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The Machine Paradigm and Alternative Approaches in Cognitive Science

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Abstract In a recent paper called *To think human out of the machine paradigm*, it is stated that psychological science operates within a machine paradigm that is committed to mechanical causality. In addition, it is emphasizes the epistemological and methodological limitations of explanations based in deterministic mechanics and instead argues for the need of an 'organic paradigm' that takes into consideration psychological processes such as subjectivity, inter-subjectivity, and agency. Although there is no doubt that much psychological science has operated under a machine paradigm, we argue that recent psychological research is pursued using a wide variety of approaches and with an absence of a partially integrated meta-theoretical corpus. The present situation looks more like a Tower of Babel of epistemological approaches and empirical programs. The reconsideration of the organic paradigm and an explicitly addressed epistemological framework could constitute a step forward and lead to an explanatory pluralism built on greater dialogue within the psychological sciences.

Keywords Machine paradigm · Causality · Mechanics · Simulation · Psychology · Cognitive sciences

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Introduction

In the paper *To Think Human out of the Machine Paradigm*, Kohler (2010) examines the marriage between classical determinism and the computer metaphor as a basis for current psychological explanations. The machine paradigm seems to produce an image of the mind that is clearly based on the properties of a computer, which makes the mind explainable using simple causal laws and mechanisms. This core conceptualization is explicitly or implicitly present in mainstream research programs and in alternative approaches that claim explicitly not to be mechanical. In order to overcome this situation, Kohler proposes an organic paradigm that would potentially reformulate the psychological explanandum in a more adequate way. This new paradigm is guided by three assumptions: (a) the inclusion of first person experience in mental phenomena; (b) the consideration of agency as an essential psychological property as opposed to the passive view of the mind inherent to mechanistic views; and (c) the consideration of human beings as possessing a creative focus, which contrasts with simple cause-effect models of explanation. The conceptual core of this new paradigm is the psychological attribute of inner uneasiness and force of life (*sap*). From Kohler's point of view, this paradigm will account for intention, experience, action, and agency as proper human features and allow for a new understanding of the interaction between objective and subjective perspectives. For these reasons, it will go beyond the limitations of formal simulation approaches.

Despite of the Kohler's interesting suggestions, we think that his proposal is lacking for several reasons. We will focus on ideas from the philosophy of mind (as well as the broader epistemological framework) and cognitive science that highlight some important issues with the view.

The Computer Metaphor

A long tradition of research has developed critical studies of the influences of analytical and computer metaphors in mind research. The limitations of such perspectives have been thoroughly discussed in fields such as artificial intelligence (Anderson 2003; Lighthill 1973; Rumelhart and Zipser 1986; Wheeler 1996), philosophy (Descombes 2001; Dreyfus and Dreyfus 1990), and cognitive science (i.e., Dietrich 2000; Freeman and Nuñez 1999; Ibañez and Cosmelli 2008). In fact, Kohler's criticism of psychological research is essentially restricted to very limited research programs (e.g., orthodox computationalism), and it neglects a great multiplicity of explanations that currently co-exist in psychology. Current mainstream cannot be characterized as being predominantly mechanistic and computational, while the concomitance of multiple paradigms competing with each another is clearly much more appropriate. The following paradigms challenge Kohler's definition of the computer metaphor: situated cognition (i.e., Brighton et al. 2003; Clark 1997), embodied cognition (i.e., Anderson 2003; Haugeland 1995), cognitive linguistic (i.e., Johnson 1987; Lakoff and Johnson 1980), enaction (i.e., Varela et al. 1991, Thompson and Varela 2001), extended mind (i.e., Clark and Chalmers 1998; Clark 2001), contextual cognition (Cornejo et al. 2007, 2009; Dufey et al. 2010; Barutta et al. 2010; Hurtado et al. 2009; Ibañez et al. 2006, 2009; Riveros et al. 2010; San Martín et al.

2010); distributed cognition (i.e., Cole and Engeström 1991; Hutchins 1995), theory of activity (i.e., Bakhurst 1995; Engelsted 1993), dynamical approaches (Ibañez 2007a, b, 2008; Tschacher and Dauwalder 2003), and synergetics (Haken 1997, 2003; Haken et al. 1985), among others. As a result, based on Kohler's definition of the machine paradigm, its application in contemporary work is considerably restricted.

