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Cognition as enacted, embodied, embedded, affective and extended

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We present a specific elaboration and partial defense of the claims that cognition is enactive, embodied, embedded, affective and (potentially) extended. According to the view we will defend, the enactivist claim that perception and cognition essentially depend upon the cognizer's interactions with their environment is fundamental. If a particular instance of this kind of dependence obtains, we will argue, then it follows that cognition is essentially embodied and embedded, that the underpinnings of cognition are inextricable from those of affect, that the phenomenon of cognition itself is essentially bound up with affect, and that the possibility of cognitive extension depends upon the instantiation of a specific mode of skillful interrelation between cognizer and environment. Thus, if cognition is enactive then it is also embodied, embedded, affective and potentially extended.

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1. Introduction

Over the past twenty years several claims about human cognition and its underpinnings have gained currency. Human cognition (henceforth 'cognition') can sometimes be *extended* – the material vehicles underpinning cognitive states and processes can extend beyond the boundaries of the cognizing organism (Clark & Chalmers 1998; Hurley 1998; Clark 2008). Cognition is *enactive* – that is, dependent on aspects of the activity of the cognizing organism (Varela, Thompson & Rosch 1991; Hurley 1998; Noë 2004; Thompson 2007). Cognition is *embodied* – our cognitive properties and performances can crucially depend on facts about our embodiment (Haugeland 1998; Clark 1997; Gallagher 2000). Cognition is *embedded* – our cognitive properties and performances can crucially depend on facts about our relationship to the surrounding

environment (Haugeland 1998; Clark 1997; Hurley 1998). Finally, cognition is *affective* (Colombetti 2007; Ratcliffe 2009) – that is, intimately dependent upon the value of the object of cognition to the cognizer.

How are these five claims related? Each appears to be logically independent of the others, yet we often find them endorsed in combination. Handbooks, special issues, conferences and research projects are devoted to discussing them as a group. The aim of this paper is to sketch one particular view of their interrelations, according to which the above claims about cognition are all true, for intimately related reasons. Our view of these interrelations will be, of necessity, one among several possibilities. For each of the above claims about cognition admits of different interpretations of varying strengths. One reason for this is that the properties attributed to cognition by each of the above claims are ambiguous – when we say that cognition depends on ‘our activity’, or upon ‘bearing relations to an environment’, the phrases within the quotation marks can be cashed out in many different ways. A second reason is that the latter four claims all invoke a dependence of cognition upon some property or feature. But one thing can depend upon another in many different ways – from being causally and instrumentally related to it, to being a transcendental condition on its very possibility. Spelling out our view of the relationship between the above claims will require our precisifying them in each of these dimensions.

Before beginning, note that our aim here is only to sketch a view of the relationship between the above claims, not to present arguments which will change the minds of those who are skeptical of any or all of them. That said, if a reader came to accept one of the above claims as a result of our treatment, we would view that as a welcome side-effect. And we do think that compelling arguments exist for each element of the position we will describe, although space constraints prevent us from giving all of these arguments in full. Where it is not feasible to summarise those arguments, we will often direct the reader to where we think they can be found. We will begin by, and devote most time to, clarifying the sense in which we think cognition should be said to be enactive. This is because, according to the view we will present, the fundamental dependence of cognition upon aspects of agency is the feature of cognition from which all the subsequent features to be discussed will follow. Understanding the sense in which cognition is enactive, we will claim, allows us to see the ways in which it is essentially embodied, embedded and affective, and why in some cases it may be extended.

2. Enactive

Broadly stated, to claim that cognition is enactive is to claim that it essentially depends on the activity of the cognizer – but what does this mean? There are two current strands of theorising about perception and cognition which have been labeled ‘enactivist’. The

first (whose proponents include Thompson (2005, 2007) and Di Paolo (2005)) builds upon the original exposition and defense of enactivism by Varela, Thompson and Rosch (1991). The key ideas of that treatment for our purposes here are first that:

