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Thinking avant la lettre: A Review of 4E Cognition

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Abstract

The “4E” approach to cognition argues that cognition does not occur solely in the head, but is also *embodied, embedded, enacted, or extended* by way of extra-cranial processes and structures. Though very much in vogue, 4E cognition has received relatively few critical evaluations. By reflecting on two recent collections, this article reviews the 4E paradigm with a view to assessing its strengths and weaknesses.

Keywords

4E; embodiment; enactivism; culture; cognition; perception; action; representation

We have categories for three types of cognition: organic, artificial, and supernatural. Most organic cognition that we know of is carried out by fish and arthropods, which together make up eighty-five percent of Earth’s non-vegetable biomass (Bar-On, Phillips, and Milo 2018). Artificial cognition is relatively new, but already able to outperform human judgment in a range of specialized tasks (Goodfellow, Bengio, and Courville 2016). We have no evidence whatsoever that supernatural cognition exists, and it would probably do us a great deal of good to stop looking for it.

If I make these points, it is because any appreciation of how cognition functions must begin with an appreciation of what counts as cognition in the first place. Two recent volumes—*Embodiment, Enaction, and Culture* and *The Oxford Handbook of 4E Cognition*—purport to do this, each giving a wide selection of essays by well-known and newer voices in the 4E cognition paradigm. In different ways, they respond (or fail to respond) to the issues that attend thinking about 4E cognition, and thus offer a useful point of entry into the field. But before engaging with the volumes themselves, I offer some thoughts on the wider intellectual project that they contribute to.

The four E’s of 4E cognition initialize its central claim: cognition does not occur exclusively inside the head, but is variously *embodied, embedded, enacted, or extended* by way of extra-cranial processes and structures (Rowlands 2010a). This is intended to contrast with traditional views, where internal representations of states of affairs are symbolically manipulated so as to output knowledge or action. Consider my planning of my monthly

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finances using an electronic calculator. Depending on the 4E theorist, this process can be described as *embedded* cognition (it facilitates thinking by causally exploiting an object in the environment) or *extended* cognition (the calculator constitutes part of my cognitive apparatus). However, the action also *enacts* a world: by budgeting for the future, certain items in the environment are disclosed to me as affordable or not affordable. Finally, my physical and cultural *embodiment* as a human being shapes my cognitive processes, such that I am most comfortable using decimal arithmetic (I have ten fingers) and will avoid thinking with degrees of precision greater than is practically useful (enculturated knowledge). Inevitably, the 4 E's shade into one another, and authors differ in how they define them. Nevertheless, most agree that they constitute a form of dynamic coupling, where the brain-body-world interaction links the three parts into an autonomous, self-regulating system.

As a historical phenomenon, the 4E paradigm draws on several precursors. Early work on externalist accounts of truth showed that it is possible to construct a semantics in which the meaning of a proposition is not solely determined by the intentions and beliefs of an agent, but also by external (and possibly unknown) facts in the environment—the famous “twin Earth” thought experiments of Hilary Putnam (Putnam 1973). In psychology, work by James J. Gibson on perception and affordances (Gibson 1979), Lev Vygotsky on socialization, thought, and language (Vygotsky 1962), and George Lakoff and Mark Johnson on conceptual metaphors (Lakoff and Johnson 1970), demonstrated how cognition is unavoidably shaped by the somatic and cultural environment it occurs in. But perhaps the most fateful encounter in the development of the 4E paradigm came with the blending of the continental phenomenological tradition (most importantly the work of Maurice Merleau-Ponty [Merleau-Ponty 2002; 1996]) with the methods of contemporary neuroscience. The ambition here was to reconcile “the body as a lived, experiential structure and the body as the context or milieu of cognitive mechanisms” (Varela, Thomson, and Rosch 1991, xvi). In a program that was to profoundly shape subsequent research in 4E cognition, this involved complementing third-person knowledge of specific brain states with a phenomenologically informed, first-person perspective on what it's like to experience these states. Most recently, this has been taken up in relation to social cognition, where 4E theorists argue that internal representations of social scenarios are not necessary for us to successfully engage with these scenarios—instead, they are processed directly by neurological mechanisms or delivered by cultural prostheses such as narrative (Gallagher 2012; Popova 2014; Hutto 2009; Carney, Wlodarski, and Dunbar 2014).

