



EMBODIED IN THE
WISSENSCHAFTSKOLLEG
STEFANO NOLFI

Stefano Nolfi is a senior researcher at the Institute of Cognitive Science and Technology of the Italian National Research Council and Associate Professor at Lumsa University in Rome. He has been a visiting fellow of the Center for Research in Language, University of California, San Diego, of the Laboratory of Microcomputing, Swiss Federal Institute of Technology, Lausanne, Switzerland, and of the SONY Computer Science Laboratory, Sony Inc., Tokyo. His research interests are in the field of neuroethological studies of adaptive behavior in natural and artificial agents and include: Evolutionary Robotics, Artificial Life, Dynamical Systems, Neural Networks, Genetic Algorithms. He has published more than 70 articles and a book entitled *Evolutionary Robotics: The Biology, Intelligence, and Technology of Self-Organizing Machines*. Cambridge, MA, 2000. – Address: Istituto di Scienze e Tecnologie della Cognizione, Consiglio Nazionale delle Ricerche, Viale Marx 15, 00137 Rome, Italy.

I came to the Wissenschaftskolleg zu Berlin with a clear goal in mind: to start to write a book on Embodied Cognitive Science.

Embodied Cognitive Science is a new broad interdisciplinary area that studies behavior and cognition and that includes researchers from biology, ethology, neurosciences, psychology, social sciences, artificial intelligence, and robotics. The main idea behind this approach is that behavior and cognition can be properly understood only by studying systems that are embodied. Indeed, natural organisms are embodied, i.e., they have a physical body, receive input from their sensors, and produce motor actions as output, are situated in an external world with which they interact, and display behaviors that are the emergent results

of the fine-grained interactions between the organism, its body, and the environment. An important consequence of this view is that the nervous system, the body, and the environment of an organism constitutes a single system, i.e., that the three aspects are so intimately connected that a description of them in isolation would not ultimately tell us how organisms are able to behave as they do. Natural organisms are not just nervous systems living within a body and within an environment, their body and their nervous system has been shaped to take advantage of each other, of their interaction, and of the interaction with the social and physical environment.

This leaves people like me, who embraces this paradigm, with a heavy burden. We have to develop complete models, i.e., models that include a detailed description not only of the processing occurring in the nervous system, but also of the physical and sensory-motor structure of the body, of the physical structure of the environment, and of their interaction. The goal of course, is not to develop models that are as complex as the reality they aim at describing; we want simple but complete models, i.e., highly simplified models that, however, describe the body structure and the environment with the same level of detail as the nervous system.

From the perspective of my own work, this means identifying the rules of an evolutionary game that might allow a population of artificial organisms (robots) to adapt to their environment and to develop forms of behavior and cognition similar to those observed in natural organisms. In the past years, I played this game thousands of times, and I was able to evolve a zoo of artificial creatures. Some of them show interesting properties. But aside from that, I am looking for the right ingredients to put in my games. This means trying to identify which of the huge amount of data coming from biology and natural science are the key ingredients that might allow us to create forms of artificial life that share the same main underlying mechanisms with natural life.

I arrived in Berlin in May, and after sorting out few survival priorities (e.g. learning the magic word “bitte”), I pleasantly realized that I was in the right social and physical environment to start such an enterprise. I just had to exploit the right interactions.

In some cases, this happened spontaneously. In the informal meeting I had with Georg Striedter, Steve Simpson, and David Raubenheimer, I felt like we had known each other forever. It was not simply like singing the same song, but rather like playing in a jam session. Indeed, the emergent results of our interactions were extremely important for my enterprise. In other cases, the synchronization process took longer. It was just a matter of playing a little faster or slower, or maybe harder or softer, – you never know until you

happen to play the right way, but once you do, you do not forget it. This was the case, for example, for the Fellows from humanities. Only at the very end did I rediscover the traces of my degree in literature and philosophy and of my old love for literature and art.

The Wissenschaftskolleg plays a crucial role in the story. I would never have started this project in my home working place. It is amazing how the quality of work conditions in research institutions has deteriorated in the last 15 years. The continuous need to find new resources and to justify what we do and why we do it waste at least half of our energies. We even forget that, once upon a time, institutions with the same spirit as the Wissenschaftskolleg were not rare exceptions. The efficiency and friendliness of the staff were of great help.

I am leaving Berlin with three brand new chapters and many new fresh ideas. I will not forget the green of the spring in Grunewald and the ever-changing soul of Berlin. I will not forget how pleasant it was to finally feel embodied in the Wissenschaftskolleg.