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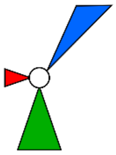
<183/c>	Nevertheless, the disruptive effects of damage may spread to other structures intimately linked to Broca's area. As a consequence, the functional modules of the brain may well be bigger than the individual areas of the cortex or subcortical nuclei that are the conventional units of analysis. Since speech takes place in the wider context of non-verbal behaviour, we also need to understand the relationship between the speech mechanisms and the other mechanisms in the brain. For example, we need to know how the speech system gets information from the systems that programme other movements so that we are capable of commenting on our own actions. While driving my car I am able to say to my passengers that I am about to turn right before I have actually done so. This requires integration between the systems that are programming my driving behaviour and those programming my speech. One of the challenges of psychobiology is to explain how this integration is achieved (Gazzaniga 1985). The cognitive challenge Psychobiologists have reacted to the rediscovery of cognitive processes in two ways. One has been to include cognitive processes in the list of functions that they are trying to relate to particular brain regions or systems. The other, much more recent development, has been to pay serious attention to modelling how cognitive functions might be carried out by the brain. The first point can be illustrated by looking at the history of thought about the hippocampus. Few scientists paid any attention to this part of the limbic system until Papez published his theory of emotion in the late 1930s, whereupon considerable effort was put into identifying its role in emotion. When the results of lesion studies proved incompatible with this simple model scientists in the 1960s shifted to response modulation models (McCleary 1966). The 1970s saw a major shift in focus and suddenly people were describing the hippocampus as a 'cognitive map' (O'Keefe and Nadel 1978) or as the repository of 'working memory' (Olton 1983). What most people wisely avoided was specifying how a 'working memory' could be constructed, or how 'temporal context' could be encoded in the nervous system. Recent developments in modelling cognitive processes on computers have changed the situation quite dramatically and there is now a realistic chance of being able to produce models of the way cognitive processes are carried out that are sufficiently precise and detailed for them to be tested properly against what happens in the brain (McNaughton and Morris 1987). However, these developments are in the early stages so there is very little concrete to report at the moment. **Laboratory models** of **the real world** Psychologists, like all other scientists, cope with the complexity of **the real world** by making
 Key: **Footprint** **ConEn1** **Footprint** **ConEn2** **Footprint** **ConEn3**	**models of it**
	and working with **those** instead. We call **these models** **theories**. **A theory** is essentially **a model of the world** that draws an analogy between the process we are trying to understand and one we already know about. For example, we often talk about 'stress', which is a term that has a very precise meaning to an engineer. In

	psychology we use the analogy of mechanical stress, and its consequences, to describe and explain what happens to people when they are subjected to excessive psychological demands. **Theories** are not optional extras in science. **They** serve two useful functions. The first is to provide simple descriptions of complex data so that we can understand what is going on in our experiments. The second is to lay down the ground-rules for generalizing from one set of conditions to another, for example, from the laboratory to the real world. Psychologists have a fairly negative attitude to **theories**, having been badly scarred by the experience of the grand **theories** of behaviour published in the 1930s and 1940s. **They** argue that we do not know enough to develop meaningful **theories** of psychological processes and relegate **theories** to the level of intellectual devices for stimulating experimentation. Many of the **theories** that are published are not really **theories** of psychological processes at all, but are **theories** of experimental phenomena. For example, in 1940 Hetherington and Ranson observed that rats with lesions involving the ventromedial hypothalamus ate excessively and became obese. In 1954 Stellar incorporated this finding in his 'two-centre' **theory** of motivation. Since then there have been a number of **theories** published on the experimental phenomenon of hypothalamic obesity (Powley 1977). While these **theories** address the problem of hunger, they do so only indirectly. The other aspect of **theories** is that they enable us to make generalizations. By itself an experiment allows us to draw conclusions about the particular conditions in that experiment, and nothing else. A **theory** tells us that a set of experimental conditions is a particular embodiment of a general process. For example, there are theories of memory that tell us that the recall of recently presented items reflects the operation of short-term storage. We can therefore generalize from one experiment in which short-term storage is believed to operate to another in which we also believe it to be present. Generalization from one set of experimental conditions is daunting enough, but the real aim of a **theory** is to allow us to generalize to what happens in the real world. For example, we want to be able to take knowledge gained from studying the free recall of nonsense syllables and make predictions about our ability to remember things like telephone numbers, or the names of people we have just been introduced to