Relative to rival models of cognition, there can be no doubt that the 4E paradigm represents a welcome turn to how much of cognition actually occurs. Cognition is always directed towards some end, and as these ends are usually practical, it is reasonable to suppose that the means by which we most often pursue them—our bodies—are integral to the understanding of cognition. There are also good a priori grounds for thinking that something like 4E cognition makes evolutionary sense. Cognition is physiologically expensive, so if a regularity in the environment can be depended on to perform computational or inferential work, any organism that exploits this regularity can divert more resources into successful reproduction. It is therefore no surprise to find evidence in support of the 4E account. One area of particular interest is in the psychology of perception, where action-based theories

suggest that the environment is disclosed through active probing—as opposed to the passive registration and subsequent synthesis of sense data (Noë 2004; O’Regan and Noë 2001; O’Regan, Myin, and Noë 2006; Bogacz 2017; Adams, Perrinet, and Friston 2012). More speculatively, it is also true that the entire apparatus of culture can, in many ways, be thought of as the displacement of challenging cognitive operations into material and symbolic artefacts in the environment (Malafouris and Renfrew 2010; Carney, Robertson, and Dávid-Barrett 2019; Hutto 2009; Gallagher 2011). Indeed, if “environment” is also understood to include the body, good empirical evidence has recently emerged that even abstract, culturally mediated concepts like “justice” and “essence” are encoded using perceptual and motor schemes (Connell, Lynott, and Banks 2018; Lynott et al. 2019). And we need no evidence at all to know that the world matters to us without us needing to reflect on the fact—a facial expression is immediately visible as sad or happy; we do not need to deduce this from evidence (Gallagher 2008). In this sense, a key value of 4E approaches is to make manifest those preconditions of thought that are invisible precisely because they are so fundamental.

And yet, one can acknowledge the value of the 4E paradigm, and even contribute to the literature (as I do), without subscribing to the revolutionary zeal that too often attends it. Cognitive science is not, on the whole, a discipline known for its febrility; writing on 4E cognition—especially when delivered by authors not involved in experimental research—is the exception to this. If there is a trademark register in the field, it is the angsty ponderousness that often attends politics passing itself off as science. What these politics might be is signaled by the rhetorical overemphasis on the material and the somatic that attends so many expositions. “The zone of the carcass and the knacker” (Adorno 2002, 117) has always been the favorite starting point of progressive thinkers, and in thematizing it, the 4E paradigm signals a curious affinity with the various iterations of Marxism, feminism, phenomenology, and queer theory that make the same move. Indeed, this alignment points to one reason why the 4E paradigm is making inroads into humanities scholarship when fields like evolutionary psychology are daubed with the mark of Cain. Evolutionary psychology foregrounds reproduction, and Mom and Dad are the least sexy people around; 4E is about bodies, and bodies are very sexy indeed. Combine a body with a historical wrong—the repression of its role in cognition—and we’re already halfway to the Finland Station.

If I exaggerate here, I do so to make visible the extent to which the arguments presented by 4E theorists are sometimes not arguments at all, but rhetorical appeals to the reader. We are told, with a straight face, that “when the phone rings, I *hear* John’s voice; I do not hear a set of electronic sounds and *infer* that John is the cause of these noises” (Moran 2017, 32)—as if the italics do anything other than change the typography. Inferring John’s voice from the electronic sounds is precisely what comprises hearing; inference is built into the process. I quote this example not because it is egregious, but because it is typical. Throughout 4E writing, the aversion to anything that smacks of inference introduces a dualism that would be untenable were it applied to physical processes. When I hear the phone ringing, do I detect from the vibration of air molecules on my eardrum that a socially agreed signal has supervened? The answer must be yes, unless I wish to deny materialism (which is to say, affirm magic). That I do not consciously experience the calculation doesn’t mean it isn’t being performed. This is a common move in the field, where the forceful assertion of phenomenal experience is presented as an argument in its own right. We are already familiar

with this mode of argumentation—it's called literature—but where the errors of literature are paid for in pleasure, we are rarely so lucky with 4E cognition.

