have a further demonstration of the influence of concurrent load on learning. At this point, we therefore shifted to measures of comprehension based on verification latency rather than retention of information. This has the advantage that the material to be comprehended can be continuously present so that there is no necessary involvement of memory.

Semantic memory and WMG

Sentence verification

We went on to carry out a series of experiments using the technique devised by Collins and Quillan (1969) whereby the subject is presented with a brief sentence describing some commonly known aspect of the world. A typical sentence might be *Canaries have wings*, or some equivalent but obviously false statement such as *Canaries have gills*. The subject is required to decide on the truth of each sentence and press a 'true' or a 'false' key as rapidly as possible.

The task was initially devised to test a specific theory regarding the structural storage of knowledge in semantic memory. This assumed a hierarchy with general concepts such as *LIVING THINGS* being split into more specific concepts such as *ANIMAL* or *PLANT*, some of which themselves split into such subconcepts as *BIRDS, FISH, TREES*, and *FLOWERS*, which in turn led to particular instances such as *CANARY* or *ROSE*. It was suggested that features that apply to most examples of a category, for example that birds have wings, are stored with that category rather than with each individual instance. This was assumed to lead to economy in storage space, but to have a cost in retrieval time. Verifying that a canary has wings for example involves two steps, verifying that a canary is a bird and then verifying that birds have wings. In contrast, a statement about canaries that is peculiar to canaries, for example *Canaries are yellow*, was said to involve fewer steps and hence, to lead to faster responding.

Our experiments intended to explore the role of WMG in comprehension using a range of examples involving different numbers of hypothetical steps. Unfortunately, however, we, like others failed to replicate the original Collins and Quillan hierarchical effect (see Baddeley 1979; Baddeley and Lewis 1981; Conrad 1972). However, provided one merely treats the sentences as broadly equivalent, then speed and accuracy of verification can be used as a convenient general measure of the efficiency with which subjects can interrogate their knowledge of the world. We have found the test to be highly reliable, and sensitive to a range of stressors including alcohol (Baddeley 1981), high pressure (Logie and Baddeley 1983) and brain damage (Sunderland, Harris, and

Baddeley 1983). This test also appears to provide a plausible example of general semantic processing in so far as our as yet unpublished results indicate that it correlates highly with both the Mill Hill vocabulary test, and with verbal fluency as measured by performance on a task involving generating items from a given semantic category.

Although we have carried out a number of experiments using the Collins and Quillan technique (Baddeley 1979; Baddeley and Lewis 1981), for the present purpose a single experiment will suffice, a study in which the subjects attempted to verify visually presented sentences while holding a load ranging from zero to eight digits spoken at a rate of one per second. We used a mixed design whereby on any given trial, a subject did not know in advance how many digits she would be required to hold. Her task was to listen to the experimenter and repeat whatever sequence she heard, continuing to articulate the sequence until after she had completed the sentence verification response. The sentence was always presented after the subject had begun to repeat the spoken digits. Where no digits were to be repeated, the experimenter said the word 'nothing' whereupon the subject was instructed to remain silent.

Sentences were typed on index cards which were stacked behind a shutter. When the shutter opened a timer was started. The subject's task was to decide whether the sentence was true or false, and press a left or right key accordingly. As soon as she did so, the shutter dropped and the clock stopped, whereupon the experimenter recorded the time and replaced the card. A total of 14 female subjects were tested on a random mixture of 20 sentences at each level of concurrent load.

Performance on this task is shown in Fig. 4.1. Overall, latency increased with concurrent digit load. There is, however, a slight paradox in that the zero load condition is in fact slower than the condition involving the rehearsal of a single item. It is probable that this stems from the fact that the zero load condition was the only one in which the subject was not required to repeat what the experimenter said. Since the subject did not know in advance what condition to expect, and since this occurred on only one occasion in every nine, it seems likely that the need to obey this atypical instruction caused some slight slowing in sentence processing. The most appropriate baseline would, therefore, seem to be the one digit load condition which is equivalent to a condition of articulatory suppression. When this is used, we find that a digit load of even two items is marginally significantly slower than that of one, three items clearly slower and so forth, with each additional digit causing an increase in response latency (for further details see Baddeley, Eldridge, Lewis, and Thomson 1984).

The question arises as to whether increasing digit load produces a continuous or discontinuous function. This has obvious implications for the underlying theory of what produces the effect. It might, for example,