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INQUIRY
Inquiry
An Interdisciplinary Journal of Philosophy

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/sinq20

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To cite this article: J. P. Bruineberg & J. C. van den Herik (2021): Embodying mental affordances, Inquiry, DOI: 10.1080/0020174X.2021.1987316

To link to this article: https://doi.org/10.1080/0020174X.2021.1987316

Published online: 15 Oct 2021.

INQUIRY
https://doi.org/10.1080/0020174X.2021.1987316

Embodying mental affordances

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ABSTRACT

The concept of affordances is rapidly gaining traction in the philosophy of mind and cognitive sciences. Affordances are opportunities for action provided by the environment. An important open question is whether affordances can be used to explain mental action such as attention, counting, and imagination. In this paper, we critically discuss McClelland's ('The Mental Affordance Hypothesis', 2020, *Mind,* 129(514), pp. 401–427) mental affordance hypothesis. While we agree that the affordance concept can be fruitfully employed to explain mental action, we argue that McClelland's *mental affordance hypothesis* contain remnants of a Cartesian understanding of the mind. By discussing the theoretical framework of the *affordance competition hypothesis*, we sketch an alternative research program based on the principles of embodied cognition that evades the Cartesian worries. We show how paradigmatic mental acts, such as imagination, counting, and arithmetic, are dependent on sensorimotor interaction with an affording environment. Rather than make a clear distinction between bodily and mental action, the mental affordances highlight the embodied nature of our mental action. We think that in developing our alternative research program on mental affordances, we can maintain many of the excellent insights of McClelland's account without reintroducing the very distinctions that affordances were supposed to overcome.

ARTICLE HISTORY Received 26 March 2021; Accepted 16 September 2021

KEYWORDS Affordance; mental action; action selection; attention

1. Introduction

> The rules that govern behaviour are not like laws enforced by an authority or decisions made by a commander; behavior is regular without being regulated. The question is how this can be. (Gibson 1979, 215)

According to Dennett (2017), the concept of affordances should be central to the study of cognition. Originally introduced by the

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psychologist James Gibson, affordances are the opportunities for action provided by the environment. Dennett argues that organisms directly discern affordances and act appropriately on them. He concludes that the 'term is growing in frequency across the spectrum of cognitive science, but many users of the term seem to have a diminished appreciation of its potential.'

In this light, the mental affordance research program proposed by McClelland (2020)[1] is a timely contribution. Affordances are often thought to be limited to possibilities for basic bodily action. Dennett (2017), for example, introduces the concept by mentioning that 'holes afford hiding in, cups afford drinking out of, trees afford climbing'. McClelland argues that the affordance concept can also be fruitful in explaining mental action, of which he discusses three examples: attention, counting, and imagination. We agree with McClelland that the affordance concept can be fruitfully employed beyond basic bodily action. At the same time, we argue that McClelland's *mental affordance hypothesis* embodies two assumptions concerning the nature of mind that run counter to the potential and ambition of the affordance concept.

Our first objection concerns McClelland's general perspective on affordance perception and the role it plays in action selection. In a nutshell, McClelland argues for a distinction between automatic and deliberate processes. The automatic processes include affordance perception and potentiation. Action selection is portrayed as a deliberate process that starts from the output of the perceptual processes. At the interface of automatic and deliberate processes, McClelland envisages a menu of possible actions. We advance three arguments against this proposal: (i) it does not capture everyday experience of action selection, (ii) it comes perilously close a form of Cartesian Materialism, and (iii) it incurs a hefty explanatory debt in accounting for action selection. While McClelland argues his proposal is supported by recent insights from cognitive neuroscience, in particular the *affordance competition hypothesis* espoused by Cisek and Kalaska (2010), we argue that this hypothesis suggest a very different perspective on affordance perception, potentiation, and action selection that we argue evades the problems of McClelland's proposal.

Our second objection concerns McClelland's distinction between mental and bodily actions. McClelland defines mental actions as *covert*, i.e. as those actions that do not essentially involve bodily movements. This leads to a view where bodily actions merely assist mental action.

