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Why do we need a Unified Theory of Embodied Cognition?

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Abstract: The range, diversity and the different metaphysical assumptions of Embodied Cognition (EC) hypotheses that have been formulated in recent years, a) do not allow for their pragmatic, problem-solving oriented adoption by Cognitive Science and (b) favor their fragmentary use by various scientific and practical fields, resulting in misunderstandings concerning their content and validity. Through a brief overview, this presentation aims to highlight the reasons why research towards a unified theory of embodied cognition can contribute to solving old and modern problems regarding Human Cognition and Artificial Intelligence.

Sub Disciplinary Area: Philosophy of Cognitive Science, Philosophy of Artificial Intelligence

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In this presentation I will attempt to answer the question of why we need a Unified Theory of Embodied Cognition (UTEC), or why we need to untangle the thread of all the hypotheses made over the last twenty years, regarding the role of the body and the world in the process of understanding and explaining mental phenomena.

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I will begin by outlining how we ended up talking about such a wide range of EC hypotheses, in what ways they differ and what their levels of study and comparison are, and I will conclude with (1) how clarifying and delineating them can lead us to a unified theory and (2) why such a theory contributes to the evolution of Cognitive Science and beyond.

It has been commonly known, ever since the early days of Standard Cognitive Science (SCS) in the 1970s, that there have been many and important objections to the philosophical assertions or the “dogma” of the computational and representational theory of mind (Gomila & Calvo, 2008:11) mainly to: a) assuming that Human Cognition (HC) is a computational process of symbolic representations and b) assuming the existence of internal representations of the world inside the brain. In the dominant model of SCS, cognitive functions have a definite beginning, with data input into the brain, and a definite end with output from it, essentially limiting research to processes “inside” the brain (Shapiro, 2011:26-27). From this solipsistic view, the body and the world are absent.

Soon, the hypothesis that the environment in which a cognitive being operates is nothing more than data entered into the system to be processed, without taking into account the world itself, began to create problems in HC and AI research programs (Dreyfus, 1972, 1992, 2007). For example, SCS could not provide an answer to the frame problem (Wheeler, 2005; Zambak, 2013), or, the referential nature of representations limited machine learning (Abrahamsen & Bechtel 2012:28).

Accordingly, the formal symbolic structure of language was unable to provide an adequate answer to the grounding problem (Vogt, 2006:176-209), and then questions regarding the nature of data and information itself occurred, as well as regarding the way meaning is derived (Shapiro, 2007:339).

Subsequently, applied research in AI faced paradoxes, such as that of Moravec, concerning the way complex cognitive computing processes (like chess) require comparatively little computational resources, while simple cognitive tasks (such as descending a staircase) require enormous amounts.

At the same time, in recent years, numerous findings of applied research in education have demonstrated the important role of the body and the environment in achieving cognitive goals such as learning, memorizing, language comprehension etc. (Skulmowski, 2018; Kosmas, 2019). More research has also demonstrated the anthropomorphic nature of cognition and the role of mirror neurons in monitoring physical movements and behaviors (Gazzola & Rizzolatti, 2007).

From the 1990s and on, all this has led the field of SCS research to move “in depth” (see cognitive neuroscience) and “outwards” (see EC) (Abrahamsen & Bechtel, 2012:29), resulting in new research programs, according to which cognition is not a process that happens inside an isolated “box” but is something more complex, which happens because an organism lives, moves and acts within an environment.

Other programs moving in this direction and often combined with EC research were: (a) neural networks, which adopted distributed and coded patterns of representations, carrying information in their internal properties (Clark, 1993:19) and

(b) dynamic systems theory, which introduced time variability as a determinant factor in the cognitive process of the system (Van Gelder,1998).

A common assumption of all these hypotheses is that cognition is not an exclusive function of a computational mind “passive” to external stimuli, but, in fact, the bodily functions and the interactions of the cognitive being with its environment, contribute directly and decisively to mental processes (Leitan & Chaffey, 2014).

However, despite the above common assumption, EC hypotheses are extremely heterogeneous and diverse (Wilson, 2002). This may partly be due to the fact that many of the research projects that have featured these hypotheses over the years originate, either independently or combined, from different scientific disciplines such as Philosophy, Psychology, Linguistics, Neuroscience, Artificial Intelligence, Robotics etc. and have possibly coupled EC with other metaphysical theories such as the emergence of properties of complex systems (Kuniyoshi et al., 2007) and others.