A cognitive being's world is not a pre-specified, external realm ... but a relational domain enacted or brought forth by that being's autonomous agency and mode of coupling with the environment (Thompson 2005: p. 407)

and, second, that cognition itself arises out of this same mode of adaptive interaction with the environment. To be a cognizer, in the sense which interests the enactivist, is to manifest an appropriate degree of attunement to the objects, features, threats and opportunities present in the immediate environment. One possible way for a system to achieve such attunement might be for it to passively receive information stemming from objective features of its environment, use that information to arrive at a representation of the relevant facts about the system's standing with respect to its environment, then use that representation to inform its dealings with its environment. For the enactivist, this picture (often labeled a 'computationalist', 'representationalist' or 'cognitivist' view of the mind) is importantly distortive. The features of the environment to which the system is attuned are not inert and independent of the system, but dependent upon, and specified at least partly in terms of, the system's activity and capacities. And so the system's intelligent behaviour with respect to such features does not require computation or deliberation to translate information about objective features of the environment into terms relating to the system's capacities, activities and interests, since the system is already attuned to its environment in just such terms. Both these aspects – the dependence of environmental features upon the activity of the cognizing system, and the dependence of cognition upon activity within an environment – are neatly illustrated by Varela et al.'s comparison of cognition to 'laying down a path in walking.' The existence of a forest trail can be brought about by the mere activity of agents navigating the forest environment. And an agent's behaviour being appropriately attuned to the presence of that trail can be the basis of their cognitive competence in getting efficiently from one point to another in the forest. Just so, the environmental features to which a system is cognitively open will be those that are a function of the system's capacities, activities and interests, and a system's cognitive competence need consist in no more than an appropriate level of attunement to such properties and their relevance to the system.¹

1. As a reviewer notes, whilst such attunement can clearly be the basis of an adaptive competence in taking an efficient route through the forest (a competence which, as a matter of definition for the brand of enactivism under discussion, qualifies as cognitive), there are other forms of forest navigation which appear more 'representation-hungry', and so less hospitable to enactivism. For example, deciding how to get from one's current location to point B might require

We will say a little more about how we think these enactivist ideas are best understood in a moment. Before doing so, note that there has also been another influential strand of recent work on perception, cognition and agency that has been conducted under the banner of enactivism. This strand (whose proponents include Hurley 1998; Noë 2004; and Ward, Roberts, & Clark 2011) focuses on a cognitive system's grasp of sensorimotor contingencies – facts about the systematic interrelations between actual and possible perceptions, sensations, actions and movements. One example of such a view is Noë's (2004) sensorimotor theory. An important attraction of that view is its promise of a solution to an apparent puzzle about perception: how can we account for the manifest fact that we perceive whole objects and their objective shapes, given that our subjective perspective on any object at a time presents us only with selected aspects of them – aspects that are compatible with the object having a range of different shape properties? For example, there is a sense in which my perceptual experience of the facing side of a tomato might be subjectively indistinguishable from my experience of one side of a tomato which has been bisected. Yet when confronted with a tomato, it seems undeniable that we perceptually experience its objective, spheroid shape without having to move around or investigate. For the sensorimotor theorist, this puzzle is solved through an appeal to a grasp of our capacities as agents. We perceive the whole tomato because we understand the ways in which our potential movements with respect to it, or its movement with respect to us, would reveal further aspects of its shape. Our perception of its complete, objective shape is a function of our understanding of how we, as agents, are related to the various perceptible aspects of that shape. So, on Noë's sensorimotor theory, perceptual openness to the world's objective properties consists in a grasp of our relationship as agents to the various perspectives that can be taken up with respect to those properties – a grasp of how our activity can bring the different aspects of those properties into view.²

On Noë's view, then, perceptual experience depends upon a grasp of how what we can do affects what we can see. Alternative sensorimotor views of perception, however, are available. According to one alternative (defended by Ward, Roberts, & Clark 2011),

knowing where one is, knowing where B is, and knowing the spatial relationships between these points. And the bare statement of the above analogy does not suffice to undermine the thought that tokening and manipulating representations is a plausible explanation of how such knowledge might be possessed. This all seems right. The path-following analogy above refers merely to path-following competence, not to navigation in the above, more demanding, sense. The purpose of the analogy is to clarify the paradigm of enactive cognition as practical attunement to features of one's environment that exist in virtue of, and are specified in terms of, one's past and potential interactions with that environment.