[1]All quotes without reference are taken from McClelland (2020).

Based on empirical work on attention and counting, we argue the bodily/mental distinction does not neatly track the overt/covert distinction. Paradigmatic mental actions sometimes involve bodily movement. A more parsimonious account can be provided by foregrounding the embodied nature of mental action.

2. Action selection

2.1. McClelland's proposal

According to McClelland, an affordance is an *opportunity for action* for an individual, defined as 'a situation in which it is possible for a subject to deploy some ability they possess' (403). Affordances are relative to individuals and the abilities they have. For example, many trees that afford climbing for a squirrel do not afford climbing for McClelland, who therefore concludes that the 'tree's climbability and my ability to climb it are *complementary dispositions*' (403).[2]

McClelland argues that affordances can help explain action selection. In pre-theoretical terms, action selection is the problem faced by any organism all the time: what to do next? In any situation, there are always many opportunities for action. Since no organism is capable of acting on all affordances at the same time, somehow a selection must be made. According to McClelland, explaining action selection is not done by affordances as such, but by our sensitivity to them. This sensitivity is understood in terms of the perception of affordances and the potentiation of the afforded action. McClelland construes perception and potentiation as *facilitating* action selection. He explains:

> With affordance perception, we can exploit a fruitful division of labour between rapid, automatic perceptual processes that present us with a menu of possible actions and slow, deliberative post-perceptual processes through which we can select which action to perform. (408)

For McClelland, perception of affordances is distinct from, and only forms the input for action selection. Affordance perception is helpful because it reduces cognitive load. Because perceptual processes present us with this menu, it is 'freeing up our cognitive resources for the task of deciding which of the available courses of action is best' (408).

[2]The view that affordances are dispositions has recently come under increased scrutiny. Chemero (2009), for example, argues that whereas a sugar cube will dissolve whenever submerged in tea (this example is also used by McClelland), it is not the case that McClelland will climb a tree whenever he comes across a climbable tree (but see Heras-Escribano 2019).

Something similar holds for potentiation: under the right conditions, perceiving an affordance automatically potentiates the afforded action. Potentiation of the afforded action is understood in terms of activation of the neural patterns, called motor patterns, that prepare the action. For McClelland, the main advantage of potentiation in explaining action selection is speed: when an action is selected from the menu of represented affordances, motor patterns have already been automatically and unconsciously prepared, and therefore we can perform the 'selected action much more quickly than if we were starting from scratch' (410).

McClelland's menu of possible actions is also supposed to capture our phenomenology. In the quote given earlier, McClelland describes how automatic processes 'present us' with the menu of affordance. The link to experience is made explicit in the following quote:

> *We experience* a menu of possible courses of mental action, some of which are automatically readied prior to selection, and many of our mental actions follow the offerings of this menu. (413, emphasis added)

We now discuss three arguments against McClelland's proposal. First of all, it is hard to see how to make sense of the metaphor of a menu that is *experienced* and selected from. Acting on affordances in our everyday life is phenomenologically quite distinct from choosing a dish of the menu in a restaurant. For example, in performing our morning routine, the affordances for making breakfast, sitting down at the table, and reading the newspaper are all present at the same time, yet we rarely have to deliberate what to do first. The root problem seems to be that McClelland models all action selection after the deliberative process we only sometimes go through in determining what to do next. It is certainly the case that sometimes something like McClelland's menu plays a role in action selection, for example when we make a to-do list to organize our daily activities and remember important tasks. We might check this list to decide what to do next. Such a list, however, is not handed to us by automatic processes: we need to create it ourselves. Although we sometimes employ these strategies for deciding what to do next, such a decision process is not involved in *all* everyday moment-to-moment action selection.

