event occurred. This event may be a public or a private occurrence.

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, and 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.
There is increasing evidence of repressed memory in cases of childhood sexual abuse. **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.
Often however repressed memories are difficult to substantiate which has led to the notion of **False Memory Syndrome** (Pynoos & Nader 1989) where 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)

Bartlett's theory of **Reconstructive Memory** is crucial to an understanding of the reliability of eyewitness 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 interpret and recall what we see according to what we expect and assume is 'normal' in a given s ituation.
Bartlett 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**.
Schemas are therefore capable of distorting unfamiliar or unconsciously s 'unacceptable' information in order to 'fit in' with our existing knowledge or schemas. This can, therefore, result in unreliable eyewitness testimony.
Bartlett tested this theory using a variety of stories to illustrate that memory is an active process and subject to individual interpretation or construction.
The War of the Ghosts.
According to Bartlett the recall showed westernised interpretation of the

American Indian folk tale thus illustrating your subjective memory construction rather than accurate objective recall of events.

Reconstructive Memory - Loftus (1974)

Loftus drew on the ideas of Bartlett and conducted research-illustrating factors, which lead to inaccurate recall of eyewitness testimony. Loftus & Palmer (1974) conducted two laboratory experiments to illustrate this **reconstructive 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 participant's 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 **confabulation.**

The Loftus & Palmer experiment can be criticised for lacking **ecological validity**. It employed **independent measures design** and therefore may be explained by **individual differences/subject variables.** The **controlled conditions** make for sound **reliability** the **ethics** of this design may be questioned, as the participants were **deceived** but this was necessary in order to **validate findings** and minimise **demand characteristics**. The participants may have been distressed/traumatised by the film and this emotional reaction may have influenced their interpretation of the event. This kind of research has led to recommendations concerning police interview techniques and can be used by lawyers in court to question the accuracy of EWT.

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.

Cohen (1966) 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 **Cross-Race Identification Bias**. Cohen suggested that people find it easier to identify people from their own race than people from a different race. This is reflected in the statement, **'They all look the same!'**

Therefore when an eyewitness and a possible suspect are from different races the identification of the suspect must be treated with caution. Cohen illustrated this by asking 86 shop workers in Texas to identify three customers, one White, one African-American and one Mexican-American who had purchased something from the shop that day. One third of the customers were White, one third African-American and one-third Mexican-American.

The accuracy of their recall was different for customers of different races and was related to the race of the shop worker. This research may have involved demand characteristics and individual differences.

Young showed how we are more likely to wrongly identify someone the less we know them. Young asked 22 participants to record how many times they made errors in recognising people over an eight-week period. There were 314 cases of mistaking a stranger for someone they knew because of similarity or dress or build. This research has implications for face recognition in identity parades.

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

The witness had described the suspect as 'attractive'. Shatford was placed in an identity parade in which in which he was the only 'attractive' member. He was wrongly selected.

Case studies are unrepresentative, making generalisations impossible.

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

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