**Student Information Supplementary Pack**

**Research Studies into the coding, duration and capacity of Sensory Register, STM and LTM**

Unit 1

Memory (supplementary)



**This pack contains information about research studies demonstrating the coding, capacity and duration of the sensory register, short-term memory and long-term memory**

**Summary of the research**

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|  | **Sensory Register** | **Short-term memory** | **Long-term memory** |
| **Coding** | *Separate sensory stores for different sensory inputs* | Crowder (1993) | *Mainly acoustic (by sound) but other codes used too* | Baddeley (1966): immediate recall study | *Mainly Semantic (by meaning) other codes used too* | Baddeley (1966): delayed recall study |
| **Capacity** | *Huge* | Sperling (1960) | *Small (5 – 9) chunks of information* | Jacobs (1887) | *Huge* | Standing et al (1970)Anokhin (1973) |
| **Duration** | *Brief (between ½ and 3 seconds) varies between sensory stores* | Treisman (1964)Walsh and Thompson(1978) | *Short (maximum of 30 seconds)* | Peterson and Peterson (1959) | *Potentially for a life time* | Bahrick et al (1975) |

**Sensory Register – Coding – Crowder 1993**

Supporting evidence: Crowder (1993) suggests that the different duration in SR between echoic and iconic registers suggests that information is coded according its sense modality. For example

Iconic register: memory for visual information (1/2 a second)

Echoic register: memory for auditory information (2 seconds)

This demonstrates that the information is coded depending on the sense modality which registers it, and it is suggested that it is pre-perceptual, that is that very little processing, if any, is conducted on the information

**Evaluation:** Because of the nature of the topic, there is very little scientific evidence into the coding of information in sensory memory.

**Sensory Register – Capacity – Sperling 1960**

The discovery of iconic memory is due to George Sperling (1960). The starting point for Sperling's work is the classical experiment on the determination of the memory-span. If a certain number of elements, letters, for example are presented using a tachistoscope (a mechanical device before modern computers which could display a stimulus for a fraction of a second) it can be seen that the number of correct responses does not exceed 4 to 5 regardless of the number of letters presented. So if the stimulus on the right was flashed for 50msecs (50 one thousands of a second), one would only expect the letters F, C, H, J and D to be recalled (for example). If fewer than five letters are presented, usually all the letters are recalled.

Sperling's main contribution to the understanding of the capacity in sensory register was to develop the *partial report* procedure. In one of his experiments he presents a matrix of 3 lines of four letters (see stimulus above) each to his participants for 50msec. If the participant is asked to reproduce what he has seen, on average four answers are correct. Under partial report procedure a high-, medium- or low- pitched tone is produced at the same time as the presentation is over and the task given to the participant is to reproduce only the first, second or third line according to the pitch of the tone. Most participants were able to correctly recall at least three corresponding letters. Since the participant was unable to foretell what line he would be asked for to report, it must be acknowledged that immediately after the end of the presentation, the information necessary to recall the letters had to be available somewhere.

This led Sperling to the hypothesis that one form of presentation of the visual stimulation remains accessible for a short time after the presentation. The reason why it is not possible to reproduce nine elements in the case of whole report procedure is that the whole picture (the iconic trace) deteriorates while the first elements are being recalled and by the time it takes to recall four or five elements there is no longer any iconic memory available.

**Evaluation**: The highly artificial situation that Sperling created means that we know very little accurate detail about sensory memory capacity in real life settings, thus we can argue his study lacks mundane realism. It is also very difficult to measure behaviour within with short periods of time with any validity

Although there is evidence for the capacity in iconic sensory memory, there is very little research on other sensory memory types, such as echoic or haptic memory, this is because it occurs to quickly to study with any validity

**Sensory Register – Duration - Treisman 1964; Walsh and Thompson 1978**

Treisman (1964) presented identical information to both ears through headphones but with a slight delay. At 2 seconds or less, participants could state that the messages were identical. After 2 seconds, this task became more difficult and errors were made. This suggests an echoic memory in SR of around 2 seconds.

