

rent *relatum*, as seems to be their accusation against the enactivists (§§41f). This way we secure an ever-present world for ourselves – an environment that is “real and objective” in the sense that ecological psychologists want, but that is also fundamentally in relation to the abilities of the organism that give it its affordance power or “meaning,” whether this has developed phylogenetically or ontogenetically. This is important not only for uniting the resources of ecological psychology and enactivism but also to develop a much richer account of how our world can be constituted by affordances. We get, as a result, an ontology of affordances that are abstract and concrete rather than “potential” and “actual,” which should go some way to dispersing some of the worries the authors of the target article have with regard to the enactivist concept of sense-making (§40–44).

« 11 » However, the distinction between abstract and concrete affordances can be developed into a yet more subtle taxonomy of affordance relations. In a recent paper (Costantini & Stapleton 2016), we drew on the conceptual apparatus provided by Chemero and further phenomenological and enactivism-inspired developments of affordance theory (by de Haan et al. 2013; Bruineberg & Rietveld 2014; Rietveld & Kiverstein 2014) to help tease out the distinctions revealed in cutting-edge micro-affordance psychology research. In so doing, we can start to unpack the differences (and explore the somewhat surprising dissociations) between perceiving an affordance (e.g., perceiving something as graspable), perceiving something as a soliciting affordance (e.g., experiencing it as demanding grasping), and bodily responsiveness to demandingness (e.g., activation of the bodily components of the specific grasping response). These considerations open ecological psychology to a subtler consideration of the perception of affordances and the role of embodiment in affordance perception.

« 12 » It seems to me that much of the research developed in the ecological psychology approach, and the conceptual tools used, are valuably incorporated by enactivists to flesh out a full framework of life and mind. Likewise, ecological psychology can benefit from the depth of the enactivist enterprise. This is not to say that there should not be careful discussion of exactly how we

should cash out the concepts of perception, environment, agency and mutuality (and indeed “affordance”). These discussions can benefit both sides, provided we respect ecological psychology and enactivism as different projects that may sometimes share, and sometimes differ in, emphasis and scope, but can nevertheless embrace and fruitfully inform each other.

**Mog Stapleton** is a postdoctoral research fellow in the Philosophy and Religious Studies Programme at the University of Macau. She is particularly interested in the intersection of neuroscience and philosophy with a focus on the biological, bodily implementation of cognition, consciousness and affect.

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## Across the Uncanny Valley: The Ecological, the Enactive, and the Strangely Familiar

Ezequiel Di Paolo

Ikerbasque, Basque Foundation  
for Science, Spain

ezequiel.dipaolo/at/ehu.es

> **Upshot** • I contrast enactivist and ecological perspectives on some of the themes raised by the authors. I discuss some of their worries about the notion of sense-making and other epistemological aspects of enactivism.

« 1 » Ecological psychologists and enactivists stare at each other across an uncanny valley – the convergences between the two approaches are many and strong, so when disparities unexpectedly crop up, they provoke an uneasy feeling of bemusement. In this context, the target article by Martin Fultot, Lin Nie and Claudia Carello is a welcomed step towards the long overdue dialogue between the two perspectives.

« 2 » For many years, ecological psychology has critically engaged the representationalist theory of the mind. The same can be said about enactivism. Both camps are used to confronting an alternative with which they see little in common. How do

they deal with an alternative with which there is very likely a lot in common? One can expect misunderstanding when these two schools face the task of evaluating each other and working out their differences. Are we saying the same things with different languages?

« 3 » I will not address all the issues raised in this article. I am hopeful that the dialogue will gain momentum and that there will be further opportunities to clarify mutual worries.

« 4 » The central claim of ecological psychology is that the environment is rich enough to explain the degree to which an agent is aware of the world. This statement is critical of the prevailing view that considers the environment as poor and to be supplemented by what the authors describe as “mental construction.” Apart from some broad agreement, enactivists would have two things to say about this central statement.

