THE WORKING MEMORY MODEL

Introduction

This model was proposed by **Baddeley & Hitch (1974)** as a way of explaining 'K.F.'s' amnesia. Instead of being a passive unitary store, which exists only to hold information temporarily before it is passed to LTM, they believe that STM is an active store which holds several kinds of information while it is being worked on (hence 'working memory'). Baddeley and Hitch see working memory (WM) as "the focus of consciousness" which holds information we are consciously thinking about.

What has research told us about working memory (WM)?

According to Baddeley and Hitch, WM consists of a number of components which work together when a task needs them to, and independently when it doesn't. The basic components are called **the phonological loop** (which consists of the **articulatory control system** and **phonological store**), the **visuo-spatial scratchpad**, and **the central executive**.

Much of the research into WM was done in the 1970s and 1980s using the **dual** (or **concurrent**) **task method**. This involves asking participants to try and do two things at once, and seeing how successful they are.

The phonological loop: (a) The articulatory control system

One dual task is called the **articulatory suppression task**. In this, participants in the experimental condition say a word (e.g.'the') repeatedly while at the same time reading a list of words. Once the list has been read, the participants have to write down as many of the words they can remember in the order they saw them. Participants in the control condition just read the list of words and try to recall them in the order they saw them.

The results of this kind of study show that the control group recall more words than the experimental group. To explain this, Baddeley and Hitch propose that part of WM is a kind of 'verbal rehearsal loop', which we use when we try to remember an unfamiliar telephone number for a few seconds by saying it to ourselves (we could call this **spoken information**). They call this verbal rehearsal loop the **articulatory control system** (or

inner voice). In terms of the articulatory suppression task, saying the word 'the' repeatedly occupies the articulatory control system and makes it difficult to verbally rehearse the words on the list because the system can only hold a limited amount of information for a limited amount of time. Note that we also use this system to hold words when we are preparing to say them aloud in the way in which they would be spoken.

The phonological loop: (b) The phonological store

Another task used by Baddeley and Hitch involved one group of participants hearing a sequence of short words (e.g. 'zebra', 'policy' 'school', etc). A second group heard a sequence of long words (e.g. 'university', 'parliament', 'hippopotamus', etc). Both groups then had to write down the words they heard. The first group remembered much more than the second group. This is called the **word length effect**.

The word length effect suggests that another part of WM deals with **auditory information** (i.e. things we hear). Baddeley and Hitch call it the **phonological store** (or **inner ear**). Because it can only hold a limited amount of information, we remember fewer longer words than shorter words because the longer words occupy more space in the inner ear.

Together the **articulatory control system** and the **phonological store** make up what Baddeley and Hitch call the **phonological loop**.

The visuo-spatial scratchpad

Another kind of dual task is called the **visual suppression task**. In this, the experimental group of participants are required to use a pointer to track a spot of moving light on a computer screen. At the same time, they have to imagine an angular capital letter (e.g. H) and verbally describe the angles starting at the bottom left of the letter. The control group of participants just have to use the pointer to track the spot of moving light.

In this experiment, the experimental group perform much more poorly. Baddeley and Hitch argue that there is another part of WM which deals with **visual information**. Having people try and do two visual tasks at the same time overloads this system, and this is why the experimental group perform more poorly. They call this part of WM the **visuo-spatial scratchpad** (or **inner eye**). One part of it can hold a limited amount of

visual/spatial information in the form of **mental images** (it is passive). They call this the **visual cache**. The second part is more active and uses the visual information as, for example, when we give someone directions to somewhere. They call this the **visual scribe**.

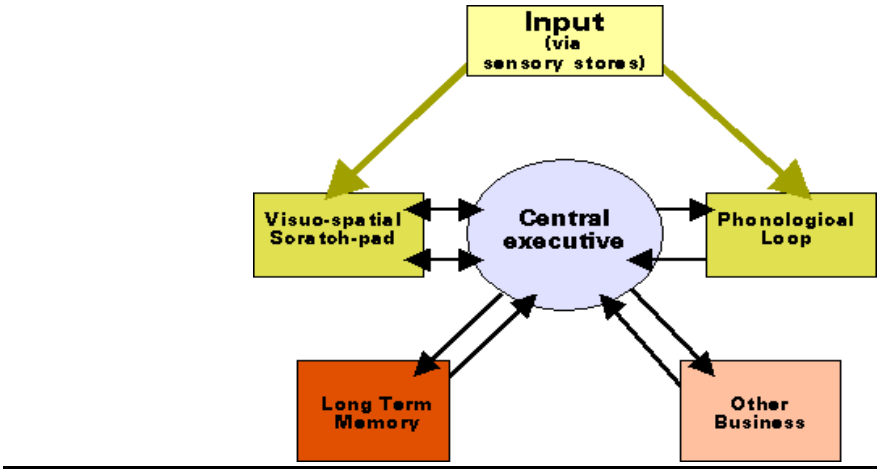
The central executive

If you ask someone to tell you how many windows there are in their house, the chances are they won't know. However, when they try to work it out, they will probably form a mental image of the house, and then take a 'mental journey' through it. At the same time, they will be counting the number of windows either under their breath or out loud.