Second, we think McClelland's proposal comes dangerously close to what Dennett calls Cartesian materialism. Dennett (1991, 107) defines Cartesian materialism as the view that there is a finish line somewhere in the brain, a special center, where sensory streams come together and consciousness takes place. The order of arrival of sensory streams at this finish line equals the temporal order of experience 'because what

happens there is what you are conscious of' (ibid., 107). As Dennett argues, such a view of consciousness requires there to be somebody to perceive what is presented at the finish line, leading to a vicious regress. McClelland's proposal that there is a menu of possible action that simultaneously forms an interface between perceptual and post-perceptual processes, *and* captures our phenomenology seems to fall prey to Dennett's criticism. This is further exemplified in McClelland's recurrent phrasing that perceptual processes 'present us' with a menu of possible actions. *We* are the entities that are perceiving the menu, which means that *we,* qua intentional subjects, are located after the automatic perceptual processes.

Third, an analogous issue arises in McClelland's definition of action. He defines actions as 'those things a subject does that are under her intentional control' (403). This leads to a distinction between *actions* and *mere movements,* where movements are not controlled by the subject. A subspecies of actions are *non-intentional actions,* which are those movements that are not currently controlled, but are controllable in principle. To have (intentional) control is understood as 'to be able to continue or terminate [what you are doing] at will' (403). However, to terminate an action *at will,* or to continue it *at will*, surely are intentional actions themselves. This means McClelland's defines intentional actions in terms of more intentional actions. Not only is this view philosophically problematic, it also leads to bad theorizing in cognitive science: it involves a 'loan of intelligence' (Dennett 1978), where the intelligent aspects of the process to be explained are 'borrowed' from the intelligence attributed to another, yet to be explained, process. In other words, by positing a subject that is presented with a menu of possible actions and that is able to select which of these actions to pursue at will, McClelland shifts rather than solves the problem of action selection.

We think the three issues facing McClelland's model arise because he sees affordance perception and action potentiation as merely facilitating action selection. His proposal does not deal with action selection proper, as that is relegated to an internal selecting subject. The question is whether such a 'loan of intelligence' can be paid back. McClelland may retort that there is in fact empirical support for the kind of division of labor assumed by his proposal. McClelland cites the affordance competition hypothesis of Cisek and Kalaska (2010) as supporting his proposal.[3]

[3]We agree with McClelland that it is important not to conflate the affordance in the environment and the 'affordance-related motor pattern'. A better, though less enticing, name for Cisek and Kalaska's proposal would perhaps be 'the affordance-related motor pattern competition hypothesis'.

However, in what follows, we argue that this hypothesis does not support McClelland's division of labor, nor the idea that action selection can be conceptualized as selecting from the outputs of perceptual processes.

2.2. Action selection as competition

Cisek and Kalaska (2010) aim to find out which neural architecture can accommodate a wide range of 'neurophysiological data about *voluntary* sensorimotor behavior' (270, our italics). They contrast a serial information-processing neural architecture with an ecological neural architecture. The serial information-processing architecture is characterized as involving a sequential separation between perception, cognition and action: 'We sense the world, think about it, and then act upon it' (270). The ecological neural architecture is inspired by ecological psychology, in which the concept of affordance originates. This architecture revolves around the questions of action specification – understood as 'the process of specifying the spatiotemporal aspects of possible actions' (277) – and action selection. The authors consider the possibility that 'at least during natural interactive behavior, these processes operate simultaneously and in an integrated manner' (277). In other words, whereas the information-processing architecture involves dissociable and serial processes of perception, action selection and action execution, the ecological architecture explains action specification and action selection through a set of competing motor patterns.

Cisek and Kalaska (2010, 275) conclude, after discussing a host of empirical evidence, that the ecological architecture is 'much more useful for guiding interactive behavior' than a serial architecture that involves processes that 'first construct an accurate internal description of objective and abstract knowledge about the world and then reflect upon it with some introspective, intelligent circuits' (275). Furthermore, they conclude that the decision making involved in action selection 'does not appear to be localized within particular higher cognitive centers' (273). Rather, 'decisions appear to be made through a distributed consensus that emerges in competitive populations' (290). Importantly, these competitive populations of neurons are hypothesized to be motor patterns, which means they are the very same populations that are involved in the execution of a movement.

