THE WORKING MEMORY MODEL

The multi-store model's concept of a unitary short term memory (STM) was criticised by Baddeley and Hitch (1974). Although they did not reject the model's view of STM as rehearsing incoming information for transfer to LTM, they argued that it was much more complex and versatile than the multistore model's conception of it as a passive 'stopping-off station' for information. For example, and as we noted earlier, information can flow from LTM to STM as well as in the other direction. Whenever we begin a sentence, we think about what we are going to say (which must be based on information stored in LTM) as well as what we have just said.

According to Cohen (1990), Baddeley and Hitch's concept of STM as a working-memory store emphasises that it is an active store used to hold information which is being manipulated. For Cohen, working memory is 'the focus of consciousness - it holds the information you are consciously thinking about now'. The original model has been modified and elaborated by Baddeley and his colleagues. In its present form, it consists of a system in 'overall charge', which is called the central executive, and a number of sub-systems or slave systems whose activities are directed by the central executive. These slave systems are the articulatory loop, the visuospatial scratch pad (or sketch pad) and the primary acoustic store. These are shown in Figure 8.1.

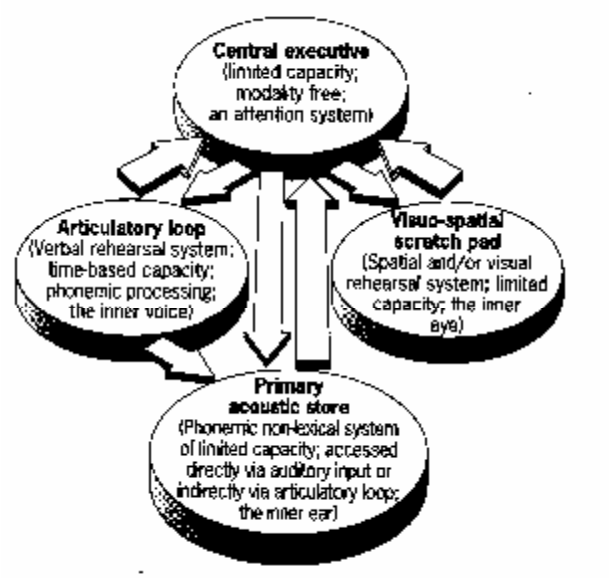

Figure 8.1 The working-memory model.

THE CENTRAL EXECUTIVE

The central executive is used whenever we deal with any task which makes cognitive demands. Although it is of limited capacity, it is a very flexible system that can process information in any sense modality (that is, it is modality free) and in a variety of ways. For Baddeley (1981), the central executive approximates to a pure attentional system.

THE ARTICULATORY LOOP

The articulatory (or phonological) loop can be regarded as a verbal rehearsal loop that we use when, for example, we try to remember a telephone number for a few seconds by saying it to ourselves. It is also used to hold the words we are preparing to speak aloud. Because it uses an articulatory/phonological code, in which information is represented as it would be spoken, it is sometimes referred to as the inner voice.

THE VISUOSPATIAL SCRATCH PAD

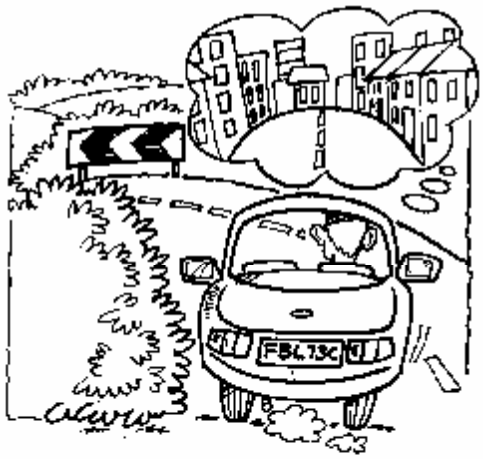

Figure 8.2 The visuospatial scratchpad is where we store information about familiar roads, so we know what is round the bend.