A more serious problem lies in how the undeclared politics of the 4E paradigm subtly forestalls criticism. To query 4E cognition is to be somehow gauche: bodies are where it's at, and you must surely wear socks with your sandals if you think otherwise. But the fact remains that there are foundational issues with the 4E paradigm that are too easily ignored or dismissed by its protagonists. Here are some of the more pertinent ones:

The hidden processing objection

4E theorists correctly claim that our bodies deliver us a world already freighted with significance; we do not usually consciously establish our interests with calculation and inference (at least with respect to perception and low-level action). But this is only true because the calculation and inference have already been carried out by evolutionary selection and hardcoded into our genome. To the extent that 4E theorists respond to this, they do so by offloading the relevant inferential activities onto some occult neurological process that implements them without the need to invoke symbolic intermediation. Gallagher (2008), for example, argues that social cognition is “directly” implemented by mirror neurons. In computing terms, this is analogous to saying that no computation occurs when graphics rendering is performed by a GPU (a built-for-purpose graphics processing unit) instead of a CPU (the general-purpose processing core), because the GPU just “delivers” the result to the CPU. Surely, such a view impoverishes our knowledge of cognition instead of enriching it. It does not matter how, when, or where the inferential activity occurs; if it is a necessary concomitant of a cognitive process, then any worthwhile approach to cognition is obliged to account for it.

The intentionality objection

No one demurs when we say that both human beings and giant squid practice cognition—despite *Architeuthis* and *Homo sapiens* inhabiting vastly different ecological niches. This is because we see different forms of cognition as having common features, like intentional directedness, that distinguish them from other organic processes. Thus, to say that cognition is shaped by the body that sustains it can be true without at the same time being useful. Human thoughts and squid thoughts are cognate in ways that human thoughts and squid heartbeats are not, because thoughts, unlike heartbeats, are “about” something. Moreover, as soon as we inquire into what this aboutness might mean as a phenomenon distinct from its token implementations, we find that bodies stop mattering very much at all. If thoughts are expressible and communicable, it can only be because they have some feature by virtue of which they pick out stable features of the world that can be accessed in an intersubjective way. We do not know for sure how this occurs—intentionality remains a riddle—but by far the best worked out candidate is the computational approach. Formulations like the Turing-Church thesis give clear definitions of what it means for a function to be computable, and thereby provide a formal model for cognition. In this view, the intentionality of thought is explained as a functional mapping from inputs to outputs, and the communicability of thoughts is volunteered as an isomorphism between compositions of mappings. Is this view

correct? Perhaps it is and perhaps it isn't, but there is no rival view that even remotely approaches the computational perspective with respect to theoretical sophistication and consilience with the rest of knowledge. Thus, to the extent we are interested in cognition in general, it may be that the 4E paradigm misleads us into emphasizing its incidental features over its essential ones.

The duplicity objection

Human beings habitually practice deception. Some authors even claim that this is responsible for the evolution of the cortex in the first place (Humphrey 1976; Hill and Dunbar 2003). If so, there is risk in naively accepting the interpretations of our social environment that our bodies deliver to us. Instead, we would be better advised to evaluate, in a Bayesian manner, the plausibility of these interpretations against contextual evidence, prior knowledge, and counterfactual models. With friends and family, such processes may be damped or suspended; with strangers they will be amplified. In between the two are those mechanisms of social association that, to greater or lesser degrees, allow us to identify strangers as allies or proxy kin (Dávid-Barrett and Dunbar 2017; Whitehouse 2000; Cohen 2012; Launay and Dunbar 2015)—even if these must then be coupled with mechanisms that prevent free-riding. To this, the 4E theorist will make the reasonable objection that we have pre-reflective intuitions for lie detection that help us negotiate tricky social environments—and indeed, it is true that there is a class of individuals in whom this skill is particularly well developed (Ekman, O'Sullivan, and Frank 1999; Ekman and O'Sullivan 1991). However, social life is only ever partially conducted through face-to-face interactions; even in the Palaeolithic, social cognition would have needed to take in proxy objects like signs, causal indexes, and symbols in the evaluation of intention. The explosion in mediated forms of communication since then has only amplified this dimension of social communication. In such a scenario, an intuition for deception is no good, because there is no stable vehicle (like facial expression) for it to attach to. Instead, one would once again need to explicitly deploy the machinery of Bayesian inference to arrive at an informed opinion concerning the social environment. No doubt, displacing this cognitively demanding task onto cultural tools like narrative solves some of the problem for the 4E theorist (Hutto 2011; 2009; 2008). But even so, on-the-fly social activities like strategizing, political maneuvering, and game-playing require formulating and evaluating beliefs using indirect evidence. Thus, while social cognition may begin with perceptually delivered and culturally supported intuitions about the mental states of others, these intuitions are simply not adequate to the complexity of social relations—for this, explicit theoretical modelling is also needed.

