

# **A Stroll Through the Worlds of Animats and Humans:**

## **Review of *Being There: Putting Brain, Body and World Together Again* by Andy Clark**

**Anthony Chemero**

Department of Scientific & Philosophical Studies of Mind  
Department of Psychology  
Whitely Psychology Lab  
Franklin and Marshall College  
Lancaster, PA 17604-3003  
U.S.A.

a\_chemero@acad.fandm.edu

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## **1. Introduction**

Every few years Andy Clark writes a book designed to help philosophers of mind get up to speed with the most recent developments in cognitive science. In his first two such books, *Microcognition* (1989) and *Associative Engines* (1993), Clark introduced the then-cutting-edge field of connectionist networks. In his newest one, *Being There: Putting Brain, Body and World Together Again* (1997), he once again provides a concise, readable introduction to the state of the art. This time, though, Clark has moved beyond (but not abandoned) connectionism for what he calls 'embodied, active cognition,' in which the primary focus of study is not the inner workings of the rational thinker, but rather the way the autonomous, embodied agent interacts with its environment.

This conception of the mind is radically different from those we've seen in business-as-usual cognitive science. And if it's anything like on the right track, it will lead to a methodological and conceptual realignment, shaking up much of what we thought we knew about the mind. In *Being There*, Clark provides a remarkably clear introduction to this new conception of the mind and then re-maps the altered conceptual landscape. In the remainder of this review, I will outline Clark's introduction to embodied, active cognition and his view of its consequences for cognitive science. Along the way, I will discuss one place where I think Clark gets things very wrong. This criticism will concern the particulars of Clark's take on the philosophical consequences of embodied, active cognition; it has nothing to do with the Clark's exposition of this new type of cognitive science, which I think is just about perfect. Anyone interested in the foundations of cognitive science or the philosophy of mind should read this book, as should anyone who wants to keep up with the newest and best in cognitive science.

## 2. Overview of the text

*Being There* is divided into three major parts: "Outing the Mind," "Explaining the Extended Mind," and "Further". In the first part, Clark synthesizes several seemingly disparate, but related fields, of study into a coherent picture of the embodied mind. Starting with autonomous agent research (e.g., Brooks, 1991) as the centerpiece, Clark then adds dynamical systems theory models of development (e.g., Thelen & Smith, 1994), connectionist networks (discussed in Clark, 1989, 1993), epistemic action (Kirsh & Maglio, 1994), Vygotskian (1986) and Gibsonian (1979) psychology, and even phenomenology (Heidegger, 1927; Merleau-Ponty, 1945). Each of these has been taken by its proponents to be a "paradigm shift" in its own right. Clark, however, shows that to rival classical cognitive science as a "paradigm" for studying the mind, one needs them all. This first section is the best part of the book. In it, Clark introduces and patiently explains each of these fields and their place in the overall account of the mind, an account that integrates the body, the brain and the environment in which they are embedded.

The first important feature of Clark's synthesis is the focus on embodiment, the inclusion of the body in cognition. To illustrate this, Clark begins with a discussion of the work of Rodney Brooks and his colleagues at MIT. In their autonomous agent research, Brooks et al. build simple creatures, called 'mobots' or 'animats,' that are capable of robust action in a dynamic environment. The focus of their work is on building simple, but complete agents, rather than trying to attain human-level competence in a very limited domain (e.g., chess-playing). For example, Brooks's mobot "Attila" can do nothing to a human-level competence. But it can walk around on its own and avoid objects; it thus displays a roughly complete insect-level intelligence, rather than a small sliver of our own.

Mobots like Attila are built by melding together a group of quasi-independent devices, each of which has a self-contained link from perception to action. These devices excite and inhibit one another, but pass no complex messages, allowing simple, adaptive intelligence to emerge with no central executive controlling the action. Much of the

behavior of humans and other animals, Clark claims, is like that of mobots in this respect. To illustrate this, Clark cites dynamical systems studies of development (Thelen & Smith, 1991), according to which abilities to act skillfully (e.g., walking) are "soft-assembled" by interactions among such factors as bodily growth, environmental factors, learning and brain maturation. So, like the mobot behavior, human development occurs without the control of a central executive deciding what to do when; in both cases, the behavior is *self-organized*, emerging over time from the interaction of several components.

