

Methodological situatedness; or, DEEDS worth doing and pursuing

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Abstract

This paper draws a distinction between two possible understandings of the DEEDS (Dynamical, Embodied, Extended, Distributed and Situated) approach to cognition. On the one hand, the DEEDS approach may be interpreted as making a metaphysical claim about the nature and location of cognitive processes. On the other hand, the DEEDS approach may be read as providing a methodological prescription about how we ought to conduct cognitive scientific research. I argue that the latter, methodological, reading shows that the DEEDS approach is *pursuitworthy* independently of an assessment of the truth of the metaphysical claim. Understood in this way, the DEEDS approach may avoid some of the objections that have been levelled against it.

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1. Introduction

Everybody knows that time, the body and the environment are important for cognition. You would not get much thinking done if you were not in a sufficiently oxygen-rich environment or if your body did not operate so as to deliver that oxygen to your organs in just the right quantities at just the right times. In addition, it is almost a truism that what we do with our bodies and environments is tremendously important for mental life; we all rely on diaries and shopping lists to help supplement our notoriously unreliable memories, and even adults sometimes resort to counting on their fingers in order to speed up calculations. This practical significance, however, has not often amounted to a kind of *theoretical* significance for cognitive science; an agent's body, environment and temporal co-ordination have mostly been seen as (mere) implementation details.

There is, however, a growing and laudable interest in a nexus of concepts one can usefully refer to as the DEEDS

approach to cognitive science.¹ Central to this development is the idea that the mind is essentially “situated”. Embodied, embedded and distributed approaches try to understand cognitive systems with reference to the bodies, environments and social structures in which they are *physically* situated. Dynamical cognitive science tries to do justice to the *temporal* situatedness of cognition, by emphasising the importance of time and timing. Both aspects of this theoretical reorientation have gone hand in hand with a novel and intriguing set of example phenomena that advocates of the DEEDS approach regard as paradigmatically cognitive. Whereas classical cognitive science was concerned with abilities such as chess-playing and logic-crunching, many now see abilities such as sensori-motor co-ordination and obstacle avoidance as central. Brian Cantwell Smith (1999) captures this new *zeitgeist*, by noting that the DEEDS approach “... views intelligent

¹ I will use this acronym to refer to approaches that see the mind as Distributed, Embodied, Embedded, Dynamical and Situated (with thanks to Leslie Marsh for suggesting it). Naturally, it would take some work to tease out the differing commitments of these different components, but for the purposes of this paper, I will take them as constituting a single family.

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human behaviour as engaged, socially and materially embodied activity, arising within the specific concrete details of particular (natural) settings, rather than as an abstract, detached, general purpose process of logical or formal ratiocination” (p. 769).

In this paper, I want to draw out a distinction between two different readings of the DEEDS hypothesis. On one reading, the DEEDS approach makes a metaphysical claim about the nature and location of cognitive processes—it claims that they may, in some cases, be constituted by factors which lie outside of the physical boundaries of the organism. On the other reading, the DEEDS approach advances a methodological prescription about how we ought to *do* cognitive science—it claims that more attention should be paid to bodily and environmental factors than has hitherto been the case. These two claims are often run together by advocates of the DEEDS approach, but they are worth teasing apart. For one thing, the distinction has some historical precedent—both behaviourism and the dynamical approach to cognition have already been outlined in accordance with similar distinctions. Further, I will argue that the methodological reading of the DEEDS approach is “pursuitworthy” independently of the metaphysical reading. It can also avoid some of the major objections that have targeted the latter. Thus, I conclude that the DEEDS approach cannot be dismissed as straightforwardly as some of its opponents would wish.

2. Motivation: babies, bugs and beliefs

The considerations that have been taken to motivate the DEEDS approach fall into two broad categories. First there is a set of (relatively successful) examples in psychology and artificial intelligence where apparently cognitive abilities are better explained from a situated perspective. Secondly, there are philosophical thought experiments designed to push the intuition that, in some cases, cognitive processes extend beyond the physical boundaries of skull and skin. In this section, I just want to lay out a couple of the canonical examples. I will return to evaluate them below.

Consider, first, how infants learn to walk. The data are relatively uncontroversial; there seem to be four stages to the development. First, a newborn infant is able to perform well co-ordinated stepping motions if held above the ground. Second, between the ages of two and eight months this ability disappears. It re-emerges between eight and ten months, and is finally followed by independent walking at about twelve months.² How should we explain this developmental pattern?

In general, the classical approach to cognitive science tries to understand cognitive processes in terms of the way the mind receives input and then forms, stores and

manipulates representations, before issuing motor commands as output. Thus, as the psychologists Thelen and Smith describe it, the received (classical) view explains locomotor development in terms of the actions, development and maturation of some kind of internal control structure, such as a central pattern generator, in the brain.

It should be noted that this kind of account is entirely *non-situated*. If the mind works by manipulating representations, and representations are to be understood as internal stand-ins for the body or the environment, it is clear that elements beyond the boundaries of an organism’s body are only of interest insofar as they provide sensory input and absorb behavioural output. On this view, encoded representations act as internal *surrogates* for the body and the environment, and so cognitive scientists need not worry about what’s going on in the *actual* body and environment. In general, this “individualistic” conception of cognition seems to have permeated much of the classical approach cognitive science.³ It would not be uncharitable, for example, to characterise Fodor’s “methodological solipsism” as the view that if you want to understand representational phenomena, you have to set aside what it is that is represented. A classical account of locomotor development thus only makes reference to the body and the environment indirectly.