The AI objection

If theories are sometimes true without being useful, it can be because they are about phenomena that we cannot easily manipulate—this is the case with cosmology, for instance. When a theory seems to have no practical issue for a phenomenon that we *can* manipulate, it raises questions about the theory. With respect to 4E, this lack of practical impact is especially visible in relation to research in artificial intelligence. Though there were promising early interactions between the two (e.g. Brooks 1991; Clark 1998), the fact is that recent advances in areas like deep learning have been achieved without any reference at all

to 4E perspectives. This is for the good reason that the architecture of most sophisticated deep learning models is based on reinforcement learning (Rescorla and Wagner 1972; Francois-Lavet et al. 2018)—an avowedly computational paradigm that optimizes reward by minimizing some well-defined cost function. To be sure, the 4E theorist will object (and the AI researcher may agree) that organic cognition and artificial cognition are not the same thing, and there is no necessary reason that one need resemble the other. But then the stunning success of reinforcement learning theory in modelling both organic and artificial intelligence needs to be accounted for. As the computational commitments of reinforcement learning make mere adjustments to the theory ideologically unacceptable, this means reinforcement learning needs to be replaced with a 4E-friendly alternative. Friston, Daunizeau, and Kiebel (2009) recognize this problem and show that indirect optimization problems like the mountain car problem can, in principle, be solved using active inference models without the need for the computational apparatus of reinforcement learning or control theory. In a similar move, Clark (2016, 111–67) updates previous work on theoretical robotics from a predictive coding perspective with a view to avoiding cost functions. The fact remains, however, that replacing reinforcement learning models with active inference has only been demonstrated for relatively simple systems in environments that are fully specified in advance. There is (to my knowledge) no successful program of work in AI that systematically explores how non-reinforcement perspectives might be used to better design learning strategies for artificial agents in the computationally intractable environments where reinforcement learning has achieved its most striking successes (Silver and Hassabis 2017). Nor, for that matter, do any of the mainstream approaches in robotics seem to make lasting use of anything other than classical models of cognition (Lynch and Park 2017; Murphy 2019), despite the occasional vogue for approaches like Rodney Brooks’s “nouvelle AI.” Both AI and robotics are well-funded areas, and any perspective that promises competitive advantage is unlikely to remain unused for long. Thus, while the fact that 4E perspectives have not been found useful by AI researchers does not invalidate them, it does raise questions about their scope of application.

The mathematical objection

Though the rule is not absolute, the more mature a field of inquiry is, the more it lends itself to mathematical formalization. The value of this formalization is that it forces human intuition into contact with unanticipated conclusions. Think, for instance, of how the difficulty of proving Euclid’s parallel postulate eventually led to the discovery of the geometrical frameworks used in general relativity, or how the Dirac equation predicted the existence of the positron on formal grounds alone. It is unsurprising, therefore, that the most recent work in 4E cognition should reference the free energy principle (FEP), which allows for enactivist accounts of cognition to be mathematically formalized. The FEP is notoriously resistant to summary, but its core claim is that agents preserve their organizational integrity by minimizing information-theoretic free energy, which is the sum of two quantities: the negative log probability (termed “surprisal”) on encountering the range of sensory inputs the agent encounters, and the divergence between its model of the environment and the updated model of the environment given new data (Buckley et al. 2017). The mathematical relationship between these quantities—surprisal cannot exceed divergence—means that the

FEP identifies, at least in theory, fundamental principles that seem to be present in most inference generating systems (Friston 2010; 2009). Where this connects with 4E is that, by mandating that the organism act on its environment so as to change sensory input and thereby minimize model divergence, the FEP lodges cognition squarely in the body that enacts it.