« 5 » The first comment is that not only is the environment rich enough, it is in fact too rich! Perception always involves a massive reduction of the inexhaustible potential sources of influence that can impinge on an agent to a rather limited set, the set of influences to which the agent is at this moment sensitive, and which depend massively on biological and socio-cultural factors as well as on the agent’s motivations and situation.

« 6 » If so, then the main problem of a psychology of perception is not to establish the availability of environmental information and stop there, but to explain how and why the organism responds *perceptually* only to the particular subset that has any meaning to it at this moment. It is fine to say, as the authors do, that what is relevant are not the animal-neutral environmental energies but “animal-referential variables” (§5), but this is to beg a question. What is relevant depends not only on the organism in a generic way, but specifically on what the organism does, which in turn depends on how it currently engages its environment as an agent. A naturalistic theory of agency, such as the one developed by enactivism, could be a contribution to this problem. In addition to a deep understanding of the environment, we need a theory that pays attention to the perceiver as an active agent and her capacity to engage her world meaningfully. “Active”

here does not mean simply “moving” (this is well-covered in ecological psychology). It means engaged in a regulated coupling with the environment, generating goals and pursuing them, moving in ways that alter the constraints that link the agent and the environment as coupled systems (Barandiaran, Di Paolo & Rohde 2009).

« 7 » Recent enactive work clarifies these differences by introducing four operational ways of studying sensorimotor regularities (Buhmann, Di Paolo & Barandiaran 2013). They range from the notion of *sensorimotor environment* (the mapping of open loop sensorimotor covariations for a given loop and environment), the *sensorimotor habitat* (closed loop trajectories modulated by the agent’s internal dynamics), *sensorimotor coordinations* (task-relevant sensorimotor structures) and *sensorimotor schemes or strategies* (norm-driven organizations of sensorimotor coordinations). It would be an interesting exercise to try to map the typical examples of ecological psychology (e.g., optic flow, time to contact) onto these categories. My impression is that many of them would be cases of sensorimotor environment or sensorimotor coordinations as they often involve a rather neutral as opposed to norm-driven agent and the agent’s internal dynamics do not often play a central role.

« 8 » My other comment regarding the sufficiency of environmental information is similar in intent. For traditional cognitive science, the problem has always been establishing that the information deemed necessary for a cognitive task is available to the cognitive agent. The ecological emphasis on the availability of information in the environment is a move within that same conversation (e.g., §§3f). But to some extent, this is a conversation that enactivists insist should not be as central as it has been (nobody claims it is totally irrelevant). It is precisely a shift of emphasis from a problem posed in terms of an informational economy (production, transformations, transactions, distribution, consumption) to a problem of how the activity is generated in a concrete situation so that it constitutes the meaningful engagement of an agent in that same situation.

« 9 » Enactivists say that cognition is a relational phenomenon involving agent and environment (Di Paolo 2009a). It does not

happen in the head. Recent extensions to the work of Kevin O’Regan and Alva Noë (2001) on the sensorimotor basis of perceptual experience demonstrate that it is possible for enactivism to provide non-representational accounts of perceptual learning, agency, and the sense of agency (Di Paolo et al. 2014; Buhmann & Di Paolo 2015). All of this is done within a *world-involving* perspective (Di Paolo 2014), i.e., one in which the environment does not play the role of source of informational inputs to the agent, but is involved *more fundamentally*, as an enabler of emergent relational dynamics. The difference between these two views is crucial for enactivism and can be demonstrated rather starkly in models where different kinds of coupling between agent and environment are examined (e.g., Aguilera et al. 2013).

« 10 » My understanding of the agent-environment relation offered by ecological psychology is that this relation is also of a dynamical coupling type. This is shown in the growing literature on interaction-dominant dynamics, which shows the deep, multi-timescale entanglement between agent and environment (including other agents) (e.g., Van Orden, Holden & Turvey 2003). But then in eco-speak this is seen as information pick-up ... And so that uncanny dissonance returns. Are we or are we not speaking about the same things?