For Iconic memory, Walsh and Thompson (1978) flashed images of the letter ‘O’ twice with a very brief interval between each presentation. The researchers recorded the interval from which participants could only report that they saw a continuous stimulus. It was found that people had an iconic sensory store for about 500mseconds (half a second)

**Evaluation:** The highly artificial setting of the laboratory means that it is difficult to accurately predict similar findings in real life situations, where the environment would be noisier or with more fleeting images, so mundane realism is an issue with such studies.

**Short-term memory – Coding – Baddeley 1966 (i)**

Baddeley was interested in how information was coded in both STM (i) and LTM (ii).

Participants were divided into groups (independent groups design) and given different lists of words to learn:

* Acoustically similar words (they sound the similar) e.g. man, mad, map
* Acoustically dissimilar words e.g. pen, day few
* Semantically similar words (they mean similar things) e.g. great, big, large
* Semantically dissimilar words e.g. hot, old, late

In the short term memory condition they had to recall the words in the correct order immediately after hearing them.

Results: In STM, recall of acoustically similar lists were remembered poorly, with a correct recall of about 10%. With the other lists, accurate recalled was much better, between 60% – 80%, with acoustically dissimilar words recalled the best.

Conclusion: as acoustically dissimilar words were recalled more accurately than acoustically similar words, there must be some acoustic confusion during recall, which suggests that coding is acoustic. As there was little difference in recall for the semantically similar and dissimilar words, this would suggest that meaning is not the coding used in STM

**Evaluation:** The laboratory study means there is a high likelihood of replicability, and internal validity, where cause and effect can be argued. However, the artificial nature of the environment and tasks means that ecological validity should be questioned, as it is unclear if this coding occurs in other situations. Therefore, conclusions about the coding of STM mainly being acoustic should be made with caution.

**Short-term memory – Capacity – Jacobs 1887**

Jacobs (1887) conducted the first systematic study on the capacity of memory. Participants were presented with a sequence of digits or letters and required to repeat them back in the same order (for example, 6,3,8,9,4,7,2 or G,S,T,J,W,V,K,L). The pace was controlled at half second intervals using a metronome. The procedure was repeated a number of times and the longest list of sequences that was correct 50% of the time was taken as the participants digital span.

Jacobs found that participants recalled more digits than letters. The average span for digits was 9.3, whereas it was 7.3 for letters. Jacobs also found that capacity increased steadily with age; in one sample of school girls he found that 8 year olds remembered an average of 6.6 digits whereas for 19 year olds it was 8.6 digits.

The capacity is usually phrased as 7 + or – 2, so the capacity of STM is known as 7+ or – 2 items (also see research by Miller.)

**Evaluation:** Miller found that chunking information could increase the number of items remembered, so we should think of capacity of STM as 7 ‘chunks’ of information. However, subsequent studies have shown that some chunks are easier to remember than others, and if the chunks of information become too large, they are forgotten easily. Other research has found that there are widely differing individual differences, with some people being able to recall up to 20 chunks from their STM if they had what was considered advanced reading comprehension (Daneman and Carpenter, 1980)

Information about the capacity of STM is useful for teachers, students and anyone else who needs to know the cognitive limitations or people.

**Short-term memory – Duration – Peterson and Peterson (1959)**

Peterson and Peterson (1959) investigated how long simple information stays in short term memory (STM) without repetition. On each trial the participants saw a trigram, which consisted of three consonants (e.g. BVM, CTG). A different trigram was used for each trial. They were asked to recall each trigram after a delay of seconds: 3,6,9,12,15 or 18. Once they were shown the trigram they had to perform an interference task, which prevented repetition of the trigram in STM. They were shown a random three digit number (e.g.866, 532) and had to count backwards from it in threes. After the appropriate time delay the trigram had to be recalled.

