A Psychology of the In Between?

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> **Upshot** • The authors offer a theory of agency that is general enough to apply to whole organisms and single cells, and meaningful enough to highlight problems that embodied cognition theory has overlooked. The authors insist that the interesting thing about minds is what goes on in between activities; this leaves unclear what a specifically enactivist empirical program could look like. But the book can be read as a contribution to a broader project of instituting a full-blown post-cognitivist science of the mind.

The traditional methodology employed in the psychology laboratory sees research volunteers being asked to carry out some task under carefully defined task conditions. The idea is to understand how that task works, in the hope that the explanation can later be applied to understanding similar tasks.

In their book, Ezequiel Di Paolo, Thomas Buhrmann, and Xabier Barandiaran suggest that this way of doing things overlooks the most fundamental phenomena of mental life. They are more interested in this question: How is it that, in the course of our lived experience, we find ourselves switching from engaging in some activity to engaging in some other activity? "Enactivism," we are told,

> "is concerned with explaining precisely these critical transitions between particular conditions that sometimes afford different functional descriptions and those 'in-between' dynamics that (re)constitute these or novel conditions." (27)

So instead of trying to understand tasks we are trying to understand what goes on in between tasks. How might we go about studying such a thing?

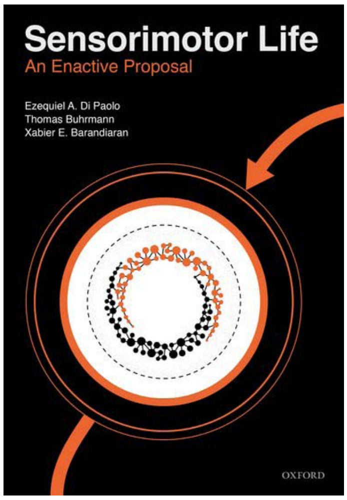
Di Paolo, Buhrmann & Barandiaran's approach to answering this question is almost entirely theoretical. At the heart of the book is a three-chapter presentation of the authors' theory of agency. These three chapters can be summarized in the following claim. To be an agent is to exhibit three constitutive components of agency:

- self-individuation,
- interactional asymmetry, and
- normativity.

To grasp the central proposal of the book, it is therefore important to understand each of these three technical terms.

The first item, self-individuation, is essentially the same as old-fashioned autopoiesis, or self-production (Maturana & Varela 1980). A self-individuating system is one that establishes a boundary between itself and its environment, and maintains itself in the face of precarious conditions, e.g., by continually consuming resources from the environment. The second item, interactional asymmetry, points to the fact that organisms do things. Agents are not mere reactive automata, as some versions of stimulus–response psychology once suggested. Agents act on their environment. They actively explore and perform, they do not wait passively for stimulation to come along. The term "asymmetry" here is intended to denote that causation comes from the animal side of the animal–environment relation: a living agent causes its own activities. The third item, normativity, is intended to account for the fact that an agent can succeed or fail in its dealings with the world. The most basic form of normativity is evolutionary adaptivity. A single cell is succeeding, in adaptive terms, in the case that it continues to avoid situations that might threaten its existence. The authors later allow other forms of normativity, e.g., certain behaviors in humans are driven by aesthetic considerations about the "correct way" to perform some activity.

This tripartite definition of agency allows the authors to categorize various phenomena as either agency-involving or not. Assembly-line robots fulfill two of the criteria: they exhibit normativity and asymmetry. They are set up to perform a task upon raw materials, and they can fail at this task. But they do not exhibit self-individuation. They do not fix themselves when they go wrong, or give birth to new assembly line robots. They are not agents. By contrast, an *E. Coli* bacterium swimming up a sugar gradient is an agent. It fulfills all three criteria: in swimming towards the food source, it is contributing to its own self-maintenance as a metabolic unit (individuation), it is acting on its environment (asymmetry), and it is behaving in a way that is adaptive to its own continued existence (normativity).



Review of *Sensorimotor Life: An Enactive Proposal* by Ezequiel Di Paolo, Thomas Buhrmann, and Xabier Barandiaran. Oxford University Press, Oxford, 2017. ISBN 0198786840 · 304 pages

A common criticism of the enactivist approach is that its analysis only properly applies at the level of the cell, and that this is an inappropriate starting point for attempting to explain cognition in general. Di Paolo, Buhrmann & Barandiaran are eager to respond to this. Their innovation is to provide an account of how their theory of agency can be applied at the whole-animal level. The key move here is to describe the animal as constituting a network of sensorimotor schemes. The animal, they argue, comes to be organized as a system of schemes. This happens as a consequence of the behaviors that it repeatedly engages in. These schemes are not motor programs, or output algorithms, in the cognitivist sense, but are "world-involving." A hawk can enact its hunting-related schemes only when the appropriate environmental conditions obtain: in an open sky with good visibility, not in a confined space or in thick fog.

The authors suggest that this network of schemes is itself a system that exhibits the three characteristic properties of agency, as earlier applied to the cell. In order for the hawk to remain a viable system, it must continually enact and maintain its various behavioral schemes (the network exhibits self-individuation), it must do this by acting on its environment in appropriate ways (the network asymmetrically causes action in the world), and it must avoid situations that threaten the continued viability of the network, or the animal (the network exhibits adaptivity or normativity). If the animal enters a situation where it is no longer able to maintain its sensorimotor network, as when the hawk becomes injured or enters captivity, then it has entered a state of decay that may ultimately issue in death. The properties of agency that were present at the level of the cell thus re-emerge at the level of the whole organism.