« 11 » Both enactivists and ecological psychologists reject the need for mental representations. Perhaps the disagreement about the use of the word “information” is an indication that in fact they might be rejecting different things? As the authors explain at length, what they mainly reject is the assumption of the poverty of the environment, and the need for mental construction in order for perception to be meaningful. Enactivists do reject this as well. However, for them, meaning is not just something that pops up in the relation between organism and environment. It necessitates a particular kind of *activity* on the part of the agent to emerge, i.e., sense-making. Enactivists reject the notion that cognition is describable in terms of information processing, as we have said. This notion is neither necessary nor sufficient for cognition, even if it might prove useful in circumscribed analyses (e.g., understanding the information-transfer properties, say in the optic nerve under sta-

tionary conditions). Ecological psychology does not reject the notion of information processing. Indeed, it looks as if it has been constructed around adapting this concept to an ecological setting as opposed to something happening in the brain.

« 12 » Similar thoughts are triggered by the authors’ discussion on affordances. To some extent, this is a concept enactivists sometimes integrate into their vocabulary, and Anthony Chemero’s (2009) dynamical interpretation takes into account enactive ideas in turn. It is through affordances that ecological psychology constructs its theory of meaning. As the authors say, to perceive affordances is always already to perceive meaning. There is no need to wonder how meaning is added subjectively to a neutral animal-environment relation (§§7–10). This is widely compatible with the enactive notion of sense-making, which is admittedly more specific as it involves notions of viability (Di Paolo 2005; Thompson 2007). Sense-making always entails two elements:

- sensitivities to virtual aspects of the environment, and
- (attempted) enactment of regulations of the agent-environment coupling.

The language is different but, at the personal, whole-organism level, it also describes an agent for whom its current situation has a meaning because it affords doing something about the conditions that are likely to affect her viability. Sense-making is thus not only enacted in terms of actual (“effective”) engagement with affordances, but also in terms of virtual (“potential”) ones involving risks and opportunities.

« 13 » There are cases of sense-making that would *not* be describable in terms of affordances (non-perceptual forms of cognition). It is also the case that sense-making is a personal-level concept, which is operationalized through a description of organized sub-personal processes, while affordances remain at the personal level (an affordance is meaningful to a whole organism, not to its parts). But the convergence is still noteworthy and the differences not necessarily irreconcilable.

« 14 » Moving to some of the authors’ many worries about enactivism, I happen to agree that, as a model of autonomy and sense-making, the cellular automaton Bit-torio (Varela, Thompson & Rosch 1991) is

not a great one. But I disagree that there are no concrete models of sense-making (see, e.g., Barandiaran & Egbert 2014).

« 15 » In connection with this, the authors raise an interesting question (§35): Is sense-making anything more than mere dynamics? If it were, they argue, enactivists would be embracing an implicit form of dualism. Indeed, enactivism claims that something sets precarious autonomy (and by implication sense-making) apart from the ontology of processes normally described as “mere” dynamics. But the issue is here one of acknowledging an aspect of materiality that is not sufficiently captured by “mere” dynamics, a potentiality for ontological jumps (Jonas 1966). Describing the material phenomena involved in these ontological jumps has long been recognized as a limitation of dynamical systems theory (e.g., Jaeger 1998). Moreover, the enactive approach puts emphasis on the precariousness of living and cognitive systems as a constitutive (not merely a contingently unavoidable) aspect of autonomy (Di Paolo 2009a). Since it involves the finitude of any positive material property, precariousness may be approximated, but by definition never entirely captured by positive dynamical descriptions. Yet it is part of the materiality of the universe. Because dynamical systems approaches work with a ground set of variables and constraints, they have difficulties and must be patched up when the phenomena of interest involve the emergence of new variables and constraints, or their transformation or destruction. We can also mention the complications involved in handling non-parametric changes in high-dimensional, nonstationary systems under stochastic coupling, what Herbert Jaeger (1998) aptly calls “wild systems.” So it is not to abide by implicit dualisms to recognize that the language of dynamics does not sufficiently describe every material phenomenon, it is simply not to assume naively that it does. One is already beckoning dualism by the uncritical use of terms such as *mere* dynamics