The visuospatial scratch pad can also rehearse information, but it deals with visual and/or spatial information as, for example, is used when we drive along a familiar road, approach a bend, and think about the spatial layout of the road beyond the bend (Eysenck, 1986: see Figure 8.2). Because it uses a visual code, representing information in the form of its visual features such as size, shape and colour, it is sometimes referred to as the inner eye. Baddeley (1986) has described the visuospatial scratch pad as:

'a system especially well adapted to the storage of spatial information, much as a pad of paper might be used by someone trying, for example, to work out a geometric puzzle'.

THE PRIMARY ACOUSTIC STORE

The primary acoustic store receives auditory input directly, but visual input can only enter it indirectly, after it has been processed by the articulatory loop and converted to a phonological form. Because it uses an acoustic/phonemic code, representing information in the form of auditory features such as pitch and loudness, it is sometimes referred to as the inner ear.

Baddeley (1995) suggests that one way of understanding how working memory operates can be gained from trying to determine the number of windows you have in your house. Most of us attempt to determine this by forming a visual image of our house and then either 'looking' at the house from the outside or taking a 'mental journey' through the various rooms of the house. To set up and manipulate the image, we need the visuospatial scratch pad, and to sub-vocally count the number of windows we need the articulatory loop. The whole operation is organised and run by the central executive.

Much of the research into working memory has used the concurrent or interference- (or dual-) task method. On the assumption that each of the slave systems has a limited capacity, then with two tasks making use of the same component or components, performance on one or both should be worse when they are performed together than when they are performed separately (Baddeley et al., 1975). If two tasks require different slave systems, it should be possible to perform them as well together as separately. Some researchers have used articulatory suppression, in which the participant rapidly repeats out loud something meaningless (such as 'hi-ya' or 'the'). This uses up the resources of the articulatory loop, and so it cannot be used for anything else. If articulatory suppression produces poorer performance on another task that is being performed at the same time, then we can infer that this task also uses the articulatory loop (Eysenck and Keane, 1995).

AN EVALUATION OF THE WORKING MEMORY MODEL

It is generally accepted that it is much more profitable to see STM as being composed of a number of relatively independent processing mechanisms than as the single unitary store proposed by the multi-store model. It is also generally accepted that attentional processes and STM are part of the same system, mainly because they are probably used together much of the time in everyday life. The idea that any one component of working memory (such as the articulatory loop) may be involved in the performance of apparently very different tasks (such as memory span, mental arithmetic, verbal reasoning and reading) is also a valuable insight.

For Gilhooly (1996), the working-memory model also has practical applications which extend beyond its theoretical importance. For example, Baddeley (1990) has proposed that the articulatory loop is 'not just a way of linking together a number of laboratory phenomena'. Rather it (or some similar system) plays an important part in learning to read. According to Gathercole and Baddeley (1990), one of the most striking features of children with specific problems in learning to read (despite being of normal intelligence and having a supportive family background) is that they have an impaired memory span. They also tend to do rather poorly on tasks which do not directly test memory, such as judging whether words rhyme. It is possible that such children experience some form of phonological deficit (detectable before the child has even begun to read) that seems to prevent them from learning to read. This deficit might be related to the development of the phonological loop system, although as Baddeley (1990) has noted, we do not yet know enough to draw any firm conclusions.

As Hampson and Morris (1996) have observed, one weakness of the model is that we know least about the component that is most important, namely the central executive. The central executive can apparently carry out an enormous variety of processing activities in different conditions. This poses problems in terms of describing its precise function, and it might even be that the idea of a single central executive is as inappropriate as that of a unitary STM (Eysenck, 1986). According to Baddeley (cited in Groeger, 1994):

'I talk about it (the central executive) as if it is a single unitary system; it probably is a system, but I do not know how unitary it is. It is almost certainly the case that what one will end up with is a number of interrelated executive processes, and indeed it may be possible ... to do away with the central executive as an entity. I don't really have a strong view about whether you have a system with a dictator at the top, or an oligarchy or a syndicalist system, but it is important to recognise that there does appear to be some form of overall executive control'.