But the question is, at what cost? For there is simply no way around the fact that the FEP brings back in all the computational and inferential machinery that 4E sought to obviate the need for in the first place. The FE-minimizing organism constructs a representation of states of the world over which it defines a probability distribution—the exact definition of a statistical model (McCullagh 2002). Equally, the quantification of model divergence using measures like cross entropy, precision, accuracy, and other metrics familiar from machine learning and information theory shift the understanding of cognition into a computational framework. Thus, the 4E theorist must pay for a formalized notion of embodied cognition by relinquishing the claim that cognition is not computational in nature. Some 4E theorists will be prepared to accept this trade-off; others will not. Either way, what remains clear is that 4E approaches face a dilemma: either eschew the apparatus of mathematical formalism and retreat into descriptive impotence or embrace it and inherit a computational model of cognition; *tertium non datur*.

No doubt, the determined 4E theorist will have answers to all of these objections—largely, because they are a matter of degree, rather than kind. This means that the issue becomes less one of arguing for a specific view of cognition, than one of arguing for where the emphasis of cognition lies. But this way grants all the élan of revolution with none of the drudge of responsible administration. And as Thomas Kuhn observes, the piling up of non-fatal objections can itself amount to a kind of fatal objection (Kuhn 1962). For this reason, if no other, it is easy to see why some critics take a harsh line with 4E. In one assessment, “for the vast majority of classic findings in cognitive science, embodied cognition offers no scientifically valuable insight” (Goldinger et al. 2016, 959). Another critic notes that “we have learned a tremendous amount about how perceptual systems process information by studying the brain, and, crucially, nothing seems to be left out” (Prinz 2006, 17). None of this is enough to damn an entire field of inquiry, but the skepticism is welcome in an area where enthusiasm all-too-frequently runs ahead of results.

Neither of the two volumes I am reviewing here displays much sustained interest in taking 4E cognition as anything other than established truth, though one does at least accommodate critical voices. *Embodiment, Enaction, and Culture (EEC)* is the more intellectually adventurous of the two, but it pays for this by containing a greater proportion of unsatisfying or merely mediocre essays. Conversely, *The Oxford Handbook of 4E Cognition (OH4E)* is explicitly designed as a reference text, which results in greater authority at the expense of risk-taking. Both feature many of the same authors saying the same things, which makes one think the field is starting to repeat itself.

The target of the *EEC* volume is, as the title suggests, the cultural end of the 4E spectrum. This is timely, given that much of the wider interest in 4E cognition has, over the last number of years, centered on the “softer” applications of the paradigm in social cognition.

The editors announce their volume as a “multidisciplinary investigation into the role of culture for embodied and enactive accounts of cognition, encompassing fundamental philosophical considerations, as well as the newest developments in the field” (Tewes, Durt, and Fuchs 2017, 1). In this, they are broadly successful, even if, most of the time, “the newest developments in the field” don’t strike one as a whole lot different from the oldest developments in the field.

The volume’s first section focuses on enactive and phenomenological approaches to culture. Dermot Moran’s chapter takes up the latter emphasis in relation to Edmund Husserl; Nicolas de Warren’s for Jean-Paul Sartre. The enactive approach manifests in the work of the other contributors, who amplify it in relation to cultural practices and consciousness (Christoph Durt), participatory sense-making (Ezequiel Di Paolo and Hanne De Jaegher), and the role of content in cognition (Daniel Hutto and Glenda Satne). The best return here comes from the chapters on Husserl and Sartre, which nicely complement a literature that is perhaps excessively influenced by Merleau-Ponty.

The “Intersubjectivity, Selfhood, and Persons” section takes in work on “we” consciousness (Ingar Brinck, Vasudevi Reddy, and Dan Zahavi), selfhood and schizophrenia (Mathew Ratcliffe), proximal intersubjectivity (Anna Claunica and Aikaterini Fotopoulou), the minimal self (Dan Zahavi), and the emergence of persons (Mark H. Bickhard). Of these, the most puzzling essay is Matthew Ratcliffe’s chapter on minimal selfhood and schizophrenia. Though philosophical anthropology must remain indebted to Ratcliffe for his magisterial *Experiences of Depression* (2015), this essay struggles to convincingly account for schizophrenia. The idea that schizophrenia may have its genesis in trauma-related distortions of interpersonal intentionality is attractive—but then, so too is the theory that psychoses are an attempt to make sense of aberrant patterns of salience conferred by a dysregulated dopamine system (Kapur 2003; Kapur, Mizrahi, and Li 2005). Given the huge body of evidence in favor of the dopamine theory, it is frustrating to see a major figure like Ratcliffe simply ignore it in favor of his own, evidentially unsupported position.

