CSC: Classic Paper Review/Analysis #4

Title and Author

Title: Embodied Cognition: A field guide

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Summary/Hook

This article discusses a new approach to understanding the forever daunting phenomena that is human cognition. Anderson moves away from emphasizing the formal operations and abstract symbols that have previously been the foundation for understanding human cognition. Instead, Anderson discusses the theory of embodied cognition and a lot of the recent work/research done in the fields cognitive science and artificial intelligence with regards to this theory. The article concludes by diving into the many arguments and criticism against the theory, shedding light on new ways of thinking about cognition and intelligence.

Knowledge Relating to the Cognitive Science Program Learning Outcomes

1. Formal Systems and Theories of Computation

Simply put, cognitivism is the hypothesis that the central functions of mind—of thinking—can be accounted for in terms of the manipulation of symbols according to explicit rules. Cognitivism has, in turn, three elements of note: representation, formalism, and rule-based transformation. First and foremost is the idea that cognition centrally involves *representation*; cognitivism is committed to the existence of "distinct, identifiable, inner states or processes"—that is, the symbols—"whose systemic or functional role is to stand in for specific features or states of affairs" [20, p. 43]. However, just as is the case in modern logic, it is the form of the symbol (or the proposition of which the symbol is a part) and not its meaning that is the basis of its rule-based transformation. To some degree, of course, such formal abstraction is a necessary condition for representation—the token for 'green' in my mental lexicon is not itself green, nor does it necessarily share any of the other properties of green. Indeed, the relation between sign and signifier seems in this sense necessarily arbitrary, and this thereby enforces a kind of distance between the inner arena of symbol processing and the external world of meaning and action. Still, as we will see in more detail later, this formal abstraction is nevertheless a matter of degree, and this aspect of cognitivism is separate—and separately criticizable—from the general issue of representation. This brings us to third important aspect of cognitivism: the commitment to explicitly specifiable rules of thought. This commitment follows naturally from the others, for having disconnected the form of a symbol from its meaning, cognitivism rules out the possibility of content-sensitive processing, and so requires formal rules to govern the transformation from one cognitive state to another.

2. Foundational Assumptions

As we have seen, traditional AI is characterized by an understanding of intelligence which foregrounds the notions of thought and reason, and adopts certain conventions for approaching these which centrally involve the creation of representations, and the deployment of high-level cognitive skills such

as planning and problem solving. For Brooks, however, such an approach “cannot account for large aspects of what goes into intelligence” (p. 134). In contrast to this high-level or top-down approach to intelligence, Brooks advocates studying intelligence from the bottom up, and specifically urges us to recall our evolutionary lineage. As evolved creatures, human beings are largely continuous with our forebears, and we have inherited from them a substrate of capacities and systems for meeting our needs in, and generally coping with a given environment. From such considerations follows the perhaps reasonable, but decidedly un-Cartesian thought: “The study of that substrate may well provide constraints on how higher level thought in humans could be organized” (p. 135, emphasis in original). As we will see, this tendency to emphasize, on evolutionary grounds, the continuity between humans and other animals, and the converse willingness to see in animals instances of intelligent behavior, is an extremely important motivation for the study of EC.

3. Language and Culture

A further problem is the holistic nature of human language and reasoning: ‘chair’ is closely related to other concepts like ‘table’. One is entitled to wonder whether knowing what sort of chairs belong at a table is part of the mastery of ‘table’ or ‘chair’. It is unlikely that clear boundaries can be drawn here; knowing one partly involves knowing the other. Likewise, ‘chair’ is related to ‘throne’, so that it is not clear whether we should say of someone who walked up and sat in the King’s throne that she failed to understand what a throne was, or failed to understand what a chair was (and wasn’t). Given that these concepts are semantically related, that there is a rational path from sentences with ‘chair’ to sentences with ‘table’ or ‘throne’, any agent who hopes to think with ‘chair’ had better have grounded ‘table’ and ‘throne’, too.

4. Embodiment, Emergence, and Distributed Cognition

According to Lakoff and Johnson, the mind is inherently embodied not just because all its processes must be neurally instantiated, but also because the particulars of our perceptual and motor systems play a foundational role in concept definition and in rational inference. Color concepts, for instance, are characterized by a “center-periphery” structure, with certain colors being “focal” and others conceptualized in terms of the focal hue. In the category “red” there is a central red, as well as peripheral hues tending toward the purple, pink, and orange. “The center-periphery structure ... is a result of the neural response curves for color in our brains. Focal hues correspond to frequencies of maximal neural response”, with the peripheral structure being determined by the overall shape of the neural response curve. “An adequate theory of the conceptual structure of red, including an account of why it has the structure it has ... cannot be constructed solely from the spectral properties of surfaces. It must make reference to color cones and neural circuitry” [72, p. 24].

5. Embodiment, Emergence, and Distributed Cognition

The last aspect of embodiment we will consider here is also the most complex, and the level at which the division between embodied and situated cognition no longer makes much sense. We have seen already the ways in which practical activity and interaction with the environment can itself be a cognitive strategy, thus in a very general way grounding cognition in agency. But for higher mammals, and especially humans, these interactions are always themselves situated in a broader social and cultural context. This means at least two things, the complex interrelation of which I have neither the space nor, probably, the acuity to detail here: (1) the interactions can take place not just with individual

objects or artifacts, but also with persisting structures, which may be cultural and social, concrete and abstract (2) actions themselves can have not just immediate environmental effects, but social or cultural ones; that is, actions have meanings which must, of course, play a role in their deployment.