Chapter XV
Cognitive Modelling Applied to Aspects of Schizophrenia and Autonomic Computing

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ABSTRACT
We give an approach to cognitive modelling, which allows for richer expression than the one based simply on the firing of sets of neurons. The object language of the approach is first-order logic augmented by operations of an algebra, PSEN. Some operations useful for this kind of modelling are postulated: combination, comparison, and inhibition of sets of sentences. Inhibition is realised using an algebraic version of AGM belief contraction (Gärdenfors, 1988). It is shown how these operations can be realised using PSEN. Algebraic modelling using PSEN is used to give an account of an explanation of some signs and symptoms of schizophrenia due to Frith (1992) as well as a proposal for the cognitive basis of autonomic computing. A brief discussion of the computability of the operations of PSEN is also given.

INTRODUCTION
Here we give an account of an algebraic method of modelling cognitive processes. What is unusual about our approach is that the material of the model consists of sets of logical sentences and entailments between them. These components are used to build a preboolean algebra, PSEN, whose elements are sets of sentences. Our approach correlates a set of sentences to a brain component, and a neural path from one component to another, induces an entailment between their correlated sets of sentences. A set of sentences correlated to a brain component is meant to model its cognitive state. This approach to brain functioning sees its behaviour as embodied in the firing of sets of neurons inducing other neurons to fire along neural pathways. This view can be modelled logically in a simple way in a language with one relation symbol, which is interpreted as the firing of a set of neurons. But it is not easy to see what the firing of a particular set of neurons might be connected to as a concept that a person, acting as a modeller, might readily comprehend. Accordingly, in our approach the complete syntax of first-order logic is used. Even though this is an abstraction from the simple language hinted at the previous, this allows for richer expression in the object language for the modeller. So at each cognitive component there will be sets of sentences expressed in first-order logic that correspond to some cognitive situation. To be useful, these sets of sentences need to be operated on and combined in different ways. The algebra, PSEN, is used to perform the operations.

We show how PSEN has sufficient power to model a cognitive neuropsychological model of some signs and
COGNITIVE COMPONENTS AND NEURAL LOGIC

We conceive of cognitive functioning being based upon a system of cognitive components, some of which are connected by neural pathways. This is an abstraction from the actual structure and function of the brain. Cognitive components are an abstraction of physical regions in the brain. Abstract pathways are taken to be channels, which convey information and each pathway corresponds to a bundle of neuronal chains linking one brain region to another. We assume that there is a resultant electrical flow of current in one direction only in a neuronal bundle. The correspondence of this abstraction to reality may not be perfect, but we take it as the basis for our cognitive modelling. Figure 1, based on Frith (1992), is an example of this kind of abstraction. It shows seven cognitive components. Some of them are connected by pathways, which are shown as arrows. For example, there

Figure 1. Action with monitoring
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