Chapter 2

Enactive Cognitive Science

This opening chapter introduces the philosophical and paradigmatic context in which the research presented in this book has been generated. It forms the foundation for the description and development of the methods employed and developed (chapter 3) and their later application (just modelling: chapters 4-7; combined modelling and experimental work: chapters 8-11). The significance of the results of each of the models and experiments for the particular research question they address is discussed within the respective chapters. The paradigmatic and methodological implications of these studies, which are the unifying research theme for the present work, are identified and evaluated in chapter 12.

In many ways, the methodological research question underlying this book can be seen as yet another episode of the decade-old paradigmatic struggle between traditional computationalist cognitive science and more embodied and dynamic approaches. Therefore, this chapter starts (Sect. 2.1) with a summary of the key issues, persons and milestones that have determined this debate, which is as old as cognitive science itself. In cognitive science, there is a tendency to present the paradigm struggle as a black-and-white battle between the traditional ‘GOFAI’ (good-old-fashioned Artificial Intelligence; Haugeland, 1985) approach, on the one hand, and everything which is ‘¬GOFAI’ (or ‘New AI’), on the other hand. Various alternative proposals (Connectionism, Dynamicism, Behaviour-Based Robotics, ...) have originated from the observation of similar shortcomings of the traditional paradigm and often have significant methodological and ideological overlap. However, they cannot be seen as a single alternative that comes in different flavours: significant tensions exist between them. Section 2.2 summarises a number of alternative paradigms, identifies their maxims and core assumptions and points out in how far they are prone to the same criticisms as GOFAI. Section 2.3 presents the enactive approach as a candidate for a new paradigm in cognitive science and that underlies the research presented in this book. Finally, Sect. 2.4 reflects on the main challenges this new paradigm faces and on the
role computational models can play in it. Special attention is paid to a criticism that dynamical modelling approaches frequently face, i.e., that such models serve well to address low-level behavioural issues but not high-level cognitive issues. This last section finishes by outlining the scientific challenge that has driven the research presented in this book, i.e., to identify ways to use simple Evolutionary Robotics (ER) simulation models in cognitive science in general and, in particular, for the scientific study of human cognition.

2.1 The Rise and Fall of Traditional Cognitive Science

To my knowledge, it is not clear when the term ‘cognitive science’ was first employed. Its birth is, however, frequently associated with the birth of a more traceable term, i.e., ‘Artificial Intelligence’ (AI; e.g., Eysenck and Keane, 2000; Haugeland, 1981; Russell and Norvig, 1995), a label that has first been used in the call for the Dartmouth Conference in 1956 (McCarthy et al., 1955). This conference brought together researchers that were employing the then newly emerging digital computer technology in disciplines as different as psychology, computing, linguistics, neurobiology and engineering.

At the time, Behaviorism was at its peak in psychology. Behaviorism had arisen out of a partially justified methodological scepticism towards introspectionism in psychology, whose data was not observable by anyone but the introspecting subject and thus did not meet the scientific standards of the natural sciences. Therefore, the behaviourists demanded to confine scientific inquiry to physically measurable behaviour. The most radical critics went as far as to claim that mind and mental phenomena “could not be shown to exist and were therefore not proper objects of scientific inquiry at all” (Stilling et al., 1998, p. 335) and the very use of mentalistic language was, as a consequence, frowned upon.

The analogy between computing processes in digital computers (or formal Turing Machines, TMs) and the human mind drawn by the researchers in the newly founded discipline AI, therefore, fell on fertile grounds with scientists that were interested in studying mental phenomena. Digital computers perform intelligent tasks that previously only humans could do, such as logical reasoning, mathematical computation, syntactically correct chaining of words, etc. If we can physically explain and formally and functionally describe how the machine does it, why would the same not be possible for the human mind, the ‘black box’ of Behaviorism? Computer technology and AI provided the language and concepts that, in the oppressive scientific climate at the time, made it acceptable to use mentalistic terms without falling subject to accusations of lacking scientific rigour.