Thelen and Smith argue that a closer examination of the case of infant walking in fact indicates that a full explanation requires us to take bodily and environmental factors, *as such*, into account. The examination of some contextual subtleties in the data, they claim, shows that the development of co-ordinated leg movement depends on factors which criss-cross the physical boundaries between brain, body and world.

Firstly, although two month old infants do not display rhythmic leg co-ordination when held upright, they *do* perform identical stepping movements when lying supine, or when supported with their legs in water. By contrast, if weights are added to the legs of stepping infants, the ability disappears. Thelen and Smith argue that, in fact, the key parameter underlying the pattern of development of stepping abilities is a (hitherto) seemingly mundane bodily feature: leg mass.

Secondly, various features of the infant’s environment seem to play a critical role in the developmental pattern. Thelen and Smith found that if non-stepping infants are supported just above a moving treadmill, they are capable of performing stepping movements at the appropriate speed, and are even able to adjust their movement when the legs are placed in contact with two treadmills moving at different speeds. Thelen and Smith argue that, in this case, the elastic, spring-like behaviour of the leg is the key variable, and what drives the observed behaviour is

² As reported in Thelen and Smith (1994, ch. 1). For good overviews, see Clark (1997, ch. 2) and Clark (2001, ch. 7).

³ See, for example, Wilson (2004) who writes “. . . the dominant research traditions in cognitive science have been at least implicitly individualistic” (p. 145).

the stretching and retracting of the leg *as controlled by the environment*.

Thelen and Smith (1994) conclude their analysis with the following provocative statement: “Our theory suggests that explanations in terms of structure in the head—‘beliefs’, ‘rules’, ‘concepts’ and ‘schemata’—are not acceptable; acceptable explanations will ground behaviour in real activity” (p. 339). This may, in fact, be overstating the case, since some central conscious control of locomotor behaviour surely *is* possible, at least in developmentally advanced stages.⁴ The first sentence of the above quotation might be better read as saying “explanations *solely* in terms of structure in the head . . . are not acceptable”. Nonetheless, the moral that Thelen and Smith draw from their studies is clear; since the development of co-ordinated stepping behaviour is governed by a complex network of bodily, environmental and cognitive factors, a full explanation of the phenomenon will have to be similarly diverse. Explanatorily relevant features may criss-cross the physical boundaries between brain, body and world that are taken to be so theoretically important by classical accounts.

Before moving on, it is worth briefly pausing to ask what conclusions can legitimately be drawn here. Critics of the DEEDS approach, such as Adams and Aizawa, argue that we should be wary of jumping to too strong a conclusion on the basis of this kind of example.⁵ Their general complaint is that advocates of the DEEDS approach often slide from showing an interesting *coupling* between cognitive processes and the body/environment to the much stronger conclusion that the mind is partially *constituted* by environmental and bodily factors. They call this the “coupling-constitution” fallacy.

It is certainly true that many authors gloss over the distinction between coupling and constitution and I shall return to this issue below. However, it is not clear that Thelen and Smith do so here. After all, in the above quotation, they are not making a claim about the constitution of the mind (i.e., what the mind *is*), but only about what should go into a good explanation (i.e., how we should understand or study the mind). This foreshadows the point I will make later that, when the DEEDS hypothesis is read methodologically, some objections effectively miss their mark.

A second empirical motivation for the DEEDS approach comes from considering the success stories of embodied robotics. In a series of studies of artificial hexapods, Randall Beer has employed dynamical systems theory to analyse the factors that go into producing stable and reliable navigational abilities despite complex and changing environments and advanced the claim that such an analysis cannot proceed without reference to bodily and environmental factors.⁶ Beer’s work is a good example

of how dynamical and embodied approaches can be integrated, in particular because he views cognition, the body and the environment as a set of interlocking dynamical systems. The mathematics of dynamical systems theory provides a common language in which to describe the different aspects of an agent in an environment, and these aspects cannot be teased apart without loss of explanatory power. He writes: “an agent and its environment are modeled as two coupled dynamical systems whose mutual interaction is in general jointly responsible for the agent’s behaviour” (Beer, 1995, p. 173).⁷

Beer’s goal was to simulate the processes responsible for the development of walking in insects. The key finding of his studies was that the most successful creatures (both in evolutionary terms of survival, and in individual terms of task accomplishment) were those whose leg controllers were partially dependent upon internal movement generators, *but also* partially dependent on environmental sensory feedback. These insects are robust to sensory damage, but are also capable of using sensory feedback, when it is available, to improve their performance.