The essays in the “Cultural Affordances and Social Understanding” take in how culture mediates social relations. These include some already-familiar speculations on enactive social cognition (Shaun Gallagher), an investigation of the social constitution of shame (Alba Montes Sanchez and Alessandro Salice), some useful work on the ontology of affordances (John Z. Elias, Zuzanna Rucinska), and an application of enactivist principles to Neanderthal cognition (Duilio Garofoli). This last chapter is by a long measure the most entertaining in the volume and gave me occasion for a brisk email correspondence with a colleague on the nature of “cool,” and what it implies about metacognition. Garofoli argues that the Neanderthal use of decorative feathers need not have depended on the propositional detours of symbolic cognition, but can be explained more efficiently by the feather’s direct enacting of coolness: “Due to its glossy material properties, the feather enacts an embodied emotional reaction of interest within the target, thus bringing forth a social affordance for a protagonist” (Garofoli 2017, 288). My colleague’s view (and mine) is that feather usage may have nothing to do with cool (i.e. they may be used to signal wealth or enhance sex appeal), and even if they do, “cool doesn’t exist except in that multilayered fragility of inferencing and counterinferencing, of awareness and meta-awareness, of ironic downplaying and

confidence that everyone will know you're downplaying" (Troscianko 2019). If correct, this position implies that Garofoli's argument is based on a misunderstanding of cool; regardless, for the chapter to prompt such speculation at all must count as a success.

The last section of *EEC*—"Embodiment and its Cultural Significance"—takes in a somewhat mixed range of topics, and offers less coherence than the other sections. These include work on embodiment, culture, and mental illness (Peter Henningsen and Heribert Sattel, Laurence J. Kirmayer and Maxwell D. Ramstead), the embodiment of collective memories (Thomas Fuchs), the experience of film and embodiment (Joerg Fingerhut and Katrin Heiman), and neoteny and social cognition (Vittorio Gallese). Gallese's chapter is, to my mind, the most important in the volume and shows him to be an original thinker of real force. In it, he skillfully blends neuroscience, evolutionary theory, and developmental psychology to argue that the human facility for culture can be traced back to the needs of extended neoteny—that is, the fact that humans take substantially longer to mature than other primates. If 4E perspectives are to convince, this is the kind of intellectually daring convincing they need to do.

The second volume of essays, *OH4E*, is a substantial tome, coming in at nearly 1,000 pages and forty-eight contributions. As a hand-book, it is not designed to read through cover to cover—which is as well, because no one not in prison has that much time on their hands. The most useful innovation in this volume is the inclusion of critical reflections at the end of each section. These will prove especially valuable for the reader who is less familiar with the field, given that points of weakness in some essays are not especially obvious. (Nevertheless, more insistent editing would have eliminated the "I don't have enough space to make my point" complaints that are sometimes visible in the reflections.) As the remit of *OH4E* is 4E as a whole, it is unsurprising that it gives a better representation of the field than *EEC*—with this being especially visible in the comprehensive and judicious introductory essay. What *is* surprising, however, is the difference in quality when the same author contributes to both volumes. Shaun Gallagher, Ezequiel Di Paolo, Dan Hutto, Matthew Ratcliffe, Vittorio Gallese, Hanne De Jaegher, and Dan Zahavi all write for both *EEC* and *OH4E*, and with the exception of Vittorio Gallese, the *OH4E* contribution is always the better one. Dan Hutto is the most egregious example of this: his *EEC* chapter with Glenda Satne is all but impenetrable to anyone not already familiar with the REC position in the philosophy of mind, while the *OH4E* chapter with Erik Myin articulates its points with clarity and patience. One could interpret this difference uncharitably if one wished to—my keyboard helpfully suggests \$E cognition?—but the difference between a volume directed at researchers and one directed at students may be enough to explain it.