2. Additional arguments for Noë's sensorimotor view, and close relatives thereof, can be found in Hurley 1998; O'Regan & Noë 2001; Hurley & Noë 2003; and Ward forthcoming a.

and there dubbed the ‘action-space’ view), perceptual experience depends on a grasp of how what we can see relates to what we can do. This approach to perception treats J.J. Gibson’s (1979) notion of ‘affordances’ as central to an account of perception.³ In Gibson’s words, “The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill” (1979, p. 127). A visually-presented tomato will afford a distinctive suite of actions to a normal human perceiver: grabbing (if near enough); reaching from over there (if far away enough); picking up between thumb and forefinger (if small enough); lifting with both hands (if enormous enough); eating (if ripe enough), rolling (if round and firm enough), and so forth. The action-space account claims that our perceptual access to the properties of the tomato is determined by our grasp of the distinctive suite of affordances that it presents. The same goes for any perceptible property or feature of the environment. For some properties, such as colours, the relevant affordances might not concern direct bodily interventions upon objects – our perception of colours might instead depend upon enabled abilities to distinguish and co-classify objects upon various axes of similarity and difference (see Pettit 2003). But the action-space theorist nonetheless holds that the perceptibility of any property or feature depends upon its having some upshot, that can be grasped by the perceiver, for the possibilities for interaction with it and the world.⁴ A perceiver’s sensory apparatus allows information to flow in from her environment. That information puts the perceiver in touch with objects and properties of the environment to the extent that it poises the perceiver to act in a suite of ways distinctively appropriate to the presence of those objects and properties, and the perceiver understands that such possibilities for action are available to her.⁵

So far in this section, we have sketched three variants of enactivism. We think that perception and cognition are enactive in a sense that combines these variants. It is this *ecumenical enactivism*, which we will now sketch, that we will use throughout the rest

3. See also Rietveld, this volume.

4. So how does the action-space view differ from Gibson’s own views? Firstly, the action-space account claims that *all* aspects of the content and character of visual perception should be understood in terms of affordances, whereas Gibson’s chief concern was merely to introduce the concept and highlight its importance. Secondly, the action-space account makes the novel claim that perceptual openness to affordances issues in conscious experience only when the presence of those affordances is appropriately factored in to the perceivers ongoing planning, reasoning and deliberating (see Ward, Roberts, & Clark 2011, for an elaboration and defence of this claim). Thirdly, the action-space account is not committed to the other aspects of the ecological framework for understanding visual perception within which Gibson houses his concept of affordances.

5. Arguments for the action-space view can be found in Ward, Roberts, & Clark 2011. See Pettit 2003 and Matthen 2005 for discussion and defense of closely related views.

of the paper to shed light on the senses in which cognition is embodied, embedded, affective and (sometimes) extended. To see how the forms of enactivism fit together, consider what they have in common. As instances of enactivism, each makes an essential appeal to agency: Varela and Thompson's enactivism appeals to the role of activity in co-constituting a meaningful environment to which the cognizer can respond, and the way in which appropriate practical attunement to that environment can be the sole basis of cognitive competences; Noë's sensorimotor theory appeals to an agent's grasp of the way her activity determines the aspects of objects and scenes which can be seen, and the role of that grasp in allowing perception of objective features and properties; and the action-space theory appeals to an agent's grasp of the range of actions she is currently poised to perform by her sensory relationship with the environment. They thus all conceive perception as essentially implicating capacities for skilful activity. The three views also share an opposition to a particular conception of the relationship between perception, cognition and agency that Susan Hurley (1998) usefully dubbed "The Classical Sandwich". Upon that conception, perception, cognition and agency are essentially separable capacities, though they may overlap. Perception consists in input from world to mind, with the possible contribution of cognition to processing that input in such a way as to render it meaningful to, or useful for, the subject. Cognition (as it relates to perception and action – the fan of the Classical Sandwich might hold that there are other capacities or processes that qualify as cognitive that have nothing to do with perception and action) works with this perceptual input, uses it to form a representation of how things are in the subject's environment and, through reasoning and planning that is appropriately informed by the subject's projects and desires, arrives at a specification of what the subject should do with or in her current environment. Agency is the output from world to mind, in the form of bodily movements, that results from this cognitive work. Fans of the Classical Sandwich may also want to count mechanisms and processes responsible for the planning and guidance of bodily movements through space as cognitive.