Beer explicitly endorses the DEEDS approach as a result of his studies, arguing that embodiment and embeddedness are fundamental to both the design and the analysis of artificial hexapods. The goal of his framework is to focus “on the problem of generating the appropriate behaviour at the appropriate time as both an agent’s internal state and external environment continuously change” (Beer, 1995, p. 204) and his conclusion is that situatedness is necessary for *understanding* behaviour. But elsewhere, he goes further, and makes the stronger claim that situatedness is *constitutive* of behaviour: “Strictly speaking, behaviour is a property only of the coupled agent-environment system; it cannot in general properly be attributed to either the agent or the environment alone” (Beer, 1997, p. 266, **emphasis in original**). In other words, not only is the situated approach a better way to understand agent-environment interaction, but that interaction is also part of *what it is to behave*. It is, of course, interesting that Beer switches to talking about *behaviour* here, rather than cognition. His view is nonetheless a good example of the DEEDS approach more generally; according to Beer, behaviour is neither generated nor explained by internal factors alone, as the classical approach would claim.

Let us now turn to look at the *philosophical* motivation for adopting the DEEDS approach to cognition. In their now-legendary paper, Clark and Chalmers (1998) come to the conclusion that “cognitive processes ain’t (all) in the head” (p. 8) by advancing a thought experiment designed to show that the privilege often accorded to intracranial aspects of cognition is in fact a misguided prejudice.

⁴ See, for example, Monty Python’s sketches about the *Ministry of Silly Walks*—locomotor control *can* be achieved by purely internal resources.

⁵ See, for example Adams and Aizawa (forthcoming a, forthcoming b).

⁶ See, for example, Beer (1995, 1997).

⁷ That is to say that he thinks that all three jointly *constitute* the organism’s behaviour. It is worth noting that dynamical systems theory is one field where coupling *does* entail constitution; when dynamical systems *X* and *Y* are coupled, they jointly constitute a broader dynamical system, *Z*.

Clark and Chalmers invite us to consider two parallel cases in which, despite superficial differences in intra- and extra-cranial location, cognitive processes are, they claim, identical in other important respects. For the purposes of exposition, I will restrict the discussion to the case of belief. Inga, so the story goes, is a ‘normal’ adult human who happens to store her memories intra-cranially. Otto, by contrast, suffers from an impairment in memory that results in him having to write information in a notebook that he carries with him everywhere he goes. In this sense, Otto’s repository of information is extra-cranial.⁸

When Inga hears about an exhibition that she wants to see, she thinks for a moment, remembers that the museum is on 53rd street, and then goes to the museum. By contrast, when Otto hears about the exhibition, he checks his notebook, finds that it says that the museum is on 53rd street, and then goes to the museum. Our folk-psychological notions of belief suggest that there is an important difference between Otto and Inga—we are tempted to say that Inga has beliefs about the location of the museum, but Otto does not (at least, not until after he has consulted his notebook). But according to Clark and Chalmers, this is a mistake—if we were to follow him around for a while, we would notice that Otto’s (external) notebook functions in just the same way as Inga’s (internal) memory. Clark and Chalmers (1998) conclude that, “In all important respects, Otto’s case is similar to a standard case of (non-occurrent) belief. The differences between Otto’s case and Inga’s are striking, but they are superficial” (p. 14. Emphasis in original.).

The motivation for coming to this conclusion is a principle which says something like “as within the skull, so without”. For convenience, I will follow Clark in calling this the “parity principle”.⁹ The parity principle amounts to the claim that there is no significant, non-question-begging difference between intra-cranial and extra-cranial systems involved in cognition.¹⁰ Elsewhere, Clark (2005) advances this claim about mental *content*, writing: “I do not believe that there is any non-question-begging notion of intrinsic content that picks out all and only the neural in any clear and useful fashion” (p. 4). Here, Clark and Chalmers (1998) are concerned to establish a similar conclusion for the vehicles that carry those contents. In their own words:

If . . . a part of the world functions as a process which, *were it done in the head*, we would have no hesitation in recognizing as part of the cognitive process, then that part of the world is (so we claim) part of the cognitive process. (p. 8. Emphasis in original).

⁸ Note that the characters’ names reflect the differing locations of their information stores—Inga, inner and Otto, outer.

⁹ See, e.g., Clark, *forthcoming*, p. 4.

¹⁰ I owe this way of putting it to André Kukla.

Notice here that Clark and Chalmers attempt to motivate their position by re-deploying a central tenet of classical cognitive science—the doctrine of functionalism. According to the most general statement of functionalism, mental states are defined by their causal roles with respect to (sensory) input, (behavioural) output and other mental states, rather than by the substance out of which they are made. As Clark (1989) has put it elsewhere, functionalism might be characterised by the slogan “it ain’t the meat, it’s the motion” that matters when it comes to individuating mental states (p. 21).

The “parity principle” follows from this functionalist perspective on the nature of the mind. So long as the machinery which implements cognition has the right functional structure, it does not matter *where* it is located. As Clark and Chalmers (1998) put it:

The moral is that when it comes to belief, there is nothing sacred about skull and skin. What makes some information count as a belief is the role it plays, and there is no reason why the relevant role can only be played from inside the body (p. 14).

We might use diaries and shopping lists to augment our *storage* capacities, or we might count on our fingers to increase our *processing* capacities. We might *passively* use existing environmental structures, or we might *actively* change the environment. In each case, Clark and Chalmers argue, if the extended structure in question plays the right causal role it ought properly to be considered *part* of cognition, rather than the (mere) intentional object of cognition. In short, the DEEDS approach is warranted, they claim, if you take the functionalist viewpoint seriously.

