

To what extent has psychology revealed the nature of memory?

The extent that psychological research has revealed the nature of memory can be shown in through research and studies into different aspects of different types of memory. Research has mostly looked into the encoding, storage and duration of short-term and long-term memory.

Jacobs (1887) did research into the capacity of short-term memory with the aim to investigate how much information can be held in the short-term memory. To do this, he devised a technique called the "serial digit span", which involved strings of digits which had to be recalled in the order in which they were given. He conducted a laboratory experiment in which participants were given these strings of number and asked to recall them in order, with the strings starting with 3 digits and increasing until the participant consistently failed to correctly reproduce the findings. He found that the average length of string remembered was between 5 and 9 items, with digits being recalled better than letters. Individual differences such as age affected the average amount of items correctly recalled, thus the conclusion that the short-term memory's capacity was 7 ± 2 (between 5 and 9) digits. This research, however, found that other factors could affect the length of the string remembered, such as memory techniques like "chunking". The research was also did not have mundane realism so it could not be generalised, and because strings of digits are meaningless, the capacity of the short-term memory could have been shorter.

Miller coined the term "chunking" and established that the capacity of short term memory was 7 ± 2 *chunks* rather than just individual digits. A "chunk" is a meaningful block of information, such as the word "cat" — it is not remembered as "C" + "A" + "T" (which would, by Jacobs' findings, take up three STM blocks), but it is instead remembered as the word "cat", which takes up one "chunk". Simon (1974) tested this Miller's theory that the size of the chunks is irrelevant to the amount remembered by presenting participants with multi-word phrases, with each multi-word phrase being regarded as a chunk — he found that in a two-word phrase the average capacity was four units, and in an eight-word phrase the average capacity was three units, concluding that the size of chunks does affect the amount of chunks held in the short-term memory.

There are problems with these pieces of research, though, in that they are not ecologically valid since the tasks presented to participants in these experiments is not likely to happen in real life, and therefore the results cannot be generalised into how the short-term memory works in real life. It does, however, help suggest how certain every-day tasks such as remembering phone numbers are carried out. It also supports the idea that the short-term memory has a very limited capacity, and the 7 ± 2 chunks model is often used when talking about short-term memory.

To this date, research into the capacity of long-term memory has not found any conclusive answers, and the assumption exists that the long-term memory either has no maximum capacity, or that its capacity is so great that humans cannot live for long enough to discover the limit.

The duration of short-term memory was researched by Peterson and Peterson (1959). Their aim was to investigate how long it is before memories disappear from the short-term memory if there is no chance for rehearsal, and was carried out by giving 24 students series of nonsense trigrams to remember. After they were presented with each series, the students would be asked to count down in threes from a randomly selected three-digit number for 3, 6, 9, 12, 15 and 18 second intervals, and then recall the trigrams correctly in the order they were given. They found that, as the interval increased, the percentage of trigrams correctly recalled decreased, and less than 10% were successfully recalled after 18 seconds, compared with 80% after 3 seconds. This supported their hypothesis that short-term memory decays after roughly 20 seconds if rehearsal is prevented, and it suggests that there is a distinction between short- and long-term memory. It also suggests that rehearsal is important in remembering information, and it is one of the techniques used in retaining information for extended periods of time (and keeping it in the long-term memory).

Murdock (1962) tested the effects of primacy and recency in free-recall of a list of words, and found that the first and last words on a list of 20 words were remembered more than the words in the middle. He concluded that this is because the words at the start of a list can be rehearsed whilst the others are being read out, and the ones at the end can be remembered because they are fresh in the mind, and can be rehearsed after the word list has been read out, but the words in the middle are often forgotten because there is no chance of rehearsal for them. This supports the assumption that rehearsal increases the recall rate of words.

As with the studies into capacity of the short-term memory, Peterson and Peterson (1959) and Murdock's (1962) studies into its duration were laboratory experiments which entailed tasks which were very unlikely to occur in day-to-day life, so they lack ecological validity. As a consequence, the results cannot be generalised, though the experiments do give us an insight into the duration of short-term memory. Another criticism is that Peterson and Peterson's (1959) study was carried out only on students, which is a biased sample resulting in lack of population validity. However, the research carried out by Peterson and Peterson (1959) and Murdock (1962) agree that the duration of short-term memory is very short, and that rehearsal increases the duration of the memory trace.

There has also been research into the duration of long-term memory. An example of this is Bahrick *et al.* (1975) who wanted to investigate the duration of the very-long-term memory and demonstrate that the duration of the long-term memory is infinite. In the study, 392 American ex-high school students were asked to do one of four tasks — a free recall of as many names of their former classmates as possible; a photo recognition test where they had to pick out photographs of their former classmates from a set of 50 photographs, some of which weren't former classmates; a name recognition test; and a name and photo matching test. They found that classmates are rarely forgotten after recognition cues have been given and that, for particular types of information, the long-term memory has no clear limit.

Because this research was a field experiment, with the participants identifying people that had been part of their lives, the experiment had high ecological validity, however remembering classmates is a very particular type of information for which the participants could have had a lot of rehearsal. This means that the results cannot be generalised, though it does demonstrate that memory can endure for very long periods of time.

Another aspect of both short- and long-term memory is their encoding. The encoding of a memory is what form the memory is stored in when it is held by a particular memory store. Conrad (1964) did research into encoding and argued that the short-term memory encodes information acoustically, however he did not say what type of encoding is used by the long-term memory. Baddeley (1966) aimed to investigate encoding in the short- and long-term memory, predicting that acoustic encoding would be the preferred method in short-term memory and semantic encoding would be preferred in the long-term memory. To test this hypothesis he conducted a laboratory experiment using an independent measures design. He presented participants with lists of words to remember and then recall, with the different types of word list containing words which were acoustically similar, semantically similar, acoustically dissimilar and semantically dissimilar. He analysed the results by looking at the amount of substitution errors made. With immediate recall (short-term memory) he found that there were more errors in the acoustically similar word list than in any of the others, therefore confirming the results found by Conrad (1964). With delayed recall (long-term memory) he found that more errors came from the semantically similar word-list, again with the other lists having fewer errors. This suggested that, as he predicted, the long-term memory encodes information semantically.

The results of this experiment seem fairly conclusive, though there are issues with the realism and validity because the experiment was carried out in a laboratory and participants were given tasks which were not likely to occur in real life.

Also, there are other types of encoding which were not tested in this experiment, such as visual encoding — for example, research by Brandimonte *et al.* (1992) supports the theory that some memories are encoded

visually. This research consisted of participants being shown six-line drawings of familiar objects, and then they were asked to visualise the object and subtract a part of it and name the resulting image. Some were asked to do this whilst repeating a meaningless chant (disabling the use of acoustic encoding), and results from the investigation show that if acoustic encoding is prevented, visual encoding can be substituted in short-term memory. This contradicts Conrad's (1964) conclusion that encoding in short-term memory is all acoustic, instead suggesting that it is *primarily* acoustic, and other forms of encoding exist in the short-term memory.

It can therefore be concluded that research into memory has revealed its nature to a considerable extent, but there is still a large amount left undiscovered. Many theories about different aspects of memory have gone a long way to help psychologists understand it and its processes, such as the encoding, capacity and duration of short-term memory. The capacity of long-term memory, for example, remains unknown as it is seemingly so vast, and many other features of both types of memory remain undiscovered.