Simple Causality and Determinism

Very few contemporary scholars in psychology assume explicit linear causality and simple determinism. On the contrary, they generally assume an epistemological and methodological indeterminism. The deterministic assumptions have changed significantly since the first reconsiderations undertaken by causality approaches (Bromberger 1966; Salmon 1989; Scriven 1962), the criticism toward the possibility of confirming the truth (Popper 1959), the criticism concerning the distinction between theory and observation (Hanson 1958), the reconsiderations inside analytical philosophy itself (Ryle 1949; Wittgenstein 1952), the emergence of historical approaches and its reactions (Feyerabend 1978; Kuhn 1962; Lakatos 1974), the sociological incursion in philosophy of science (Bloor, 1996; Collins 1998; Kusch 2000; Latour 1987), contextualism (Hayes et al. 1993; Reese 2001; Schouten and de Jong 1996; Stanley 2004; van Fraassen 1980, 2000a,b), pragmatism (Hoshmand 2003; Laudan 1977; Shook and Ghiraldelli 2004; Stegmüller 1976), and postmodernism (Cilliers 1998; Jencks 1987, Lyotard 1991; Fisher 2003). At the core of cognitive science, several programs has criticized the mechanical assumptions, such as interactivism (Bickhard 1999, 2003, 2004), interfield theories (Maull 1977), explanatory pluralism (de Jong 2001), and PNP program (Bechtel and Graham 1998; Bechtel et al. 2001; Craver 2000; Mundale and Bechtel 1996), among others. Many of these approaches include dynamical causality models of global/local causes or macro-causation. Others rely on combinations of non-causal explanatory strategies.

In fact, the preponderance of explanatory models that differ from the homuncular analysis essential to computer metaphor and mechanistic explanations has been discussed elsewhere (Bechtel 1998; Clark 1997). Hence, a great variety of explanations (evolutionary, teleological, systemic, mechanical, formal, and emergentist) play a part in scientific psychological explanations (Bechtel 1998; Bechtel and Richardson 1993; Bem 2001; Chemero 2001, 2003; Emmeche et al. 2000; Van Fraassen 1980).

It is also noteworthy that the most striking problems of contemporary approaches do not stem from deterministic or simple causal explanation. By contrast, they rest on much more complex problems. Some of them are related to the development of less reductionist models of the psychological phenomenon, the inclusion of multiple inter-level perspectives, or the application of crossed explanations between different description levels of the psychological phenomenon (see for example, Barutta et al. 2010).

Formal Models and Simulation

The idea that simulation is a necessary and sufficient mathematical tool to model every psychological event has gained popularity along with the development of

engineering in science. However, to assume a perfect isomorphism between the properties of a formal system and those of a psychological phenomenon leads to ominous consequences. In simulation, the simulated phenomenon that stands for the *explanandum* is represented through a formal model, which is explained though another formal model, as the *explanans*. It follows that simulation is a relation between formal models (Mikulecky 1999). At this point, a theoretical difficulty is unavoidable; the descriptions, explanations, and predictions about the formal model, even though they are valid, do not necessarily apply to real phenomenon (since these are not the *explanandum* of the simulation).

Briefly, as Kohler points out, the difficulty of using formal models alone is that it is impossible to distinguish the model with the thing being modeled. However, a simulation can be a perfectly adequate tool at the service of a theory, without reducing the explanation to a formal language. Formalization is a potent scientific tool that allows one to construct a model of a particular phenomenon using the knowledge domain available. With the exception of some extreme cases (see for example Wolfram 2002), simulation is generally used in order to increase our understanding of a phenomenon, and it is not incompatible with other non-formal explanations. Therefore, it does not pretend to be an identical copy, simulacrum, or substitution of the phenomenon under study.

Organic Paradigm

Even though Kohler's proposal of a new organic paradigm is interesting, it is not easy to find a precise definition or adequate predictions to evaluate its empirical applicability. At the epistemological level, the author does not take into consideration the existence of multiple traditions that have already highlighted the organic attribute of the psychological phenomenon (see Cosmelli and Ibañez 2008). Even in more recent conceptualizations such as Gibson's and Turvey's ecological psychology and in the project of an integrative neuroscience, it is possible to find this trend (Gordon 2000, 2003; Wright et al. 2003). Currently, there are programs based on an organic-holistic reconsideration of the psychological phenomenon (see for example, Diriwächter 2004).

Finally, topics of psychological processes such as subjectivity, consciousness, agency, inter-subjectivity, and the ecological approach of the psychological organism in its environment were actually put aside by orthodox computationalism and classical mechanical explanations such as Newell & Simon's early models in 1976. To the contrary, current social science, psychological science, and neurosciences provide multiple perspectives that take into consideration all of the aforementioned psychological processes (for a review, see Cosmelli and Ibañez 2008).

Conclusions

Although there is no doubt that much psychological science has operated under a machine paradigm, we argue that recent psychological research is pursued using a wide variety of approaches and with an absence of a partially integrated meta-

theoretical corpus. The present situation looks more like a Tower of Babel of epistemological approaches and empirical programs. The reconsideration of the organic paradigm and an explicitly addressed epistemological framework could constitute a step forward and lead to an explanatory pluralism built on greater dialogue within the psychological sciences.

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