Take these mobot bodies and add connectionist-network-style brains. There are two features of connectionist networks that are important for Clark's purposes here. The first of them is that because connectionist networks are parallel processors, they support a view of cognition as highly decentralized. Just as with the mobot bodies in which they are housed, there is no one in charge, no central executive, so the brain's activity, like the body's, is best viewed as self-organizing. Secondly, cognition in connectionist networks is construed as *pattern completion*, instead of classical reasoning. Connectionist networks, like most humans, are good at recognition and action, but not particularly good at math or logic. But if, as Clark claims, we humans just are mobots with connectionist brains, how do we do math and logic?

The answer to this question leads to consideration of the third part of Clark's formula: the world. The connection between a thinker and its world, in Clark's picture, is so intimate that it is difficult to decide where one ends and the other begins. Indeed, given the nature of the brain and body as described, the environment must be utilized actively in cognition. Since there is no central executive in mobots with connectionist brains, there will be no detailed, action-neutral representation of the world. In most cases, agents will use the world as its own model. We can see this in animate vision research (Ballard, 1991), for example, in which an agent uses rapid, repeated saccades to extract information from a visual scene as needs arise, rather than building an intricate three-dimensional model of its surroundings in its head.

To accomplish the things we humans can accomplish without building detailed, internal models, we must rely on *epistemic action* and *external scaffolding*. Epistemic actions (Kirsh & Maglio, 1994) are actions taken to alter the nature of cognitive tasks. Think, for example, of moving Scrabble tiles around on their tray to see what words you can spell. Doing so changes the nature of the task from one of trying to come up with words inside one's head to one of completing patterns, a task our connectionist brains are good at. Imagine that you have the following letters on your tray:

O G T S O S E

The easiest way to make a word is to re-arrange the actual, concrete tiles on the tray (an epistemic action), and try to use the re-arranged pieces as a basis for your brain's pattern-completing abilities, like this:

ST OO S G E

which we can quickly complete as "STOOGES". In this case, the tiles act as external scaffolding, parts of the world we rely on to aid and abet our thought. Both these categories, epistemic action and external scaffolding, Clark points out, are extremely large: maps, models, tools, language and culture can all act as external scaffolding; using any of these pieces of scaffolding, for example, writing one large number above another to multiply them with pen on paper, is epistemic action. In all these cases, we act so as to simplify cognitive tasks by "leaning on" the structures in our environment. (The third part of the book "Further" explores the ways that such structures in our environment, most notably public language, can be utilized to allow creatures like us to participate in more advanced cognition.)

Clark's view of the embodied, active mind--that is, of human thinkers as connectionist brains in mobot bodies, living in a highly scaffolded environment--is a compelling alternative to traditional computationalism.

What makes it so compelling is the way it incorporates the best recent empirical work in the cognitive sciences in a far-reaching view of the mind, one that shows what is special about humans (our abilities to construct and utilize external scaffolding to complement our "on-board" resources), yet respects the fact that we must be evolutionarily continuous with other animals (there is no difference *in kind* between our bodies and brains and those of other animals). And it really is different, too: problem solving is pattern completion rather than logical inference; there is no central system or language of thought; the roles of the body and environment have been upgraded in status from input device and problem space, respectively, to crucial parts of the cognitive system. Clearly, with all these changes to our image of the mind, there must also be changes in our science of the mind. In the second section of the book, Clark reconstructs the conceptual foundations of cognitive science to fit his new picture of the mind.

Clark's main concern in this reconstruction is to head off the more radical claims made by the scientists whose theories are the building blocks of embodied, active cognition. In particular, he is opposed to attempts to spin situated robotics (e.g., by Brooks, 1991, or Beer, 1995) or dynamical systems theory (e.g., by Thelen & Smith, 1994, or Port & van Gelder, 1995) into *anti-representationalism*, the claim that views of cognition as involving mental representation (and hence computation <1>) are just mistaken. Clark argues that anti-representationalism is a case of throwing out the baby with the bath water. What we need, he says, is not a non-representational story, but a *better* representational story, one that leaves room for other explanatory strategies. This better story requires three interlocking types of explanation:

1. A dynamical systems account of the gross behavior of the agent-environment system;
2. An implementation account, describing how the components of the agent-environment system interact to produce the collective properties described in (1);
3. A representational and computational account of the components identified in (2).