It doesn't matter, for our purposes here, whether anyone in fact endorses the simplistic picture we have just presented – what is important are the specific ways in which enactivists reject it. The action-space theorist rejects the claim that cognition needs to intervene between perception and action to build a representation of the environment upon which practical deliberation can work. Instead, perception simply consists in grasping the affordances of the sensible environment in such a way as to inform the subject's ongoing plans and deliberations. Noë's sensorimotor theory rejects the claim that cognition (as distinct from action) needs to work on the material provided by perception in order to arrive at an experience that discloses features and properties of the world that go beyond the sensible aspects with which the subject is presented at a given point in space and time. Instead, perceptual experience that is such as to disclose the world to the subject already involves a grasp of the way that the perceiver

is potentially related, as an agent, to other perceptible aspects of the same scene.⁶ And the enactivism of Varela and Thompson rejects the Classical Sandwich conception in related ways. It rejects the assumption that perceptual experience of the world requires an autonomous faculty of cognition to work raw data into a form that is intelligible and meaningful for the subject, since we are perceptually open to features of the world that are functions of our practical capacities and activities. And it rejects the assumption that intelligent behaviour with respect to the environment must issue from an explicit representation of how things are which serves to guide action. Instead, intelligent behaviour can be a direct product of appropriate perceptual attunement to the environment – just as a forest creature might be unreflectively guided along the correct route by being appropriately attuned to the path that it and its fellow creatures had laid down through their collective scampering activity.

The ecumenical enactivism we wish to endorse here, and from which our account of cognition as embodied, embedded, affective and extended will flow, rejects the view of the relations between perception, cognition and action suggested by the Classical Sandwich conception for all of the above reasons. It claims, with the action-space account, that the most basic form of perceptual attunement to the environment is a grasp of the practical possibilities that the environment currently holds for the perceiver. Our perceptual experience of the world, however, also presents us with objects, features and properties that go beyond such a momentary window onto the relationship between the visible aspect of the environment and our practical concerns. As Noë's sensorimotor theory suggests, experience does this in virtue of our grasp of our potential access, through our capacities as agents, to an interrelated network of such momentary windows. However, we should not conceptualise the requisite ways of grasping our capacities as agents as dependent on a faculty of cognition that operates autonomously with respect to perception and action, that computes or represents the rules that relate perceptual input to practical possibilities, or to potentially accessible patterns of related perceptual input. As Varela and Thompson suggest, such rules and regularities exist in virtue of our activity with respect to our perceptible environment. Because of this, we do not need to explicitly compute or represent such rules and regularities – we can instead be guided by them through appropriate perceptual and practical attunement, as when we are unreflectively guided along the correct course by

6. Of course, it is overwhelmingly plausible that grasping the relationship between potential movements and visible aspects, or the way in which a space of currently afforded actions meshes with occurrent plans and projects, constitutes the exercise of cognitive capacities. The aim here is not to argue that nothing worthy of the name 'cognition' is essentially involved in perceptual experience, but to suggest that such cognition as is involved in experience is essentially related to capacities for agency – not distinct from, and prior to, such capacities as the Classical Sandwich fan would have it.

following a path or trail. Finally, as Varela and Thompson suggest, we should not think of the world upon which our minds are directed in perception, cognition and action as constituting an autonomous domain from our perceptual, practical and cognitive capacities, a domain with which those capacities must struggle to put us in touch as best they can. Rather, the world and the mental capacities that put us in touch with it are co-constituted – just as the world informs what we can see and do, our perceptual and practical capacities play a role in demarcating that which is in our world.

Given the shape of the ecumenical enactivism we endorse here, in what sense does cognition depend on our activity? In answering this, we must first address the fact that the above discussion slid, without remark, from considering the role of agency in an account of cognitive capacities as such to considering the role of agency in an account of perception. We are now in a position to see the relationship between these two projects. For a system to count as instantiating cognitive capacities, it is necessary that its states and behaviour (either overt or dispositional) be flexibly and adaptively geared to relevant aspects of the ways things are in the system's environment – mere causal commerce with the environment, involving only rigid stimulus/response pairings, will not suffice. The requirement that a system's informational sensitivity to its environment be appropriately related to its actual and potential activity thus appears to be built into the very concept of cognition. Suppose, more controversially, that flexible and adaptive attunement to the environment is, on some appropriate specification, sufficient for a system's instantiating cognitive capacities.⁷ Then we can read the enactive account of perception as providing the specification of what the relevant mode of attunement consists in. As we saw above, the enactivist holds that perception implicates a grasp of the ways in which a system is poised to flexibly and adaptively interact with its environment. For the enactivist, such attunement to the affordances of the environment is the most basic form of both cognition and perception. We might also think that there is an important and more demanding sense of 'cognition' according to which it requires more than mere practical attunement to the environment – an important cognitive benchmark is the ability to grasp how things are or might be in the world independent of one's current and transient sensory relationship with it. For the enactivist, this is secured through grasping the existence and content of alternative viewpoints to that which one currently occupies with respect to the environment. And, as we saw above, activity is also fundamental here, since such alternative viewpoints are grasped through an understanding of the perceiver's potential relation to them through agency. Thus, for the enactivist, the kind of attunement to the environment

