EMBODIMENT FROM PHILOSOPHY TO LIFE SCIENCE AND BACK

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1. INTRODUCTION

In recent years, there have been a growing number of publications focusing on the notion of embodiment, a problem that could be seen as a transdisciplinary matter that recurs in several contemporary fields of research, as philosophy (Valera, 1991), psychology (Thelen, 1994), neuroscience (Damasio, 1994), robotics (Arkin, 1998; Brooks, 1991), and education (Van Gelder, 1995). The more significant part of the literature on embodiment is concerned with an 'ontological' delimitation of the concept, as in the phenomenological analysis of Husserl (Husserl, 1983) and Merleau-Ponty (Merleau-Ponty, 1962). This contribution aims to go beyond these studies and explore the biological foundation of embodiment. As Hans Jonas wrote in the introduction to his book *The Phenomenon of Life,* a philosophy of life has to comprise a reflection on the organism, from philosophy of biology, but also a philosophy of mind, which could "offer an 'existential' interpretation" (Thompson, 2007; Jonas, 2001). The most relevant problem that Jonas has to find in the scientific biology is that this discipline ignores "the dimension of inwardness that belongs to life: in so doing, it submerges the distinction of 'animate' and 'inanimate'." (Jonas, 2001) For this reason, we propose an integrated analysis in order to respond to the following question: what does the embodiment means from an epistemological point of view?

2. FROM ONTOLOGICAL TO EPISTEMOLOGICAL ANALYSIS

The 'ontological'/theoretical perspective on embodiment was developed in phenomenology by Edmund Husserl and Maurice Merleau-Ponty. In the book *Ideas Pertaining to a Pure Phenomenology and to a Phenomenologi-*

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cal Philosophy. Second Book: Studies in the Phenomenology of the Constitution (1983), Husserl distinguished two different types of bodies: *Körper,* the physical and inanimate one, and *Leib*, the living and lived-body. Maurice Merleau-Ponty proposed a more integrated approach for a phenomenology of the body in the book *Phenomenology of Perception* (Merleau-Ponty, 1962), where he affirmed that "the experience of our own body teaches us to embed space in existence." (Merleau-Ponty, 1962).

These findings are the theoretical foundation for the cognitive science (Rosh, et al., 1991), in which the concept of embodiment addresses in a new perspective the old problem of the mind-body relation, "suggesting the existence of a bodily root for several cognitive skills" (Zipoli Caiani, 2014). The mind is embedded in a body, which plays a critical role in shaping our cognitive life.

The concept elaborated in the cognitive science, based on Merleau-Ponty reflection, and the second use of the word prove that the ability to be/have-a-body, able to move in the physical environment, has positive consequences on knowledge, even in case of an inanimate machine, like robots. The issues that we are going to address in the following paragraphs are: 1. In which sense does the biological foundation establish a difference between a machine embodiment and a living embodiment? 2. Why does this biological foundation have consequences on the epistemological level?

3. THE BIOLOGICAL FOUNDATION OF EMBODIMENT

In this paragraph, we intend to present the biological foundation of embodiment and try to answer the two-issue posed at the end of the previous one.

According to Mark H. Bickhard (Bickhard, 2009), the most critical difference between a robot and a human being is the emergent cognition (in Bickhand's work, the emergence of cognition is based on the model of interactivism, in which the biological foundation is crucial for the emergence), based on the fact that 'robot's body is *not* far-from-equilibrium, cannot be self-maintained, and certainly not recursively self-maintained. Conversely, the only part of the robot that is far from equilibrium, the battery, is not self-maintaining. Biological organism involve elaborate infrastructure—organs, bones, and so on—that are themselves (mostly) 'far-from-equilibrium and self-maintained in the constant overturning of molecular constituents' (Bickhard, 2009). His work concludes that, from this perspective, one of the essential requirements of cognition is a far-from-equilibrium system, based on the self-maintenance.

The best strategy to foster this approach is thus to consider not the nervous system but the general organization of living being (Maturana & Valera, 1987). Maturana and Valera describe living beings as 'molecular

networks and interactions that produce themselves and specify their own limits' (Maturana & Valera, 1987). This description is useful to understand three dimensions of living beings: 1. The molecular basis that identifies the biological root, 2. The internal organization, as a network system, and 3. The dynamical property of interaction that is able to find criteria of unity based on the identification of limits or boundaries (Bertolaso, 2016).

Therefore, the 'organization' of living beings implies a series of relations 'that must be present in order for something to exist' (Maturana & Valera, 1987). For example, the autopoiesis organization is necessary for the self-producing ability and is based on a dynamical relation in the network of 'ongoing interaction,' as in the case of metabolism.

FIGURE 1

Figure 1 represents schematically the reciprocal power of a living being in which the inner dynamics is not an end in itself, but determines a differentiation from the outside, defining a unity by boundaries.

To answer the second question concerning the consequences of biological foundation on epistemological analysis, the relation between life and knowledge is a key point in an ongoing debate in philosophy of science and epistemology. As Karl Popper said in the book *A World of Propensities*, in an evolutionary and biological meaning of knowledge, not only the humans, animals and plants but all the living organisms have an epistemological power. "(My purpose is) … defending the existence of animal knowledge, not as a mere metaphor, but as a serious evolutionary hypothesis" (Popper, 1990).

Therefore, while wishing for more future work in developing the thesis, inputs and insights we have inherited from classic and contemporary authors, we conclude that: 1. In the case of living being's organization, there is no chance to propose a dualistic vision that distinguishes markedly the inner from outside, yet it is necessary to think about a reciprocally influenced interaction between the two dimensions. 2. The environmental condition helps the internal dynamics to identify itself and build boundaries. 3. This analysis of living being could be interpreted, in light of section two, as a case of embodiment in the sense expressed by Andy Clark (1999), because it describes both 'a theory of inner organization' and the transformative power for the subject in the relation with its environment. 4. Since

this dynamical process of living beings produces an identity, then we can conclude that the embodiment implies, even in the case of a simple cell, an epistemological power.

4. CONCLUSION

This contribution has examined the biological root of embodiment and has identified the convergence of different disciplines on 'embodiment' as an epistemological tool. The theoretical implications support the idea of the importance of going more-in-deep in a fundamental feature of life sciences that is precisely related with the possibility not to distinguish (both in conceptual and in descriptive term) the dynamics from the boundaries. Further research in this field would be of great help to deal in a dialogic way with the tension that is typically generated, for epistemological and gnoseological reasons, with the typical sides of contemporary dualistic terms: mind, body, parts-wholes, and so on. The scope of this study was limited to the identification of the biological root of embodiment as a requirement for a philosophical inquiry; however, more research is required to examine the ontological and epistemological differences and relations between human and robotics embodiment (Bertolaso, 2019, Corti & Bertolaso, 2019).

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