The "What is Cognition?" section of the volume opens the author contributions with several big-picture reflections on the implications of 4E. Ezequiel Di Paolo, for instance, offers an intriguing reflection on how enactivism can be used to frame a philosophy of life, while other contributors engage with the nature of extended cognition and the negotiation of multiple affordances. However, it is Dan Hutto and Erik Myin's chapter that is most provocative, in that it seeks to "abandon the information-processing and representationalist views of cognition in favor of a purely embodied know-how" (Hutto and Myin 2018, 105). That this is unlikely to succeed is made clear by their unconvincing handling of information-

as-covariance. Despite this being the only successful model of representation in existence, the authors ask, “How can relations that hold between covarying states of affairs be literally ‘extracted’ and picked up from the environment so as to be ‘encoded’ within minds?” (2018, 101). If an answer were actually being sought here, the authors might do well to attend to research in deep learning, which explicitly designs artificial networks around information-extracting processes in the brain (Hassabis, Summerfield, and Botvinick 2017).

The “Modelling and Experimentation” section of *OH4E* provides what could have been a fruitful engagement with the highly contentious issue of model construction in 4E. Jakob Hohwy’s chapter on predictive processing opens the section well enough with a candid concession of the tension between 4E and predictive coding models and an attempt to bridge the gap using Judea Pearl’s notion of “Markov blankets.” The issue is whether the deflated account of 4E that emerges will satisfy its most vigorous proponents. The subsequent contributions, however, do not do a great deal to advance thinking on either modelling or experimentation. The problem is stated baldly enough in Tom Froese’s chapter, when he acknowledges that “there continues to be a lamentable disconnect between this growth in phenomenological and theoretical research on the one hand and the relative lack of experiments on genuine intersubjectivity on the other” (2018, 173). His response to this is to cite the perceptual crossing experiments of Auvray, Lenay, and Stewart (2009) and allude to some results from agent-based modelling. The intentions are good, but the perceptual crossing results are overworked (Di Paolo and De Jaegher also rely on them in *EEC*), and the degrees of freedom available for parameter selection in agent-based modelling too often makes it the last refuge of the scoundrel (I’ve authored enough to know).

Things start oddly in the “Cognition, Action, and Perception” section of the volume, in that we are once again presented with an essay (this one by Michael Kirchoff) that explores the relation between 4E and predictive coding. Why this should be needed in addition to Hohwy’s earlier chapter is not clear, unless it’s that the savage god of 4E must be placated with Kirchoff’s more orthodox genuflections. Matthew Ratcliffe’s essay on touch provides a judicious appreciation of a topic that is of fundamental importance to the 4E project, which more than compensates for the poor showing on schizophrenia in *EEC*. Joel Krueger also offers a worthwhile survey of direct social perception, usefully working through the various objections to the claim that we directly perceive emotions in others rather than indirectly infer them. But for reasons outlined above, this can only be achieved by shunting the inferential machinery somewhere else and asserting its irrelevance—whether it’s conscious or not is beside the point.

Mark Rowlands opens the “Brain-Body-Environment Coupling and Basic Sensory Experiences” section with a confession: “There is a view of cognitive processes that I’ve been peddling for more years than I care to remember (Rowlands 1995, 1999, 2002, 2003, 2006, 2010, 2011, 2013, 2015a, 2015b)” (Rowlands 2018, 350). As I was one of the undergraduates howled at by his wolf in 1990s Cork (Rowlands 2010b), this is a collective memory that dismays us both. Unfortunately, the *OH4E* essay does not do much to extend Rowlands’s back catalogue into new areas, but there’s no denying its value as an authoritative appreciation of what’s needed to defend the 4E view of cognition. Like Rowlands’s, Shaun Gallagher’s chapter offers a worthwhile reprisal of his previous work,

even if the solemn assurance that “the brain is part of the body, and has always been part of the body” (Gallagher 2018, 361) must count as one of the more inane trivialisms of 4E writing.

The essays in the “Social Cognition” and “Situated Affectivity” sections consist of eleven essays that take up the broad challenges posed by both topics. To me, the difference between the two sections does not clearly emerge from the chapters that comprise them, and the chapters themselves cover much well-trodden ground. These are two sections where the critical reflection section does particularly useful work in disentangling a nonobvious mélange of claims and counterclaims.