7. Of course, at present no consensus exists on exactly how (or even if) necessary and sufficient conditions for the presence of cognition can be specified. See Adams & Aizawa 2008; Rupert 2009; and Rowlands 2010, for relevant discussion.

which is necessary and perhaps sufficient for the instantiation of cognitive capacities depends on perceptual sensitivity being appropriately related to agency. The enactivist's reasons for holding that perception essentially depends upon agency are also her reasons for holding that cognition depends upon agency.

What sort of dependence do we have here? Enactivists (e.g. Thompson 2007; Di Paolo 2005) standardly hold that their account applies to all biologically instantiated instances of cognition. If we agree, then perhaps cognition depends on activity in at least this sense: the instances of cognition with which we are most familiar, and through which we grasp the concept of cognition, all involve the relationship between perceptual and practical capacities sketched above. To demonstrate a stronger dependence of cognition upon agency we would need to provide reasons to think that cognition *couldn't* be instantiated without the requisite relationship obtaining. There are various ways in which enactivists might do this. One strategy would be to claim that being a locus of plans and projects, and grasping the ways in which one's sensible environment relates to such plans and projects, is required for a cognizer to solve (or avoid) the frame problem – the problem of generating behaviour that is appropriately and selectively geared to the most contextually relevant aspects of their situation, and ignoring the multitude of irrelevant information that might be counter-productively transduced, processed and factored into the planning and guidance of behaviour.⁸ The enactivist might hold that since perceptual (and thus cognitive) attunement to the environment fundamentally consists in a grasp of the relationship between the environment's perceptible affordances and the perceiver's plans and projects, the frame problem does not arise upon an enactivist conception of cognition.⁹ It might thus be argued that enactivism is our current best theory of how cognizers solve the frame problem, and that this supplies a reason for holding that cognition essentially depends upon agency. If the case for an *essential* dependence is to be truly convincing, however, the enactivist needs to show that cognition is *impossible* in the absence of the relationship between perception and agency they emphasize – that the very possibility of cognition is only intelligible upon the assumption that such a relationship obtains. After all, perhaps there are successful ways to work around the frame problem that we have yet to imagine or discover – some cognitive system, perhaps to be built by future engineers, that accords with the Classical Sandwich conception, may be possible. The enactivist, as we have characterised them above, can respond to this challenge. Since

8. See Dennett 1987a, for a lucid introduction to, and discussion of, the frame problem, and Dreyfus 2007 and Wheeler 2008, for discussion of the relevance of enactivist ideas to solving the frame problem.

9. Dreyfus 2007, and Wheeler 2008, explore similar territory. See also McManus 2007, for a helpful discussion of the background issues.

they hold that the world to which a cognizer is responsive in perception and cognition is constituted in terms of the cognizer's activity and capacities, the very idea of appropriate attunement to the environment that is built into the concept of cognition is intelligible only in terms of the cognizer's agency. Thus, the enactivist position we have outlined in this section holds that cognition essentially depends upon the activity, both actual and potential, of the cognizer.¹⁰ Making a full case for the essential dependence of cognition on action thus involves motivating and clarifying the sense, merely sketched above, in which a cognizer plays a role in constituting the world to which they are responsive. That task is, unfortunately, far beyond the scope of the present paper. But note that the thesis in question for the enactivist has considerable pedigree – the claim that the mind's activity plays an essential role in the constitution of the sensible world is familiar from Kant's transcendental idealism. The fact that the case for enactivism turns on our attitude toward such Kantian claims hopefully lends credence both to our view that enactivism is a philosophically interesting and important thesis, and to our claim that we lack the space to convincingly establish it here.¹¹ We hope it will also foster tolerance towards our strategy for the rest of the paper – to consider what, if the enactivist position sketched in this section were correct, would follow for the other claims about cognition with which we began.