« 16 » We must acknowledge the authors’ disenchantment with the quick dismissal of ecological psychology by Francisco Varela, Evan Thompson and Eleanor Rosch (1991). It is unfair to dismiss ecological psychology by implying that in it one could only build a theory of perception from the side of

the environment. And yet, to be astonished about this, as the authors are, is to fail to acknowledge some realities about ecological psychology (in this very article we find the heading “Embracing the environment,” not “Embracing the organism-environment coupling”).

« 17 » Despite the accent on agency as always situated in an environment, it is correct that there is a dearth of enactive theorizing about the environment, as noted by Marek McGann (2014). Does this mean that such theorizing is unwanted or that it could not fit well with other enactive ideas? I do not think so. It is more a case that it has not been done yet, and what better encouragement to do this than to engage in ongoing dialogues with ecological psychologists.

« 18 » As to the authors’ concern about whether enactivism can escape representationalism, the only honest answer is that so far it has done so and there is no obvious reason why in principle it could not. One could mention that the ground covered by non-representational enactive proposals is not negligible (accounts of agency and meaning, social cognition, emotions, sensorimotor contingencies, skills, habits, language, narrativity, pretend play, perceptual attitudes, and application of these ideas to psychiatry, therapeutic interventions, music making, education, anthropology, etc.) These are concrete positive proposals, each to be evaluated on its own merits and limitations, but they exist and they are non-representational.

« 19 » Finally, let me address the authors’ worry about something that for enactivists is fundamental: the need to adopt a perspective centered on the organism. It seems odd for the authors to emphasize the organism-environment mutuality so much and then claim that the actual organism could well disappear if we left in its place a shadowy idea of it. They say that sucrose would constitute food for bacteria even if there were no extant bacteria (§42). Such statements can only be made with hindsight. They simply hide the need to know the actual organism in the first place. Suppose we face a question that involves extracting knowledge about the metabolism of an unknown species. Can we answer it without engaging with actual organisms? The relevant chemical dynamics not only involve NP-hard problems, such

as that of protein folding, that put limits on what we can formally predict, but conceivably the task requires establishing new empirical facts whose sheer possibility we may not have even registered before. Unless we abandon the realm of science, we cannot state that compound *X* has the potential to have a particular effect *E* on an imaginary metabolism *M* if we factually don’t have sufficient knowledge about what we should even imagine. Conversely, we cannot be certain that what we do imagine is sufficient for supporting such universal, “disembodied” statements.

« 20 » Enactivists embrace the situatedness of the observer and the fact that scientific knowledge can only be based on the foundation of what we do know in our time, place and culture. Furthermore, concrete material processes are not fully exhausted by scientific descriptions (possibly they will never be). Scientific ideas are sufficiently established only to the extent that they fit some relevant norm (of accuracy, of applicability, of predictability, of profitability, etc.). There are more virtualities in material processes than are dreamt of in either of our philosophies. However, virtualities are tied to a current concrete situation so they are particulars, not universals; and we can only know them partially, which makes them a poor basis for generalizations such as the universal nutritional value of sucrose.

« 21 » In short, there can be no *un-situated* theory of life and mind.

« 22 » For this reason, many enactivists take Hans Jonas at face value when he says that only life can know life. No amount of analyzing chemical processes from a disembodied perspective can reveal that organisms possess an interest in what they do, that they care about it. But we have first-hand evidence of this from the fact that we are living embodied observers with privileged inside knowledge of what it is to be alive. This is far from anti-scientific, it is an acknowledgment that all the sciences of life and mind are implicitly done in this way.

Ezequiel Di Paolo’s interests include evolutionary robotics, embodied cognition, intersubjectivity, and philosophy of mind.

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