3. Metaphysical vs. methodological approaches

Having laid out some of the evidence that is often taken to motivate the DEEDS approach, I now want to take a closer look at how to interpret the claims made by the authors considered above. In this section I will distinguish between two different readings of the foregoing evidence. These two readings are often run together, but by distinguishing them, the DEEDS theorist has a way both to avoid some objections and to show that their approach is worth pursuing.

It is instructive to consider the DEEDS approach in terms of a distinction that is already familiar from the history of psychology. Although behaviourism has largely been discredited or abandoned, the distinction between *methodological* and *metaphysical* versions of the theory is still a useful one. Very briefly, methodological behaviourism is the view that any science of psychology can only study observable behaviour (in experiments using stimuli and responses, reinforcement, conditioning and so on). Metaphysical behaviourism is the (stronger) claim that mental states do not exist and that behaviour is *all there is*. One might read the former as making a claim about

science (how, as a matter of fact, we ought to do psychology), whilst the latter makes a claim about the mind itself (i.e., about the existence and nature of the *subject matter* of psychology).

This distinction is echoed in van Gelder's (1998) description of the *dynamical* hypothesis in cognitive science. He argues that there are, in fact, two hypotheses; one is metaphysical (the "nature hypothesis") and one is methodological (the "knowledge hypothesis"). As van Gelder (1998) puts it, "The *nature* hypothesis is a claim about cognitive agents themselves: it specifies what they *are* (i.e. dynamical systems). The *knowledge* hypothesis is a claim about cognitive science: namely that we can and should *understand* cognition dynamically" (p. 619).

A similar distinction can be drawn within the DEEDS approach to cognition. On the one hand, there is the metaphysical version of the thesis—it concerns the nature and location of cognitive states and processes, and claims that, in some cases, these are partly constituted by factors which lie outside of the physical boundaries of the organism. On the other hand, there is a methodological reading of the thesis. This is the claim that, in studying and explaining cognitive phenomena, we will need to make reference to bodily and environmental factors. In this latter respect, the DEEDS approach is a significant departure from the individualism prescribed by Fodor and other classical cognitive scientists. To be sure, the authors already considered often run the metaphysical and methodological claims together—as far as I know, there are no authors who hold one without endorsing the other. But these readings *should* be distinguished—they are, after all, different claims, and as I will show, the methodological reading has the distinct advantage of avoiding some objections to the DEEDS approach.

By and large, Clark and Chalmers (1998) argue for the metaphysical thesis; they are mostly concerned with providing an account of what (and where) the mind is. This is captured by their deliberate echo of Putnam, when they write "Cognitive processes ain't (all) in the head" (p. 8). However, Clark and Chalmers run this claim together with an epistemic, or methodological claim—that we have to *understand* or *study* the mind in DEEDS terms. Just as methodological behaviourism is motivated by an *a priori* claim about the kinds of entities that can feature in psychological explanations, so Clark and Chalmers' methodological argument is motivated by an *a priori* principle about what constitutes a good explanation. In short, Clark and Chalmers invite us to adopt the DEEDS approach to cognition for reasons of explanatory simplicity.

Consider a potential objection to the thought experiment involving Otto and Inga. The opponent of Clark and Chalmers might insist that Otto's actions should really be understood in terms of his (internal) beliefs about the contents of his notebook. What happens, they will say, is that Otto has a desire to go to the museum, and he has a belief (stored internally) that the museum is wherever his notebook says it is. These two propositional attitudes com-

bine with the *fact* of his notebook containing a certain piece of information to lead to Otto's going to the museum. Note here that the traditional boundaries between mind and world are maintained—Otto's beliefs and desires are fully intra-cranial, and they combine with extra-cranial states of affairs to generate his behaviour. If the objection works, then the metaphysical claim is undermined; Otto's mind is wholly within his head.

Clark and Chalmers argue that this explanation is "pointlessly complex". One would not claim that *Inga's* behaviour should be explained in a tri-partite way, with reference to her desire to go to the museum, her belief about the contents of her memory, and the fact of her memory's containing the information about the right location. Similarly, Clark and Chalmers argue, "The notebook is a constant for Otto, in the same way that memory is a constant for Inga; to point to it in every belief/desire explanation would be redundant. In an explanation, simplicity is power" (p. 14). Notice that this point is epistemic, or methodological. The issue concerns what we ought to pay attention to when studying Oscar's actions, and how well the competing approaches can explain the observed phenomena. The claim advanced by Clark and Chalmers is that explanations of Otto's cognitive processes are better expressed in DEEDS terms, precisely because they are simpler.

This interpretation is borne out by other remarks made by Clark. Elsewhere, he endorses a similar methodological reading of the extended mind hypothesis, writing:

In the light of . . . the apparent methodological value . . . of studying extended brain–body–world systems as integrated computational and dynamical wholes, I am convinced that it is valuable to (at times) treat cognitive processes as extending beyond the narrow confines of skin and skull. (Clark, 1997, p. 215)

There are two important factors to note here. First, Clark's emphasis on *treating* cognitive processes as extended has a ring of instrumentalism to it—we are invited to defer concern about whether or not the metaphysical claim about extendedness is true, and (for now) note that the concepts of extendedness are useful for describing and explaining cognitive phenomena. Secondly, the phrase "methodological value" indicates that it is *worth doing* cognitive science using the resources of the DEEDS approach—examples like those mentioned in the previous section indicate that the DEEDS methodology is *pursuit-worthy* independently of an evaluation of the metaphysical claim.¹¹