3. Embodied and embedded

If enactivism as described above is correct, then it follows that perception (and hence, for the enactivist, cognition) is essentially embodied, in at least the following sense: the categories and structure of perception and cognition are constrained and shaped by facts about the kind of bodily agents we are. For example, for experience to present us with a world at all, it must present things in the environment as spatially arrayed

10. Note that we are not claiming that we have shown here that cognition essentially depends on agency. Rather our claim is that *if* the enactive account described in this section is endorsed, *then* the dependence of cognition upon agency is *essential* (rather than contingent or instrumental). As we note here and at the outset, providing arguments that compel acceptance of this enactive view is beyond the scope of our task here. Thanks to an anonymous reviewer for prompting clarification on this point.

11. It also suggests another gloss on our claim that, for the enactivist, the mode of attunement to the environment entailed by the relationship between perception and action that they emphasize is the most fundamental instance of cognition. Enactivists are empiricists in a Kantian sense – they hold that any potential object of cognition is also a potential object of experience. For the enactivist, the possibility of cognition is dependent on the possibility of perception, and perception is dependent on activity.

in ways allowing for embodied interaction. As Charles Taylor notes, in a summary of some ideas of Merleau-Ponty's:

it is of course as a bodily agent functioning in a gravitational field that 'up' and 'down' have meaning for me. I have to maintain myself upright to act, or in some way align my posture with gravity. Without a sense of 'which way is up,' I falter into confusion. My field has an up and a down because it is the field of an agent of this kind. It is structured as a field of potential action. (Taylor 1978, pp. 145–5)

Our experience of the world has such an orientational structure not as the result of our inferring it through perceptual cues, nor simply as a result of the objective direction of gravitational pull. Rather, because of the kind of bodily agents we are, and the environment in which we find ourselves, the world must be presented to us in thought and experience in this way if we are to successfully interact with it. And since, for the enactivist, experience and cognition arise out of successful interaction with the world, contingent facts about our embodiment help fix the boundaries of categories which permeate perception and cognition at the lowest levels. The role of such facts about our embodiment in structuring our perception and cognition is essential rather than contingent since their correspondence to the categories which shape our experience is not accidental, but a result of the constitutive role those facts play in setting the boundaries of the categories. So the essential embodiment of perception and cognition, on the view we present here, is again a consequence of the enactivist's Kantian view that the cognizer's activity plays an essential role in the constitution of the world as it is accessible to them in perception and cognition. For the same reasons, it follows that perception and cognition are essentially embedded for the enactivist. The possibility of engaging in the embodied activity which is constitutive of perception and cognition depends on the existence of an arena of potential engagement – the embedding environment. Moreover, the cognizer's activity plays an essential role in constituting the boundaries and contents of that environment. Cognition is essentially embedded because the mode of activity on which it essentially depends simultaneously constitutes both the cognitive life of the subject, and the environment to which the subject is responsive.

4. Affective

According to the enactivism sketched and endorsed above, the form of openness to the world characteristic of cognition essentially depends on a grasp of the affordances and impediments the environment offers to the cognizer with respect to the cognizer's goals, interests and projects. And from this it follows that cognition is essentially affective – it essentially depends on the cognizer occupying an *evaluative*

stance with respect to the objects of cognition and their relationship to the cognizer's interests. One recent proposal that dovetails nicely with this feature of enactivism, and which might be read as an elucidation of its phenomenological implications, is Matthew Ratcliffe's (2009, 2010) suggestion that affect comprehensively permeates our perceptual openness to the world, acting as a transparent background that constrains and informs the features of the environment which show up for a perceiver.¹² This is not to say that it is impossible to direct our attention to our affective state – transparency here is not invisibility. But our attention is usually directed outward, upon the world, with our affective state serving to structure and limit the aspects and possibilities that show up for us. We can compare the transparency of affect to the transparency of pink lenses through which we can view the world. The colour of the lenses need not remain in the forefront of our experience. It can gradually recede to the background, shaping what we see by constraining and altering the wavelengths of the light which reaches us, but without being the object upon which experience is directed.¹³

