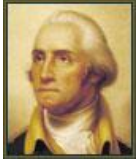


Enactive Cognitive Science

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Enactive cognitive science is an outgrowth of and has its roots in constructivism, developmental psychology, systems theory, "constructivist AI", and co-evolutionary models of biology. This radical constructivist approach to cognitive science differs from others in that the emphasis is not on the "recovery" of (pre-given) features of the world, but rather on how the mechanisms of autonomous systems can arise and participate in the generation and maintenance of viable "phenomenal worlds" through their activity.

Within the constructivist tradition we can distinguish between realist and radical constructivism. The former leaves largely untouched the belief in an external, objective, knowable world. By this view, constructive mechanisms tend to be "in the head" of the cognitive agent -- and cognitive construction is a way by which a cognitive agent comes to have such things as interpretations, opinions, beliefs, and models of that objectively existing world. For this view on constructivism, knowledge is still a "mirror of nature," but some of that knowledge is the result of active construction by the cognitive agent. To the extent that constructivist thought has become a force in educational theory, it is this realist version that is most prevalent. And, as such, constructivism is often treated as one option among many for pedagogical design; that is, discussion often turns on such things as "when one should use constructivist approaches in teaching" and "techniques for motivating students by having them engage in constructive activities."

The latter, radical, orientation holds that it is not just (some) "knowledge of The World" that is constructed by the cognizing agent, but rather, the phenomenal world -- the world as it is for the cognitive agent -- is inseparable from the agent's knowledge about it (and indeed, inseparable from the agent's knowledge about self). Further, this knowledge, the known world, and the agent itself, are all the result of active construction. Within this radical orientation, researchers take different positions on such questions as whether there is an objective reality ("behind the phenomenal reality"), whether there is an "ultimate" grounding (and if so, what it is). Nonetheless, by and large, radical constructivists agree that an objective reality, whether or not it exists, is not the world to which humans have direct access. The world as we know it is the result of constructive activity. And this fundamental belief informs in a radical way the study of cognition -- and the development of materials based on the insights of such study.

Radical constructivism as a philosophical study of mind in the Western tradition can be traced back at least 2500 years; within the scientific study of mind, the pioneering efforts Jean Piaget, Lev Vygotsky, and Jakob von Uexkull initiated research to propose and empirically verify possible constructivist mechanisms of cognition. During the 20th century relevant research also occurred within the fields of cybernetics, the life sciences, artificial intelligence, and artificial life.

Enactive cognitive science emerged at the end of the 1980s as a specific extension of the radical constructivist approach to cognitive science. In addition to the basic radical constructivist premises, it added a number of key concerns as part of its research agenda: structural coupling, embodied action, situatedness, emergence, intersubjectivity, consciousness (or first-person cognition), and neuro-phenomenology. A further, crucial unifying theme for the entire enactive research agenda is that it does not merely focus on some particular "enactive" phenomenon or mechanism, but is crucially concerned with co-specification, co-determination, co-adaptation, and co-evolution. Thus, to take the example of emergence, the enactive approach is not only interested in how "higher level phenomena may emerge out of lower level mechanisms," but simultaneously concerned with whether/how higher-level phenomena have causal efficacy with regard to their constituent components ("out of which they arise").

As with other scientific efforts based on the constructivist orientation, enactive cognitive science is broadly "conventional" in its scientific methodology. That is, there is a strong emphasis on testable hypotheses, empirical observation, confirmable (or disconfirmable) models and mechanisms, and the like. Nonetheless, the constructivist approach to scientific enquiry does raise a number of specific methodological questions and assumptions, particularly as regards the nature of verification.

Although enactive cognitive science was initially introduced in terms that make it clear it is clearly within the radical constructivist tradition, the term has since been taken by realist cognitive scientists who wish to stress their own interest in certain key features, such as embodiment, emergence, or situatedness. Thus, it may become necessary to begin distinguishing between radical (original) and realist enactive cognitive science; however, for the remainder of this paper we will concentrate on the radical orientation.

This paper is a brief introduction to enactive cognitive science: a description of its main characteristics, its methods, its potential as both a theoretical and applied science, work to date, and several of its remaining major research problems.

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