These divergences stemmed mainly from philosophical and conceptual assumptions and resulted in significant differences in both their technical terminology and the meaning of the common terms they use.

Influenced by theoretical traditions such as Phenomenology, American Naturalism, the Ecological Theory of Visual Perception (Gibson, 1979), Gestalt psychology, Cognitive Development Theory and others, EC theories have attempted to exempt themselves (more or less) from the standard metaphysical or epistemological assumptions of SCS, such as the “Cartesian theater”, the autonomy and causality of mind, the formal syntactic structure of mental content, the meaningful data hypothesis and others.

At the same time they made new claims that could be summarized according to Shapiro (ibid:4) as follows: a) the bodily properties of an organism delimit or constrain the concepts that the organism can acquire, b) the interaction of an organism with its environment replaces the need for a representational process, c) the body and the world play a constitutive, rather than simply a causal role in the cognitive process.

Such a classification, although extremely useful in understanding the general content of the EC spectrum claims, is not “competent” enough to lead in the direction of unification.

The need for a unified EC theory has been formulated for about a decade (Barsalou, 2008; Gomila & Calvo, 2008), while efforts have been made to classify individual theories based on their ontological characteristics (Gallagher, 2011). However, research in this direction has not been very fruitful, mainly because of the researchers' attempt to somehow adapt a unified theory in the framework of their own assertions.

Most will agree with Shapiro's (2011:3) claim that a UTEC, or at least a unified field of research, will make it possible to compare and evaluate two fields that will then be clearly defined –UTEC and SCS– rather than comparing a series of heterogeneous research programs, as found in EC today, with a compact field such as SCS. This comparison would essentially reveal whether these two approaches: a) offer competing explanations for the same phenomena, b) aim at a different explanatory model overall, or c) develop different yet compatible views through which they understand the cognitive process.

This is certainly a good and useful reason why we should step up and intensify research in this direction, but in my opinion it is not the main reason. The main reasons are that through a UTEC we will be able a) to preserve and b) to utilize in an interdisciplinary manner the wealth of EC ideas such as the notion of “affordances” (Gibson, 1977), the systemic theories of meaning and its independency from representations, as well as the possibility to eliminate the traditional assumptions of “folk psychology” and its inherited terminology that lead us to dead ends.

Clearly, the main beneficiary of such an endeavor will be the theory of Next Day Cognitive Science (NDCS), but those who are involved in applied research such as neuroscience as well as robotics and artificial intelligence research programs, will also benefit greatly, since a UTEC can become a tool for shaping research hypotheses and can make a substantial contribution to the progress of their research objectives.

Incidentally, as various EC theories are selectively, and rather superficially, adopted by fields of applied science such as clinical psychology, education, sports science, modern marketing and advertising (Leitan & Chaffey, 2014) among others, there will be a clarification of the distorted assertions that create a veneer of science, and above all, the authority of the sciences of the mind, cognition and intelligence will be safeguarded.

If we consider an NDCS oriented towards problem solving as a commonly accepted demand, we should be willing to move on to a cash value - pragmatic approach of a UTEC, so that the differences in the spectrum of EC hypotheses will be addressed at a practical level. An important first step in such a venture may be to classify existing EC hypotheses according to the area and the objectives of their study. For example:

[a] at a level of compatibility or not with SCS, [b] at a level of scientific fields of application, [c] according to characteristics mainly related to the philosophical origins, [d] at a conceptual level, [e] at a terminology level, [f] at a methodology level, etc.

Finally, an additional (visionary) reason that a UTEC can prove to be extremely useful is the possibility of reaping a significant payoff: The unification of EC theories is likely to pave the way for the unification of the sciences of the mind, cognition and intelligence and possibly explain the precise role that the body, the environment, language and other systemic factors play in mental processes.

Such an understanding may help to conceptualize and formulate new “bridging laws” between the various description levels among research fields, from the level of the cognitive organism acting in the world and interacting with others, to the level of the basic elements (i.e. neurons, molecules, etc) or, respectively for AI, from the level of the agent coping in the world to the basic level of data.

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