So, according to the enactivist framework outlined above, capacities for perception, agency and cognition are essentially intertwined, and in turn essentially depend upon the cognizer's being embodied, embedded within a meaningful environment, towards which she occupies an affective stance. The relations we have presented between cognition, perception, agency, embodiment, embeddedness and affect have been *essential* because we have sketched and endorsed a specific enactivist view of the co-dependence of perception, agency and cognition from which the essential dependence of cognition upon embodiment, embeddedness and affect have followed. However, our discussion thus far risks giving an impoverished conception of the enactivist research program and its appeal. Because our focus has been on tracing essential dependences between the concepts and capacities under discussion our attention has been on conceptual natures and considerations. But this threatens to obscure the extent to which enactivism has been informed by, and reciprocally informs, much work in contemporary cognitive science. And, it might be thought, the kinds of conceptual considerations we have been presenting can seem suspect if considered outwith the context of such empirical work. The history of philosophy shows that attempts to spell out the essential nature of a concept, or to specify transcendental conditions of the possibility of a phenomenon, can go wrong. Seeing whether a given

12. These parallels are not accidental – both the enactivist framework presented here and Ratcliffe's suggestion flow through Heidegger.

13. See Colombetti 2005, 2007, 2009; Thompson 2007; and Thompson & Stapleton 2009, for related enactivist proposals about emotion, cognition and transparency. Barrett & Bar 2009, adopt a similar framework, drawing on Berridge & Winkielman 2003, on unconscious affect.

conceptual framework makes successful testable predictions, and can make fruitful sense of otherwise puzzling empirical results, is a useful way of enforcing checks and balances on philosophical thinking.

To this end, we'd like to sketch here one recent proposal that nicely corroborates the framework presented above. Consider the increasingly influential generalised predictive coding paradigm in neuroscientific research and theory (e.g., Barrett & Bar 2009; Friston 2009; Friston & Kiebel 2009). It holds that we should understand the brain as a predictive engine, geared towards the successful anticipation of its own sensory states. The information garnered from the world is encoded in the errors in the brain's predictions about these states, which force a resolution of the errors, and thus new predictions to be generated until no errors occur. An example of this framework as applied to perception is provided by a recent paper by Barrett & Bar 2009. They liken the predictive view of perception to the Dutch style of painting in the sixteenth and seventeenth centuries; first the gist of a situation is sketched, then, over time through the recursive application of ever smaller dabs of paint, a detailed picture emerges. Drawing on research from Aude Oliva's computational visual cognition lab at MIT, Barrett and Bar propose that the brain quickly makes an initial prediction about an object using low spatial frequency visual information, then fills in the details from memory. That is, given the overall gist of a situation or object in context, the brain is left to predict what the details might be given its previous knowledge. The recurrent nature of the neural dynamics underlying this processing¹⁴ entails that the physiological and behavioural responses are activated right from the time when only the gist of the situation is being represented. Efferent copies and the representation of the changes that occur as a result of these responses feed back during the ongoing refinement of the perception and are thus not mere responses to the perception as such but an integral part of the perceptual process. Importantly, it is not just those areas related to motivation and action that are integrated into the perceptual process, but those related to internal bodily (autonomic and endocrine) functions. The changes which are effected in the body are then represented in the brain via interoceptive pathways (the afferent limb of homeostatic regulatory function) and thus become part of visual processing right from the stage at which the gist of a situation is being processed by the frontal systems, giving even early perception – at this paucity of specificity – an affective flavour which helps code the relevance and value of the object of perception.

This framework thus allows us to see how action, affect and neural traces of bodily states may be inseparably integrated into perception and cognition at the level

14. See Barrett & Bar 2009 for detailed suggestions of the neuroanatomical underpinnings of the framework they propose.

of neural dynamics.¹⁵ Such inseparability of perception, agency, cognition, affect and embodiment at the level of neural implementation is just what we should expect if the conceptual framework we have been outlining above were true. As we noted at the outset, our aim has been to provide a geography of a region of conceptual space from an enactivist perspective, not to provide arguments which compel acceptance of the positions whose conceptual relations we are considering. However, we think that the way to provide such arguments involves a balance of the conceptual considerations with which we have mainly been concerned, and the kind of empirical considerations just considered. Our conceptual frameworks should be shaped and informed by our best cognitive science, and should be assessed with regard to their predictive and explanatory fertility as well as their internal consistency. So one way in which the enactivist account of conceptual geography we are pursuing here might be supported is through appeal to the past, present and (hopefully) future successes of the type of framework just presented.