All of this is indicative of the fact that the metaphysical and methodological versions of the DEEDS approach are subject to different standards of evaluation. The metaphysical claim—that the mind literally extends beyond the boundaries of the skull—is either true or false. The meth-

¹¹ The term "pursuitworthy" is borrowed from Kukla (2001).

odological thesis, however, is more or less *pursuitworthy*, and pursuitworthiness is independent of truth. It may sound perverse to assert that a theory is pursuitworthy independently of a consideration of its truth. This would amount to the claim that, in some cases, it might be worth pursuing even theories that are exceedingly unlikely. That is a bullet I am prepared to bite, however, because it does not amount to saying that *any old* theory is pursuitworthy. Rather, I think there are at least three ways in which we may restrict the class of pursuitworthy theories, and as I will show, the methodological DEEDS approach survives these restrictions.

First, we must factor in considerations about the *cost* of pursuing a theory and the potential payoff of doing so; thus unlikely theories might be pursuitworthy if the cost of pursuing them is relatively low, but the potential payoff is relatively high. The probability of metaphysical behaviourism being true is very close to zero. But pursuing a behaviourist methodology has a relatively low cost, and the payoffs might be quite high. Indeed, it is at least arguable that contemporary cognitive-behavioural therapy owes a great deal to its behaviourist predecessors, since it relies heavily on the notions of reinforcement and conditioning, and has deployed these with great success in, for example, the treatment of phobias and other anxiety disorders. Thus, for behaviourism, even though the metaphysical claim has long since been abandoned, the methodological approach, insofar as it has a low cost and a high payoff, has proven to be pursuitworthy regardless. (Indeed, there is a certain “cannot lose”¹² scenario here—even if the pursuit of a methodology fails, we will most likely still learn some important details of the subject matter along the way.)

Secondly, a theory may be pursuitworthy when there are no alternatives. This kind of argument can be found in the classical cognitive scientific literature. In the 1980s, Fodor argued that the classical approach (the “language of thought” hypothesis, or the “Representational Theory of Mind”) was the “only game in town”. Since there was no other candidate theory on the table, cognitive scientists faced a choice between pursuing the classical approach (despite the numerous objections to it) and doing nothing. In other words, Fodor thought that classical cognitive science was pursuitworthy, despite the fact that it was likely not to be true. Summarising this situation more recently, he writes:

...when I wrote books about what a fine thing [the computational theory of mind] is, I generally made a point to include a section saying that I do not suppose that it could comprise more than a fragment of a full and satisfactory cognitive psychology; and that the most interesting—certainly the hardest—problems about thinking are unlikely to be much illuminated by any kind of

computational theory we are now able to imagine (Fodor, 2000, p. 1).

Of course, the DEEDS approach cannot be supported by an “only game in town” argument, because it is supposed to be an *alternative* to the existing games in town. Nonetheless, if the successes so far are anything to go by, the DEEDS approach can still be seen as pursuitworthy by running a “better game in town” argument from methodological premisses.

Thirdly, a theory may be pursuitworthy if it coheres with other well-established theories. The DEEDS approach can thus be seen as pursuitworthy because it fits well with current trends in biology. Despite claims like those made by Clark and Chalmers sounding like something from science-fiction,¹³ they are in fact motivated by a more general, evolutionarily inspired, approach to studying the mind as a biological phenomenon. Wilson and Clark (*in press*) argue that it is natural to take the DEEDS approach to *cognition* as continuous with the emphasis on extendedness elsewhere in biology. They claim that Dawkins’ famous “extended phenotype” theory, views such as Turner’s “extended physiology”¹⁴ and the extended mind hypothesis, all share a central premise: that “The individual organism is an arbitrary stopping point for the scientific study of at least a range of relevant processes in the corresponding domain” (Wilson & Clark, *in press*, p. 8).

These considerations take evolutionary constraints on biological systems to be paramount. Offloading one’s computational tasks onto the environment (by using it for the processing of information) is one way of freeing up inner resources that can subsequently be dedicated to the canonical “four Fs” (feeding, fighting, fleeing and reproduction) of evolution.¹⁵ Clark points out that this principle may apply to any kind of processing—whether it is advanced information processing or low-level food-processing. Presumably, one reason we cook food is because heating it serves to break it down in ways that avoid the costs of doing so internally. Similarly, Clark (1989) writes, “... evolved creatures will neither store nor process information in costly ways when they can use the structure of the environment and their operations upon it as a convenient stand-in for the information processing operations concerned” (p. 64). One might characterise the inspiration thus; if I write my shopping list on an external piece of paper, then I can dedicate my internal resources towards not dying on the way to the supermarket.

Rodney Brooks (1991) takes this kind of insight as motivation for a bottom-up cognitive scientific methodology in robotics and AI. One methodological principle he advocates is that “At each step we should build complete

¹³ Indeed, Wilson (*forthcoming*, p. 6) describes these kind of thought experiments as “cyborg fantasy” arguments.

¹⁴ See Turner (2000).

¹⁵ Thanks to Ronnie de Sousa for bringing this memorable way of putting it to my attention.