The longer the time delay, the more the forgetting occurred in STM. After 3 seconds 90% of the trigrams were recalled, but after 18 seconds only 5% of the trigrams were recalled. Therefore it was concluded that nformation is lost rapidly from STM when there is no opportunity for repetition. Without repetition, STM lasts for little longer than 18 seconds. (most textbooks refer to 15-30 seconds duration)

**Evaluation:** The artificial nature of the task means that there is low ecological validity, as information is rarely in such basic form. So it is difficult to conclude this study tells us anything other than how people recall trigrams under strict laboratory conditions. For example March et al (1997) showed that if people were not expecting to have to recall information, STM had a maximum duration of four seconds. It also fails to explain STM for other types of information, such as visual or haptic memory.

**Long-term memory – Coding – Baddeley 1966 (ii)**

Baddeley was interested in how information was coded in both STM (i) and LTM (ii).

Participants were divided into groups (independent groups design) and given different lists of words to learn:

* Acoustically similar words (they sound the similar) e.g. man, mad, map
* Acoustically dissimilar words e.g. pen, day few
* Semantically similar words (they mean similar things) e.g. great, big, large
* Semantically dissimilar words e.g. hot, old, late

In the long term memory condition they had to recall the words in the correct order 20 minutes after hearing them.

Results: In LTM, recall of semantically similar lists were recalled the worst, with a correct recall of 55%. With the other lists, accurate recalled was much better, between 70% – 85%, with acoustically dissimilar words recalled the best.

Conclusion: as semantically dissimilar words were recalled more accurately than semantically similar words, there must be some semantic confusion in LTM during recall, which suggests that coding is semantic. As there was little difference in recall for the acoustically similar and dissimilar words, this would suggest that the sound of the words is not the coding used in LTM

**Evaluation:** The laboratory study means there is a high likelihood of replicability, and internal validity, where cause and effect can be argued. However, the artificial nature of the environment and tasks means that ecological validity should be questioned, as it is unclear if this coding occurs in other situations. Therefore, conclusions about the coding of LTM largely being semantic should be made with caution.

**Long-term memory – Capacity – Standing et al 1970; Anokhin 1973**

Standing et al, (1970) gave participants a single presentation of a sequence of 2560 photographs for 5 or 10 seconds per picture. Even after 36 hours, participants could identify the correct photo when paired with a new scene approximately 90% of the time. This shows that a vast amount of material can be stored in LTM, at least in picture form, and gives support for the argument that LTM is probably an unlimited store.

Anokhin (1973) calculated that no human has been born that has used the total capacity of his or her brain. He claimed that the number of neuronal connections possible would be approximately 1 followed by 15 .5 kilometres of noughts. This shows that there are vast numbers of new connections that can be made, therefore human memory is extremely large (limitless?)

**Evaluation:** The capacity for LTM is impossible to study with any scientific rigour, and until we develop advanced technology, the precise capacity for LTM is likely to remain unknown.

**Long-term memory – Duration – Bahrick et al, 1975**

Their aim was to investigate the duration of long term memory to see if memories can last over decades, and thus support the idea that the duration of memory can be a lifetime.

A sample of 392 American ex-high school students aged from 17-74 was studied. They were asked to remember the names of their classmates (free recall) and they were then shown faces and names of classmates and asked if they recognised them.

The accuracy of participants recall could be assessed by using their high-school year-books, which contained both pictures and names.

There was 90% accuracy in face and name recognition, even with those participants who had left high-school 34 years previously. After 48 years this was 80% for name recognition and 40% for face recognition. Free recall was less accurate: 60% after 15 years and 30% after 48 years.

Bahrick et al concluded that peoples’ long tem memories can last for their whole life, even though they may weaken over time. Recognition is better than recall

**Evaluation:** This research does have mundane realism, as the participants were using their everyday memories for faces. It is also supported by research into LTM for olfactory (smell) information, as Goldman and Seamon (1992) found that there was reasonable recognition of smells from participant’s childhoods, thus there is reliability in the findings across the senses.