5. Extended

Finally, let us very briefly consider a possible reason for holding that the possibility of cognitive extension – of the vehicles of a cognitive state extending beyond the skin and skull of a cognizing organism (Clark & Chalmers 1998; Clark 2008) – depends on the relationship between perception and agency emphasised by the enactivism we have outlined here. It comes from a plausible worry about the thesis of the Extended Mind mentioned by Chalmers (2008):

It is natural to hold that perception is the interface where the world affects the mind, and that action is the interface where the mind affects the world. If so, it is tempting to hold that what precedes perception and what follows action is not truly mental. And one might use this to draw a principled distinction between the cases of Otto (the Alzheimer's patient who uses a notebook as memory) and Inga (the ordinary subject who uses her brain). To interact with his notebook, Otto must read it and write in it, requiring perception and action, where there is no such requirement for Inga. If so, then the boundaries above would place the notebook outside the mind. (Chalmers 2008, p. *ix*)

15. This is in keeping with other recent work suggesting that cognitive and affective processing are inseparable at the neural level, whether in terms of structure, function or connectivity. See Pessoa 2008, 2010 and Thompson & Stapleton 2009 for discussion. See also Damasio 2010 on the role that multimodal maps in the superior colliculus play in perceptual, affective and cognitive processing.

In response to this, consider the “Transparency Constraint” upon instances of cognitive extension proposed by Thompson and Stapleton (2009): “*For anything external to the body’s boundary to count as part of the cognitive system it must function transparently in the body’s sense-making interactions with the environment*” (p. 29, original emphasis). In this context, the relevant sense-making interactions are to be understood in terms of the practical capacities that the enactivist described in our first section takes to be essential to cognition. And transparency is to be understood in terms of the sketch of the previous section, as implying not the impossibility of the subject’s directing their attention to the relevant external artefact, but the artefact’s serving to structure and constrain the subject’s cognition while simultaneously being a potential object of experience. Suppose that Otto’s practical and perceptual relationship with his notebook conforms to these constraints. Then, when skillfully interacting with his notebook in the service of pursuing some plan or project of his, the enactivist suggests that Otto’s perception of his notebook will recede to the background of his experience, which will instead be directed upon a range of situations and possibilities the shape of which is constrained by his skillful interactions with the notebook. If Otto indeed comes to experience the notebook in this way, then the enactivist has a principled reason to hold that the notebook constitutes part of the cognitive apparatus through which Otto’s mind is directed upon the world. For, in such a case, the notebook would make just the same kind of essential contribution to shaping and constraining Otto’s cognition as the bodily and affective states and properties upon which cognition, for the enactivist, essentially depends. The objection Chalmers describes relies on inviting us to think of Otto’s case in terms of his perception being directed upon information in the notebook, which then informs cognition and deliberation, which is then put to use in the guidance of action. No doubt Otto’s interactions with the notebook can take this form. And, for the enactivist, such interactions would indeed fail to bring about an extended cognitive system comprising both Otto and his notebook. In such a case perception, cognition and agency are related in the way the Classical Sandwich conception envisages, and as we saw above, this is not the relationship that the enactivist holds to be an essential feature of cognitive systems. However, if Otto’s perception of the notebook can recede into the background of his experience, in the way that his perception of his bodily or affective state can, and that is symptomatic of the notebook functioning as a horizon which shapes his dealings with the world, then the enactivist has principled reasons to hold that Otto’s manner of using the notebook in his flexible and adaptive interactions with his world allows the notebook to constitute part of his cognitive apparatus. If the enactivism we sketched above is endorsed, it is natural to use it to provide necessary and sufficient conditions for cases of cognitive extension in just this way, and thus hold that cognitive extension too essentially depends on aspects of the cognizer’s activity.

6. Conclusion

We have presented a specific elaboration of the claims that cognition is enactive, embodied, embedded, affective and (potentially) extended. According to the view above, the essential dependence of perception and cognition upon the cognizer's interactions with their environment is fundamental. If such a dependence obtains, we suggested, then it follows that cognition is essentially embodied and embedded, that the underpinnings of cognition are inextricable from those of affect, that the phenomenon of cognition itself is essentially bound up with affect, and that the possibility of cognitive extension depends upon the instantiation of a specific mode of skillful interrelation between cognizer and environment. If cognition is enactive, then it is also embodied, embedded, affective and potentially extended.

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