¹² Compare with Kukla (2001, p. 54).

intelligent systems that we let loose in the real world with real sensing and real action. Anything less provides a candidate with which we can delude ourselves” (p. 140).

Justification for this methodology comes from an interesting observation. If we look at the evolution of cognitive systems, we notice that adaptively successful embodied, embedded, low-level sensori-motor behaviour took *much longer* to develop than the kinds of activities with which cognitive science has traditionally been concerned. Single cell organisms appeared around 3.5 billion years ago, whilst primates did not arrive on the scene until only 120 million years ago. Skills like language-use and chess-playing only arose in the last few thousand years, and this is extraordinarily *recent* in the grand scheme of things. Brooks (1991) writes:

This suggests that problem solving behaviour, language, expert knowledge and application, and reason, are all pretty simple once the essence of being and reacting are available. ... I believe that mobility, acute vision and the ability to carry out survival related tasks in a dynamic environment provide a necessary basis for the development of true intelligence (p. 141).

Of course, at first glance, it seems possible to turn this argument on its head.¹⁶ Brooks’ claim is that, since higher level abilities arose fairly quickly, whereas low-level abilities took a long time to evolve, this must mean that the low-level abilities are more difficult, or more complex, and therefore require more work within AI and robotics. But since the high-level abilities arose *after* the low-level abilities had already developed, this in fact shows that that high-level cognitive abilities require *all* the evolution necessary for low-level abilities, *and then some more*. So Brooks’ argument could be interpreted as requiring the conclusion that the high-level abilities *really are* quite special after all. Nonetheless, we should note that, according to Brooks, the low-level behaviours are a “necessary basis” for the higher levels. Thus, reading the argument methodologically gives a clear prescription about how we ought to conduct scientific research; a bottom-up approach is needed, and what we have at the bottom (i.e., what we must *start* with) are embodied and embedded abilities.

4. Advantages of the methodological reading

So far, I have argued that the DEEDS approach can be read in two different ways, and that the methodological version of the approach is pursuitworthy independently of the truth or otherwise of the metaphysical claim. In this section, I want to take a look at the benefits of this reading by examining how a methodological DEEDS can avoid a couple of objections.

As noted above, the kinds of empirical examples which are taken to motivate DEEDS cognitive science contain an

interesting, but potentially problematic, shift of focus. Recall that Beer described his studies of insect locomotion in terms of how behaviour is jointly constituted by *both* the organism and the environment. Similarly, Thelen and Smith are concerned with how best to model and explain the development of motor co-ordination in infants. Perhaps the most common response to many otherwise successful DEEDS models is a feeling of unease concerning the sense in which they may properly be regarded as genuinely *cognitive*. The objection here is that empirical examples of DEEDS research in action cannot constitute a genuine foundation for *cognitive* science because they focus on behaviour alone, or on abilities that are too “low-level”. Whereas the classical approach identified a task domain which is uncontroversially cognitive, it’s not clear that the situated approach can cope with more than (mere) kinesiology, ethology or physiology.

The difficult question, then, concerns the extent to which the low level abilities that are characteristic of DEEDS models can be “scaled up”. The assumption that they *can* depends on what Andy Clark (2001) has called “cognitive incrementalism”—the view that “you do indeed get full-blown, human cognition by gradually adding ‘bells and whistles’ to basic (embodied, embedded) strategies of relating to the present at hand” (p. 135). Thelen and Smith (1994) explicitly endorse this, writing: “[T]here is in principle no difference between the processes engendering walking, reaching, and looking for hidden objects and those resulting in mathematics and poetry. Our developmental theorising leads us to a view of cognition as seamless...” (p. xxiii).

Kirsch (1991) captures the incrementalist assumption with a slogan: “Today the earwig, tomorrow man”. The question here is whether or not such an assumption is *justified*. Kirsch himself thinks that it is not. He writes: “I am not yet convinced that success in duplicating insect behaviours such as wandering, avoiding obstacles, and following corridors proves that the robotics approach is the royal path to higher-level behaviours. Insect ethologists are not cognitive scientists” (p. 162).

But the considerations put forward by Brooks already provide a response to the scaling-up objection. According to Brooks, incrementalism is not an *assumption*, but rather a methodological *hypothesis* that comes from observing the evolution of cognitive agents. Thus, he advocates another principle: “We must incrementally build up the capabilities of intelligent systems, having complete systems at each step of the way and thus automatically ensure that the pieces and their interfaces are valid” (Adams & Aizawa, forthcoming b, p. 140).

So, for Brooks, it is an open question as to whether incrementalism can be justified (and the “scaling up” objection met) and thereby whether the DEEDS approach will apply to “high-level” cognitive phenomena. But if Brooks’ methodological prescription is right, then cognitive science must *postpone* directly answering the objection and focus on building low-level or peripheral models until such time

¹⁶ Thanks to an anonymous reviewer for this point.

as we are able to revisit the issue. On Brooks' view, the extent to which DEEDS models will "scale up" is a post-dated cheque that DEEDS research in the mean time will hopefully be able to generate sufficient funds to honour. Brooks' *hypothesis* is that we will ultimately be able to justify the metaphysical claim, but it is only by pursuing the DEEDS methodology that we will be able to tell.