The third, representational, type of explanation here will be somewhat different from the usual in that representations will be geared to particular actions; they will be what Clark calls 'action-oriented'. <2> Action-oriented representations are both *local* and *personal*: they are local in that they relate to the circumstances currently surrounding the agent; they are personal in that they are related to the agent's needs and the skills that it has. Since action-oriented representations are attached to a particular agent and its situation, they are non-objective, they are always attached to a particular point-of-view. Put most simply, they stand for what's happening to me, right here, right now.

Clark calls this overall three-tiered explanatory strategy 'minimal representationalism', carving a central ground between traditional computationalism, where fully-objective representations are the main explanatory tool, and anti-representationalism, where representations are never invoked. <3>

Clark's picture of the embodied, active mind has metaphysical consequences that go along with the methodological ones just sketched. The first of these, which Clark embraces, is that the mind is not confined to the brain, or even the body. Since the agent's body and normal environment (including, especially, external scaffolding) are crucial to cognition, these should be considered *part of the mind*. As Clark puts it, "... it may for some purposes be wise to consider the intelligent system as a spatio-temporally extended process not limited by the tenuous envelope of skin and skull." (p. 221) The mind, this means, is *ontologically complex*, spreading out over space and time and including bits of the world, language and social structures, along with the brain and body.

There is another, more serious, metaphysical consequence that Clark does not embrace. In his discussion of the relationship between his project and a similar one described in Varela, Thompson and Rosch (1991), Clark says the following:

Varela et al. use their reflections as evidence against realist and objectivist views of the world. I deliberately avoid this extension, which runs the risk of obscuring the scientific value of an embodied, embedded approach by linking it to the problematic idea that objects are not independent of the mind. My claim, in contrast, is simply that the aspects of real-world structure which biological brains represent will often be tightly geared to specific needs and sensorimotor capacities. (p. 173)

This casual sweeping under the rug of such an important issue is the one place in *Being There* where Clark lets the reader down. The non-realist conclusions that Varela, Thompson and Rosch reach seem genuinely to follow from Clark's picture of the mind, a picture whose acknowledged historical precedents (Heidegger, Merleau-Ponty and von Uexkull) were opposed to realism. To see that the embodied, active mind leads to non-realist conclusions, consider Clark's discussion of von Uexkull's essay "A Stroll through the Worlds of Animals and Men" (1934). <4>

Von Uexkull and Clark both suggest that we should expect creatures (including humans) to be sensitive *only* to those aspects of their environments that matter to the actions they

regularly undertake; their representations, to use Clark's phrasing, will be action-oriented. The world represented by animals with much different needs than humans will be much different than the world humans represent. This is the case because throughout their evolutionary histories, animals develop perceptual systems responsive to opportunities to fulfill their needs. Because the needs of one type of animal can be so different from those of another, the perceptual systems that result will constitute the world in very different ways, as full of barbecues and highways and myriad other things for humans, but, for example, as containing only three things--what we see as butyric acid, pressure and temperature changes--for ticks (see von Uexkull, 1934, p. 10). And given the way evolution works, we should not think of the perceptual systems (or any parts of animals) as ideal solutions to problems posed by the environment. [5](#) Instead, animals that survive and reproduce are those that do well enough to find food and so on. So, there is no reason to assume that any particular animal's perceptual system gets the world, as it is independently of thought, *just exactly right*; they all do only well enough.

Since, as Clark suggests (p. 25), there is no reason to except human perceptual systems, there is also no reason to think the world that humans live in has any special claim on being the *true reality* or *world-in-itself* from which ticks, poor things, know only three aspects.

The everyday human world, far from being an objective, action-neutral environment, is just as "tightly geared to specific [human] needs and sensorimotor capacities" (p. 173) as the tick's world is to specific tick needs and sensorimotor capacities. Thus, as Varela, Thompson and Rosch suggest, the world as registered by the perceptual systems of humans (or any other type of animal) cannot be fully independent of those perceptual systems. If, as Clark claims, representations are action-oriented, it follows that cognitive agents, with their particular phylogenies and ontogenies, their physiology and education, play an important role in constituting their worlds.

So far Clark would probably agree. But in so doing, he must also admit the falsehood of so-called "common-sense realism," in which the world-in-itself is thought to correspond to everyday human categories. For if humans and ticks and rats and so on are all able to live successfully in the very different worlds constituted by their perceptual systems, there can be no principled reason to privilege the human world (or any of the others) as the world-in-itself. Indeed, cockroaches, for example, are arguably more successful than humans. Yet no one ever claims that we should adjust our ontology so that it meshes with the categories that cockroaches use. Thus, the ontology implied by our usual human categories has no claim on being the world-in-itself.

