

## 17. MEMORY

In [psychology](#), memory is an organism's ability to store, retain, and recall [information](#). Traditional studies of memory began in the fields of [philosophy](#), including techniques of [artificially enhancing the memory](#). The late nineteenth and early twentieth century put memory within the [paradigms](#) of [cognitive psychology](#). In recent decades, it has become one of the principal pillars of a branch of science called [cognitive neuroscience](#), an interdisciplinary link between [cognitive psychology](#) and [neuroscience](#).

### **Sensory memory**

Sensory memory corresponds approximately to the initial 200 - 500 [milliseconds](#) after an item is perceived. The ability to look at an item, and remember what it looked like with just a second of observation, or memorization, is an example of sensory memory. With very short presentations, participants often report that they seem to "see" more than they can actually report. The first experiments exploring this form of sensory memory were conducted by George Sperling (1960) using the "partial report paradigm." Subjects were presented with a grid of 12 letters, arranged into three rows of 4. After a brief presentation, subjects were then played either a high, medium or low tone, cuing them which of the rows to report. Based on these partial report experiments, Sperling was able to show that the capacity of sensory memory was approximately 12 items, but that it degraded very quickly (within a few hundred milliseconds). Because this form of memory degrades so quickly, participants would see the display, but be unable to report all of the items (12 in the "whole report" procedure) before they decayed. This type of memory cannot be prolonged via rehearsal.

### **Short-term**

Short-term memory allows recall for a period of several seconds to a minute without rehearsal. Its capacity is also very limited: [George A. Miller](#) (1956), when working at [Bell Laboratories](#), conducted experiments showing that the store of short term memory was  $7 \pm 2$  items (the title of his famous paper, "[The magical number 7±2](#)"). Modern estimates of the capacity of short-term memory are lower, typically on the order of 4-5 items, and we know that memory capacity can be increased through a process called [chunking](#). For example, in recalling a 10-digit [telephone number](#), a person could chunk the digits into three groups: first, the area code (such as 215), then a three-digit chunk (123) and lastly a four-digit chunk (4567). This method of remembering telephone numbers is far more effective than attempting to remember a string of 10 digits; this is because we are able to chunk the information into meaningful groups of letters. Herbert Simon showed that the ideal size for chunking letters

and numbers, meaningful or not, was three. This may be reflected in some countries in the tendency to remember telephone numbers as several chunks of three numbers with the final four-number groups, generally broken down into two groups of two.

Short-term memory is believed to rely mostly on an acoustic code for storing information, and to a lesser extent a visual code. Conrad (1964) found that test subjects had more difficulty recalling collections of words that were acoustically similar (e.g. dog, hog, fog, bog, log).

### **Long-term**

The storage in sensory memory and short-term memory generally have a strictly limited capacity and duration, which means that information is available only for a certain period of time, but is not retained indefinitely. By contrast, long-term memory can store much larger quantities of information for potentially unlimited duration (sometimes a whole life span). The capacity can also approach infinity (unlimited). For example, given a random seven-digit number, we may remember it for only a few seconds before forgetting, suggesting it was stored in our short-term memory. On the other hand, we can remember telephone numbers for many years through repetition; this information is said to be stored in long-term memory. While short-term memory encodes information acoustically, long-term memory encodes it semantically: Baddeley (1966) discovered that after 20 minutes, test subjects had the most difficulty recalling a collection of words that had similar meanings (e.g. big, large, great, huge).