Read as a methodological hypothesis, the DEEDS approach can also avoid Adams and Aizawa's charge that it commits the "coupling-constitution fallacy". Adams and Aizawa (forthcoming a) claim that the move from coupling to constitution is illegitimate, and they illustrate it with a number of examples:

The neurons leading into a neuromuscular junction are coupled to the muscles they innervate, but the neurons are not a part of the muscles they innervate. The release of neurotransmitters at the neuromuscular junction is coupled to the process of muscular contraction, but the process of releasing neurotransmitters at the neuromuscular junction is not a part of the process of muscular contraction (p. 2–3).

It is tempting simply to deny the claim made by Adams and Aizawa. If we think in terms of processes, their claim seems flat-out wrong; the release of neurotransmitters *just is* a constitutive part of the process of muscular contraction. Consider this point counterfactually; if the neurotransmitter had not been released, the muscles would not have contracted. It seems that in *some* cases, coupling *really does* entail constitution (see, for example, my footnote #7 on Beer's use of dynamical systems theory). The really interesting issues are *which* cases permit the inference from coupling to constitution, and what it is about those cases that makes the inference legitimate. Nobody has yet provided an answer to *that* question, but we can view DEEDS advocates as putting forward a coupling-constitution *hypothesis*. DEEDS research in cognitive science is trying to uncover the specific conditions under which coupling *is* sufficient for constitution, and that is why the DEEDS methodology is pursuitworthy.

A further line of objection arises specifically in conjunction with Clark and Chalmers' extended mind hypothesis, but applies to the DEEDS approach more generally. As noted earlier, the "parity principle" of the DEEDS approach follows from functionalism in the philosophy of mind. One of the reasons that functionalism has been so popular is that it allows for the possibility of "multiple realisability". Since all that matters for cognition is how you are functionally organised, then functionalism permits cognitive states to be implemented by *different* kinds of physical structures in different agents.

One might see the DEEDS approach as extending this functionalist insight to a kind of "multiple locatability".¹⁷ Once one accepts the view that mental states are individ-

uated by their functional roles, then one might ask why it is that the material that plays those functional roles has to be located within the boundaries of skull and skin. If how you are functionally organised is all that matters for cognition, then there seems to be no good reason to restrict that functional organisation to the inside of agents.

Interestingly, opponents of the DEEDS approach such as Adams and Aizawa do not take issue with "multiple locatability" *per se*—they agree with Clark and Chalmers that "the difference between being in the head and being outside the head does not constitute a mark of the cognitive" (Adams & Aizawa, forthcoming b, p. 4). The trouble is that once one abandons the skin–skull boundary as a boundary of the cognitive, it is no longer clear that one can place *any* boundaries around what counts as cognitive. Classical functionalism had to contend with thought experiments in which multiple realisability permitted all kinds of bizarre implementations that we would not normally want to count as cognitive (such as Searle's Chinese Room or Block's Chinese Nation). Now the DEEDS approach runs into a similar potential *reductio ad absurdum*, since it provides no principled way of imposing any limits on the *location* of cognitive processes.¹⁸

One worry is that, according to the parity principle, any part of the universe could potentially play the same role in Otto's cognitive processes as his notebook (which in turn plays the same role as memory in "normal" minds such as Inga's). So, for example, Otto might tell the time of day from the position of the sun in the sky, and might thereby remember to keep certain appointments using celestial motions. If he does, then the functionalist parity principle will lead Clark and Chalmers to conclude that the sun is part of Otto's mind. We might also concoct further plausible scenarios where a similar causal role is played by distant quasars, other people, or anything else in the portion of the universe that is in Otto's light cone.¹⁹

Now, usually, when we were talking about the intra-cranial aspects of cognition, we readily grant that a system in our heads that can potentially play a cognitive role already qualifies as being part of the mind, even if it is actually never called upon to play that role. Suppose, for example, that a child is reared in such a way that she never sees colours. Then the elaborate systems dedicated to colour recog-

¹⁸ This *reductio* argument comes from Andre Kukla (manuscript) "The Mystical Philosophy of Clark and Chalmers".

¹⁹ This is a consequence of what Clark has described as "Clark's Law". In 2004, *The Edge* website invited numerous scientists and philosophers to spell out a law that might be named after them. Clark's Law is: "Everything Leaks. There are no clear-cut level distinctions in nature. Neural software bleeds into neural firmware, neural firmware bleeds into neural hardware, psychology bleeds into biology and biology bleeds into physics. Body bleeds into mind and mind bleeds into world. Philosophy bleeds into science and science bleeds back" (see: <http://www.edge.org/q2004/page6.html#clark>). In the current objection, there is no principled way to stem the leakage.

¹⁷ I owe this way of putting it to Dan Deasy.

inition never get called into action. But presumably they could still be counted as part of the child's mind insofar as they are "poised" to play that cognitive role *if* called upon.

When taken together with the functionalist parity principle, this insight entails that any extra-cranial system that can potentially play a role in Otto's cognitive processes is already a part of Otto's mind. But now we seem to be forced to admit that the sun, distant quasars, and indeed any part of the universe that is in Otto's light cone is a part of Otto's mind. So Otto's mind is the universe. By parity of reasoning, the same could be said of Inga's mind. So Inga's mind is the same as Otto's mind. This line of argument can be repeated until we reach the grand conclusion that there is only one mind, and that mind is identical to the universe. Counterfactually, any difference in any part of the universe would, *ipso facto*, be a difference in Otto's mind (and Inga's mind, and anybody else's mind). The ultimate conclusion is like a cognitive version of the Gaia hypothesis whereby the entire cosmos is seen as a single functioning organism.