To do these two things at the same time, there must be another part of Working Memory which is in overall charge of organising the other parts. Baddeley and Hitch call this the **central executive**, and propose that it delegates tasks to the other parts as and when it needs to. The other parts are sometimes called 'slave systems to reflect their lowly position. When they have done their jobs, they report back to the central executive which co-ordinates what they have reported.

For example, when you count the number of windows in your house, the central executive first of all finds a LTM of your house, which it sends to the visual cache of the visuo-spatial scratchpad. As you use the visual scribe to take a mental journey through your house, the articulatory control system sub-vocally counts the number of windows. Delegating tasks like this frees up the central executive so it can make decisions, solve problems, make plans, co-ordinate performance on separate tasks, retrieve information from LTM, etc.

Your central executive is very useful. When you're in the car with your dad, try talking to him as he performs a difficult manoeuvre such as reversing into a narrow parking place. Although the central executive is very flexible and can process information from any of the senses, Baddeley and Hitch argue that it has a very limited capacity. Because of this, your dad's central executive will devote all its efforts to reversing the car, and he will probably tell you to 'shut up' to avoid overloading his Working memory.



EVALUATION: What are the strengths and limitations of the WM model?

One of the **strengths** of the WM model is that experimental results do seem to support the idea that the STM is made up of a number of different components, each of which has a particular job to do. If any of the components is overloaded, which is what happens in the dual task method, performance is worse than when the tasks are done on their own.

However, if a person is required to do a task that involves two different systems (e.g. the articulatory control system and the visuo-spatial scratchpad), they can do both together just as well as they can do either on its own. Baddeley and Hitch say that this supports the idea there are different components that make up WM.

However, there is a problem with this: if two tasks cannot be done together, it is *assumed* that this is because both of them are overloading one of the components of WM. If two tasks can be done together, then it is assumed that they are being dealt with by different components of WM. In other words, the model can explain *any* experimental results. Philosophers call this a **circular argument** (or 'Heads I win, tails you lose'). This is a **weakness** of the WM model.

Baddeley and Hitch's response to this is to use the results of brain scan studies to support their model. These show that *different* areas of the brain are active depending on whether a verbal or a visual task is being performed. This would suggest that the components of WM really are different, so this is a **strength** of the model.

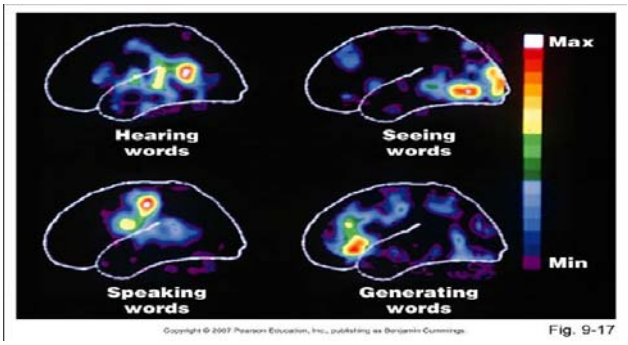


Fig. 9-17

Other **strengths** of the WM model are the following:

The model has been very influential – most researchers talk about 'working memory' rather than STM, and it is generally accepted that STM has more than one component, and must involve processes other than the simple storage of 7 + or – 2 items.

The model can explain findings that the Multi-Store Model can't. Remember that K.F. was an amnesiac with a normal STM for visual material, but an acoustic digit span of only one or two digits. This suggests that there are different components of STM just was the WM model says.

The model can also explain why people may be good at one type of memory task but not at another. It therefore has potentially important practical applications, such as in job selection.

Apart from circularity, there are some other **weaknesses** of the WM model. Since it only addresses STM, it is not a *comprehensive* model of memory, which the Multi-Store Model is. Also, whilst the 'slave systems' have been the subject of much research, the central executive hasn't. It is not known exactly how the central executive works, and its exact role hasn't been clearly defined. Since the central executive is the most important part of WM, this is a weakness.