Formal Approaches in Computational Psychoanalysis and the Embodiment Issue

Rosapia Lauro Grotto, Department of Health Sciences, Psychology and Psychiatry Unit, University of Florence, Florence, Italy

ABSTRACT

In the last decades in the domain of cognitive sciences benefitted from the integration of contributions coming from different disciplines, such as neurosciences, cognitive neuropsychology, I.T., linguistics and so on. The functional architectures approach, either implemented with hard or soft computation, or with mixed models, has been a relevant conceptual tool that has provided a unifying framework for many research attempts in the field. The advancement of new conceptualizations based on embodied cognition, the research paradigm emerging from the discovery of mirroring systems in the animal and human brain, is questioning this unitary approach. In fact, mirroring systems seems to provide an explanation for human behaviour that cannot be easily reduced to a computational description. Here then author will present and discuss some formal approaches to the psychoanalytic theory, which could favour a better integration of disembodied and embodied cognition. These models are based on a topological implementation of the classical Freudian Conscious/Unconscious distinctions and on the theory of Bi-Logic mental functioning proposed by Matte Blanco.

Keywords: Computational Complexity, Embodied Cognition, Emotion, Matte Blanco, Metrics, Ultrametricity

INTRODUCTION

The second part of the 20th century can be considered as the ‘golden age’ of cognitive psychology and cognitive neuroscience; cognitive psychology is based on the founding metaphor of the mind as an information processing device while in cognitive neuroscience the basic assumption is that the information theory approach is crucial in order to derive well founded structure to function inferences connected to brain/neural activity. The mind/brain as an information device metaphor provided a common conceptual framework which allowed productive exchanges between many different disciplines such as psychology and neuropsychology, neurophysiology, artificial intelligence and I.T., theoretical physics, linguistic and neuro-linguistic, philosophy of mind and to some extent, social sciences. An paradigmatic example of the success of this conciliency strategy can be seen in the domain of cognitive informatics (Wang, 2003, 2009a, b; DOI: 10.4018/ijcini.2014100103
Wang et al., 2011) where information is considered as the crucial variable to be considered in order to model natural/mental phenomena.

Given the peculiar nature of this huge disciplinary convergence the conceptual and empirical tools that were developed in this domain are heterogeneous, including behavioral data, single/multiple cells recordings, human and animal lesions data, imaging evidences, simulations and analytical studies in the domain of both hard and soft computation, analytic modelling based on statistical mechanics theory and linguistic analysis tools. Given this very large base of evidence, the problem of deriving appropriate methods to obtain valuable scientific inference is one of the main issues in cognitive psychology and neuroscience (Shallice, 1988). The development of box-and-arrows diagrams and the cognitive architectures approach is an example of an efficient conceptual device in this respect. Anderson & Lebiere, 2003, elaborating on Newell’s positions, derived 12 criteria that a human cognitive architecture should fit in order to be functional: flexible behavior, real-time performance, adaptive behavior, ability to resort to a vast knowledge base, ability to face a dynamic environment, ability to integrate in an efficient way different sources of knowledge in order to implement high level knowledge manipulation, such as required in order to support inference, induction, metaphor, and analogy, use of ‘natural’ language, learning from the environment, sensitivity to developmental constraints, capacity to exhibit consciousness and self-consciousness and brain realization. They then compared two of the most prominent competitors, ACT-R (Anderson & Lebiere 1998) and Connectionist Models (McClelland, Rumelhart & PDP Research Group, 1986) along these criteria. Here I am not interested in reporting the results of this comparison, as I will focus instead on some of the areas in which both types of models seem to be defective.

A FRUITFUL CONVERGENCE AND ITS LIMITS

A first critical area in the cognitive architectures approach is knowledge integration. The issue of knowledge integration is a crucial one not only in the domain of high level cognitive processes, but even when considered at a more basic level neural domain, such as in the well known features binding problem (Treisman,1996). Although many attempts to solve the binding problem have been made, especially by recurring to the temporal synchronization hypothesis or even to chaotic neural models (see for example Morelli, Lauro Grotto & Arecchi, 2006), these attempts remain largely at the level of toy models and therefore are still unsatisfactory. The situation is even less favourable when coming to higher level inferential reasoning: the attempts to model inferential processes (Anderson, Budiu & Reder, 2001), performing induction (Haverty, Koedinger Klahr & Alibali, 2000), and using metaphor and analogy (Salvucci & Anderson, 2001), have been considered as based on ad hoc solutions of very limited scope, while J.A. Fodor argued against the idea that any computational approach, of any kind, would ever be able to support this type of inference, basically abduction, a typically human way of reasoning (Fodor, 2001). Self-awareness and the possibility to develop a sense of the Self has been addressed as a possible criterion to test cognitive architectures that seems to remain largely unfulfilled. The issue of awareness has been addressed substantially in the form of the distinction between implicit and explicit processing. A recent approach rephrases the issue of self-awareness in the domain of social cognition. For example, a workshop entitled “From Cognitive Activity to Artificial Self Awareness” was held at the Centre for the Study of Complex Dynamics in Florence in June 2013 to help disseminate some of the findings from the RECOGNITION project, a multi-national research project as part of the FET Proactive Initiative on Awareness. The emphasis was on cognitive science, social psychology, socio-physics, and computer science, since the target of the project was the development of a
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