

**CONCEPTUAL AND METHODOLOGICAL BLENDING IN COGNITIVE SCIENCE:
The role of simulated and robotic models in scientific explanation**

Xabier BARANDIARAN

Department of Logic and Philosophy of Science
University of the Basque Country, P.O. Box 1249, 20080 San Sebastian/Donosti, Spain

Roberto FELTRERO

Department of Logic, History and Philosophy of Science
UNED, Senda del Rey, 7, 28040, Madrid, Spain

ABSTRACT:

Mechanistic (neurophysiological) and functional (behavioural) levels of description cannot always be integrated and explained by traditional analytic decompositional methods. In complex adaptive systems, where internal and external non-linear interactions give rise to an emergent functionality, analytic decomposition of component and isolated functional evaluation of them is not a viable methodological practice.

More recently, embodied bottom-up synthetic methodological approaches have been proposed to solve this problem. Evolutionary simulation modelling (specifically evolutionary robotics) provides an explicit research methodology in this direction. On the framework of recent discussions on the epistemological and ontological status of simulation models we argue and illustrate (with case studies on evolutionary robotics) that the scientific relevance of such methodology can be best understood in terms of a double conceptual blending:

1. A *conceptual blending* between structural and functional levels of description embedded in the simulation; and
2. A *methodological blending* between empirical and artificial modelling in scientific research.

Simulation models show their scientific value on: *reconceptualization of theoretical assumptions* by means of the dissonances that come about in their implementation; *hypothesis generation* by discovering intermediate explanatory patterns; and *proof of concept* by producing certain behavioural patterns with or without certain lower level mechanisms.

We conclude that simulation models are capable of extending our cognitive and epistemological resources to (re)conceptualise scientific domains and to establish causal relations between different levels of description. Simulation models become, blended with traditional empirical methodology, crucial tools for the scientific research on complex systems and cognitive science.