An attractive property of Di Paolo, Buhrmann & Barandiaran's account is that it incorporates a theory of learning. The authors advocate a dialectical understanding of the emergence of new skills. Borrowing from Jean Piaget, they conceive of the animal as an active explorer of its environment. As the animal explores, it encounters new structures that present difficulties, and it must respond to these by assimilating the new structures into its sensorimotor network, i.e., it must learn to deal with new situations. In this sense, the authors' account is a constructivist one.

Where the authors depart from classical, anti-realist constructivism is in their attempt to accommodate some of the insights of the explicitly realist program of ecological psychology, instigated by James Gibson (1966, 1979). A central claim Gibson makes is that the environment of a species already has meaningful structure even before a particular animal encounters it. The authors are somewhat cautious about embracing this:

> "We agree with ecological psychologists when they highlight that real environments are rich enough to access directly their relevant meaningful aspects. We think they are in fact too rich, in that sense-making always involves a massive reduction of all the environmental energies that might affect the agent, to those within the dimensions of biological, sensorimotor, and social historically contingent meaning." (227)

Di Paolo, Buhrmann & Barandiaran lean heavily on the work of Gibson's followers in dynamic systems approaches (e.g., Van Orden et al. 2003), but, puzzlingly, they are dismissive of Gibson's own work. Their beef is that Gibson's approach leaves the animal as a passive reactor to environmental features. Echoing Varela, Thompson, & Rosch (1991), they suggest that Gibson's view leaves too little for the animal to do, and gives the environment too great a role in driving behavior (18). On page 74 they write:

> "in the ecological approach, the origin of the particular motor patterns that bring about the invariant-revealing transformations is not always considered relevant; instead, what matters in many cases is simply the structure of movement-induced flows."

But this is a misreading of Gibson's project. Gibson never claimed that the environment alone could cause the animal to perceive or act in a certain way. Like the enactivists, he understood natural vision as something the animal does: "we look around, walk up to something interesting and move around it so as to see it from all sides" (Gibson 1979: 1). Gibson's methodological move was to start with an account of the kind of structure that exists in the environment. To understand the animal's behavior, the thinking goes, we must first understand what the animal's behavior is directed towards. Di Paolo, Buhrmann & Barandiaran acknowledge the importance of this environmental structure, but overlook the empirical implications.

Having an account of structure in the environment is important because it provides a basis for understanding how an animal performs a particular task. An understanding of optic flow patterns produced during locomotion allows us to identify dynamic properties that are implicated in the control of, say, braking behavior (Warren 2006). An instance of braking to avoid a collision is characterized by a recognizable start and end point and a pattern of transition between the two. First, the driver detects an obstacle in the road ahead, then the driver must control the slowing of the vehicle relative to the perceptual looming of the obstacle, finally the vehicle is brought to a stop, preferably before it hits the obstacle. Crucially, for Gibsonians, the optic looming pattern occurs as a lawful consequence of the way the obstacle reflects light to the moving position of observation occupied by the driver's eyes. The control structure is a property of the animal–environment system. The tools of dynamic systems thinking are most effective when deployed in understanding this type of well-defined task. A task here refers to a convenient, tractable unit of study: a start–transition–end. Talking about tasks is what allows us to understand the structure of a particular behavior without inappropriately decomposing the animal–environment system into component units.

This brings us back to where we started. Di Paolo, Buhrmann & Barandiaran are suspicious of attempts to divide the problem space of cognitive science into functional units, or tasks. What we want to explain, they assert, is the dynamics of what comes "in between." But having thus rejected seemingly all forms of reductionism, they are left with an impossible project. They devote much of the first half of the book to providing a dynamic systems gloss on various aspects of their theory – their concept of the sensorimotor network, and their Piagetian account of learning. But without a method for breaking down the system and studying it piece by piece, it is not clear how their approach can ever lend itself to a productive program of empirical research.

Then again, perhaps a specifically enactivist program of empirical research is not needed at this point. The book should be read in the context of ongoing attempts to unite various non-representational approaches into a single full-blown post-cognitivist science of the mind, which the authors mention approvingly (18; see, e.g., Chemero 2009; McGann 2014). Where Di Paolo, Buhrmann & Barandiaran succeed is in highlighting what has been missing from post-cognitivist approaches to date. Their account of sensorimotor agency is to be applauded in that it provides a way to understand how an organism's individual history gets into the system and is able to causally influence its subsequent behavior. This is something that has been neglected in dynamical systems approaches outside of the developmental field (for a treatment of development in dynamical terms, see Thelen & Smith 1994). *Sensorimotor Life* is probably the most important book in enactivism since Evan Thompson's *Mind in Life* (2007). More than that, though, it is a contribution to a broader conversation on what a future cognitive science can and should look like. A tension remains between the anti-realism of their constructivist project and the realism of the ecological/dynamical account they seek to accommodate. Perhaps a dialectical resolution of this tension is possible. If such a resolution could be found, cognitivism would be faced with a formidable competitor.

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