Essential understanding

✪ *The working memory model provided an explanation for some phenomena that the multi-store model could not explain, for example, the phonological similarity effect, the word length effect, and the effects of articulatory suppression.*

Findings that could not be explained by the multi-store model of memory

- **The phonological similarity effect**: this was first discovered by **Conrad and Hull in 1964**. They showed that lists of phonologically similar letters (such as B, D, P) are more difficult to remember than lists of letters that do not sound similar (such as P, R, X). Presumably, this is because acoustically encoded traces of rhyming letters are easier to confuse with each other. However, the effect also appeared when the stimulus was presented in writing.
- **The word length effect—Baddeley, Thompson and Buchanan (1975)**: this showed that the capacity of STM is greater for short words than for long ones. There is nothing in the multi-store model of memory to explain why STM capacity should change from the standard 7 ± 2 units depending on the length of the words.

Explanation of these findings

Introducing the articulatory rehearsal component (the inner voice) in the working memory model explained these effects.

- The phonological similarity effect may be explained by assuming that all speech material (even when in writing) is subvocally pronounced and encoded as an articulation pattern. Letters with similar articulation patterns are more easily confused with each other.
- The word length effect is explained because articulation patterns of longer words are also longer. In a given amount of time you can subvocally pronounce fewer long words than short words.

Further testing was done by suppressing the inner voice. If the explanation is correct, suppressing the inner voice (so that speech information is processed visually, for example) should result in disappearance of both the phonological similarity effect and the word length effect. This was observed in a number of experiments that used **articulatory suppression**.

Further research: effects of articulatory suppression

Articulatory suppression is a technique that requires participants to repeat a sequence of sounds while at the same time performing the experimental task. This is used to block the "inner voice" and see how human memory performs without it.

- It was shown that the phonological similarity effect disappears under articulatory suppression when material is presented visually (Murray 1968; Baddeley, Lewis, Vallar 1984). In terms of the working memory model, information cannot enter the phonological loop, so it goes to the visuospatial sketchpad instead, where it is stored visually. It makes no difference for the visuospatial sketchpad whether or not letters sound similar.
- It was also shown that when articulation is suppressed, the word length effect disappears with visual presentation (Baddeley, Thomson, Buchanan 1975). By the same logic, information cannot enter the phonological loop through the inner voice, so it enters the visuospatial sketchpad instead. When it is processed visually, it does not matter anymore how long the word is.

This evidence supports the idea that visual and auditory information is processed in separate stores within working memory.

Evidence of the working model of memory

- There is evidence of working memory in the so-called dual tasks experiments. The model assumes that there is a division of tasks between the different slave systems according to modality.
- If two tasks are done simultaneously (e.g. in dual tasks experiments or in multi-tasking) it is possible to perform well if separate systems are used. If concurrent tasks use the same system, it will affect performance negatively.
- **Baddeley and Hitch (1974)** asked participants to answer increasingly difficult questions about simple letter combinations that were shown at the same time. Reaction time increased as the questions became more difficult. The participants were then asked to do an articulatory suppression task (e.g. repeating "the" all the time, repeating numbers from 1 to 6, or repeating random numbers) while they answered the question. There was no significant difference in reaction time between the group who was asked to repeat "the" or to repeat numbers from 1 to 6. The group who was asked to repeat random numbers had the worst performance. This was interpreted as overload problems for the central executive.
- **Quinn and McConnel (1996)** asked participants to learn a list of words by using either imagery or rehearsal. The task was performed on its own or in the presence of a concurrent visual noise (changing patterns of dots) or a concurrent verbal noise (speech in a foreign language). The results showed that learning words by imagery was not affected by a concurrent verbal task but it was disturbed by a concurrent visual task. The opposite was found in the rehearsal condition. This indicates that imagery processing uses the visuo-spatial sketchpad whereas verbal processing uses the phonological loop. If two tasks used the same component, performance deteriorated. The study thus lends support to different modality-specific slave systems and the idea of limited processing capacity.