Of course, one person's *reductio ad absurdum*, is another person's important result. Mystics and proponents of the Gaia hypothesis may find that this conclusion is a pleasing confirmation of their perspective. But it is surely not a concept of mind upon which we can rest the foundations of cognitive science. The "limitless mind" conclusion is, I suspect, one that most cognitive scientists would want to reject.

The challenge, here, is for Clark and Chalmers to come up with an alternative formulation of the functionalist parity principle in a way that permits *only a subset* of extra-cranial systems to be part of cognition. Such a reading is not yet forthcoming. But one way forward, as I have suggested, is to read the DEEDS approach as advancing a methodological *hypothesis*. By conducting DEEDS research, we are investigating the conditions under which coupling might be sufficient for constitution, and by extension (pardon the pun) we are thereby likely to discover the conditions under which it is *not*. Paying closer attention to these cases, therefore, is one way of going about finding a non-question-begging way in which to stem the "leakage" of the mind. We do not yet know what that is, but the DEEDS methodology is pursuitworthy because it's one way of trying to find out. Only by doing the research will we be able to gather enough data to see whether the "limitless mind" objection is really damaging.

5. Concluding remarks

This brings me to a final issue with which I would like to conclude. Even though, as I have argued, the metaphysical and methodological readings of the DEEDS approach to cognitive science are distinct, they are not often *treated* separately in the literature. I do not know of any authors who endorse the methodological reading without *also* endorsing the metaphysical claim. It is instructive to examine *why* the claims are run together.

Recall that Clark and Chalmers prefer to explain Otto's behaviour in DEEDS terms on the grounds of simplicity. We might also read Clark and Chalmers as attempting to run an abductive argument from the success of DEEDS explanations (i.e., from the pursuitworthiness of the methodology) to the truth of the *metaphysical* version of the extended mind hypothesis. As they see it, the success of DEEDS explanations might give us grounds to accept the metaphysical reading. The warrant for this inference depends on something like Putnam's famous "no miracles" argument for realism in science—as Putnam (1979) writes, "[t]he positive argument for realism is that it is the only philosophy that does not make the success of science a miracle" (p. 73).

Of course, this argument is subject to numerous limitations that I shall not go into here. We can, however, grant Clark and Chalmers at least this much: the truth of the extended mind hypothesis would be *one* (possible) reason for the success of the DEEDS explanations. After all, the truth of a theory is *an* explanation for why that theory is explanatorily successful—what's wrong with the "no miracles" argument is that it says that the truth of a theory is *the* explanation of a theory's success. This means that DEEDS theorists in general, and Clark and Chalmers in particular, need to work out whether the truth of the extended mind hypothesis is *the* reason for explanatory success, or whether there is some *other* reason for explanatory success that leaves the likelihood of the metaphysical claim untouched. This seems to be another argument for pursuitworthiness; we ought to investigate DEEDS models more thoroughly to work out whether their truth is the reason for their explanatory success.

Brooks' arguments can also be read in a way that sees him making an abductive inference from the success of DEEDS methodology to the metaphysical claim. For evolutionary reasons, Brooks argues, we ought to look more carefully at low-level, embodied and embedded explanations, and such phenomena as are explained in this way, he hypothesises, will turn out to be paradigmatic of cognition. His conclusion is that *this* is where cognitive science should concentrate its efforts, and that, as it happens, many of these foundational, low-level abilities will turn out to vindicate the DEEDS perspective. He concludes "only experiments with real creatures in real worlds can answer the natural doubts about our approach. Time will tell" (Adams & Aizawa, *forthcoming b*, p. 158).

Finally, since I mentioned Fodor's "only game in town" argument earlier, it is worth returning to it. When considering DEEDS accounts by comparison with their classical rivals, we want to be in a position where we can assess the relative merits of the competing theories—we want to see whether there might in fact be *another* game in town. But in order to do *that* we need to know whether the DEEDS approach can *be* an empirically equivalent rival to the classical approach (or whether it can be empirically adequate *simpliciter*.) Initial indications, as shown by the above, seem to indicate some explanatory success. But since the data are

not yet in, the final assessment cannot yet take place. The conclusion for now is just that we have to play the new game in town in order to see whether it is any good.

This leads me to a broadly programmatic conclusion. We have several arguments to the effect that, when the DEEDS approach is read as advocating a methodology—a way of *doing* cognitive science—it is worthy of pursuit. This pursuitworthiness is independent of the truth (or falsity) of the metaphysical claim, and so cannot be undermined by the numerous objections to the latter. Cognitive science ought to pay more attention to the bodies, environments and time-scales in which cognitive processes are situated. Whether or not this methodology will ultimately make its way into a fully-fledged metaphysics of mind is an open empirical question which must be postponed, pending further empirical work. There is a suggestion that the DEEDS approach might be a “better game in town”, but we *do* need to play it to work out whether that suggestion will come to fruition. As the old aphorism goes: “You have got to be in it to win it”.

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