In the “Language and Learning” section, the emphasis falls on two topics that are challenging for the 4E paradigm. Perception and action are “embodied” in an obvious, hard-to-deny way; language and learning are not. Mark Johnson opens the section with an accessible summary of why language rewards being thought of as embodied, even if his case would have been even stronger had he made reference to the word norms literature showing how words are encoded using emotional and sensorimotor schemes (e.g. Brysbaert, Warriner, and Kuperman, 2014; Lynott and Connell, 2009; Warriner, Kuperman, and Brysbaert, 2013). Indeed, this latter criticism could be directed with even greater force at Michiel van Elk and Harold Bekkering’s attempt to ground concept acquisition in predictive processing, which fails to mention the word norm data that provides exactly the evidence they need to ground their claims. (I should say that I’ve worked in word norm research, so I may be overly sensitive to the omission.) Of the other chapters, Marco Schmidt and Hans Rakoczy’s essay on normativity in human behavior stands out as a nuanced appreciation of a challenging topic, even if—the occasional reference to shared intentionality notwithstanding—it doesn’t seem to take from or add much to the 4E paradigm.

Louise Barrett opens the “Evolution and Culture” section with a defense of the basic-minds-without-content thesis previously advocated by Hutto and Myin. Barrett’s wide range of ethological reference and more accessible exposition makes this seem a much more attractive option than when expressed by Hutto and Myin. However, the inevitable concession that “some of the interesting issues of human psychology are best understood using a representational framework” (2018, 730) duly arrives, inviting one to query whether “all” should be substituted for “some” to the disadvantage of the minds-without-content approach. The other highlight of the section is Kim Sterelny’s chapter on how material culture impacted on cognition in deep time. Its value has less to do with any theoretical flashiness than its no-nonsense appreciation of how different classes of material and social artefact have shaped and amplified human thinking across the paleo-anthropological record. If the contact with empirical evidence here is archaeological rather than experimental, it is no less welcome for that.

The final section of *OH4E*, “Applications,” is the least satisfying, if only because it seems like a dumping ground for essays that didn’t easily fit into the other sections. Topics range through psychopathology, intuitive rationality, robotics, philosophy of law, the humanities, and embodied aesthetics. Of these, Amy Cook’s piece on the humanities had the best claim on my interest. In it she does well to cover as much ground as she does, but even at that, the

emphasis on literary and theatrical approaches might still be broadened to include other disciplines. Equally, the uncritical valorization of 4E approaches in the humanities might be improved by more critical reflection on the challenges that emerge from these applications—both with respect to how the scientific perspectives of 4E might be legitimately (or illegitimately) used in the humanities, and how the humanities might broaden the perspectives of 4E (and cognitive science generally). This is especially needful now that digital and experimental methods are, for the first time, making interpretive hypotheses testable. The humanities are in flux as they have never been before, and if they are to have a future (which one hopes they do) it cannot be one in which 4E just replaces, say, Marxism or psychoanalysis as an interpretive framework—methodological innovation is also needed (Carney and Troscianko 2014). *OH4E* ends on a pleasant note with an informed and lively investigation by Barbara Gail Montero of how proprioception might inform aesthetic judgment.

So where now for 4E cognition? To start with, it is no longer the future and probably needs to stop saying so. The shambling, wheezing Brezhnev awarding himself the Order of Lenin for zeal in the cause of revolution is not a good look, but that is what 4E resembles when it burnishes its revolutionary credentials thirty years after the revolution has ended. Secondly, the two volumes I have surveyed here make it quite clear that, even if the claims of 4E can in principle be empirically supported, they are not yet sufficiently supported by the evidence available. Theoretical speculation is obviously valuable, but at some point, empirical claims about the world (and the minds that it accommodates) need to be measured against that world—and no amount of phenomenological reflection is up to compensating for that. And finally, 4E needs to ditch the covert theology. As Jesse Prinz notes, “scientists have had to work hard over many, many years to support the conclusion that experiences are in the head” (2006, 16). The subjective attractiveness of taking them back out again should make us suspicious, and this means being especially careful that 4E approaches are appealing to our reason and not our sensibilities. If this vigilance succeeds, 4E will merge with the wider body of hard-won truths about the human cognitive endowment. But if it fails—and failure is the norm—4E will join psychoanalysis, structuralism, functionalism, cybernetics and all those other perspectives on the mind that monopolized the correct answers right up to the point where they didn’t. This would be a disappointing fate for a paradigm that, for all its failings, still has a great deal to offer the study of cognition.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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