Furthermore, it is a small step to see that "scientific realism" or "objectivism" (see Husserl, 1970), in which the world as it is described by the mathematical idealizations of physics is taken to be the world-in-itself, is also false. Consider that Clark argues that "higher thought," the kind exhibited in mathematical and scientific theorizing, depends on the scaffolding provided by public language. He also suggests (pp. 211-13) that language is adapted to the way our brains worked pre-linguistically; human language, that is, is adapted to and built upon action-oriented representations. But, as we have seen,

these representations are biased by pressures to fulfill human needs throughout evolutionary history. And if the foundation on which language is built is biased, it is overwhelmingly likely that language itself is similarly biased. So if physics and other sciences depend upon our language-using abilities (and Clark argues that they do), they have no claim on being reflections of the world-in-itself.

Indeed, the commonly held belief that the physical is somehow equivalent to the world-in-itself is especially baseless: nothing but the tools that physicists build are able to perceive things like reflectances and protons.

Clark resists these conclusions, and with good reason. They require changing the way most of us, as cognitive *scientists*, view the world. Cognitive scientists persuaded to accept Clark's picture of the embodied, active mind cannot do as most scientists do; that is, they cannot just assume common-sense or scientific realism. This is especially true when trying to assign content to the mental states of non-human animals (not to mention states of artificially evolved neural networks and controllers for animats). These states may frequently stand for objects and situations that have no clear analogue among our common-sense and scientific categories, as these categories do not necessarily reflect anything other than human needs and sensorimotor abilities. This is a high cost indeed. It makes the task of cognitive science considerably more difficult, and that alone might dissuade many members of the cognitive science community from following Clark down the road he so skillfully builds in the first part of *Being There*. What Clark needs to do is explain why his embodied, active cognition does not have these consequences, or explain why accepting them is not such a bad thing. Alas, he does neither. [6](#)

### 3. Conclusion

Serious though it may be, this problem seems less significant when compared with the obvious virtues of Clark's book. Clark's patient exposition of the newest work in cognitive science, unfamiliar to many, and his synthesis, from that work, of a new plan for studying the mind is truly exciting. His rebuilding of the conceptual territory is thorough and always reasonable.

Clark's picture of the embodied, active mind is a conservative revolution: he raises, then rejects, the most radical claims made in its vicinity (anti-representationalism and problems for metaphysical realism), while foundational concepts like computation, and representation are maintained, but rethought. The third part of the book, in which Clark speculates widely about the roles of marketing(!), language and the social world in advanced, human-level cognition is provocative and always entertaining.

I recommend this book to everyone interested in the sciences of the mind. Those who are unfamiliar with this territory will be excited by what they've been missing; those who are specialists in one of the fields Clark lassoes into embodied, active cognition will learn how their work fits in to a complete picture of the mind. *Being There* will also work well

as a textbook for courses in the foundations of cognitive science or the philosophy of mind, as long as it is balanced by works on more traditional cognitive science. Most importantly, though, I recommend Clark's book to any philosopher of mind who wants to do a better job keeping up with developments in cognitive science.

## Notes

<1> Computation is usually taken to involve the manipulation of representations according to rules. No representations, no computation.

<2> Action-oriented representations are similar to Ruth Millikan's "pushmi-pullyu representations" (1995). Both Clark and Millikan relate these representations to Gibson's affordances (1979).

<3> Although Clark leaves the question open, there is good reason to think that even pure dynamical systems theory explanations (his type (1)) have elements that can be singled out as representations. See Bechtel (1998) and Chemero (1998).

<4> Clark reads von Uexkull as agreeing with him that the worlds of animals are just aspects of the "normal, physical environment (pp. 23-31). This is, I think, a misreading of von Uexkull's essay. Von Uexkull is recommending the sort of constructivist position that I am suggesting follows from Clark's picture of embodied, active cognition. See especially the last few pages of von Uexkull (1934).

<5> Dennett would disagree. His *Darwin's Dangerous Idea* (1995) is an extended argument that we should think of parts of animals as ideal solutions to problems posed by their environments.

<6> For what it is worth, I think that the same conclusions follow from any psychology or philosophy of mind that takes evolution seriously, e.g. Millikan's teleosemantic picture (Millikan, 1984) or ecological psychology (Gibson, 1979).

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