It is therefore hard to see how McClelland can find support in Cisek and Kalaska's work for the 'fruitful division of labor' between automatic perceptual processes and action potentiation, and deliberative post-

perceptual processes. In fact, the exact opposite conclusion is reached by Cisek and Kalaska. Competition between affordance-related motor patterns is not helping with, but doing the action selection. The authors do not present an account of relevant action possibility presentation for an internal selecting subject, as suggested by McClelland, rather they present a wholesale distributed account of action selection.

To summarize, following the affordance competition hypothesis, there is no clear separation between affordance perception and action selection. Similarly, there is no separation between action selection and action potentiation. Action selection happens through a competition between the very same motor patterns that prepare the execution of an action.[4]

2.3. Competition and control

How does the affordance competition hypothesis hold up to the three arguments we leveled against McClelland's proposal? First of all, we identified the phenomenological implausibility of the menu of affordances. As the affordance competition hypothesis concerns action selection rather than phenomenology, it does not, in and of itself, specify what we experience. There are however other proposals in the literature that concern the experience of affordances that we take to be in line with our reading of Cisek and Kalaska.

In order to think about the experience of affordances, it is crucial to see that they are not mere neutral possibilities for action. As discussed by McClelland, theorists of affordances have introduced the concept of solicitation to refer to affordances that have an inviting character (Dreyfus and Kelly 2007; Withagen et al. 2012). How strongly a solicitation invites behavior, is based on a person's skills (the large boulder affords lifting for the weight-lifter, but not for the authors of this text), the activity one is currently engaged (the cup of tea affords drinking while reading the newspaper, but not while running on the home trainer), and the demands of the current situation (the philosophical text does not afford reading if one is bicycling through a thunderstorm).[5]

[4]Cisek and Kalaska are explicit that their review addresses interactive sensorimotor behavior and is not to be seen as a general theory of brain functioning. They leave it as an open important question how higher cognitive abilities are related to this kind of sensorimotor behavior. We return to this question in the next Section.

[5]The inviting character of multiple affordances simultaneously has been characterised as a *field of affordances* (de Haan et al. 2013; Rietveld and Kiverstein 2014).

The paradigmatic phenomenology of action selection, on such an account, is not one of making a deliberate decision, but rather of giving in to the demands of the situation. Dreyfus and Kelly (2007, 52, our emphasis) describe:

> We sense the world's solicitations and respond to their call all the time. In backing away from the 'close talker', in stepping skilfully over the obstacle, in reaching 'automatically' for the proffered handshake, we find ourselves acting in definitive ways *without ever having decided to do so*. In responding to the environment this way we feel ourselves giving in to its demands.

This of course leaves open the question how such an approach could account for the kind of action that is controlled and requires more of our cognitive capacities than stepping over obstacles and reaching for offered handshakes. We reflect on the question of control when we reach point three below.

Second, we argued that McClelland's proposal came close to a Cartesian materialism. Cisek and Kalaska's (2010) affordance competition hypothesis, however, is in line with Dennett's (2001) fame-in-the-brain response to the problems faced by Cartesian materialism. Both models reject the idea that there is one place in the brain where 'everything comes together', and substitute this for a metaphor of processes that are distributed across the brain and are in competition. Hence, unlike McClelland's proposal, the mental affordance competition does not fall prey to the worry of Cartesian materialism. Of course, our reflections so far have done nothing to explain consciousness per se, and we make no claim to do so. The only conclusion reached here is that a theory of experience that would start from the affordance competition hypothesis evades this particular objection of Cartesian materialism.

Third, we argued that McClelland's proposal took out a loan of intelligence because the menu metaphor implies a selecting subject located after perceptual processes that performs the actual action selection. Cisek and Kalaska's account of action selection makes this selecting subject superfluous, and thereby avoids the loan of intelligence. At the same time, their model does not provide a philosophical conception of action. We agree with McClelland that an account of action in terms of control is promising because it can be fruitfully applied across philosophy, psychology and cognitive (neuro-)science. There is, however, a different way of thinking about control that is in line with the affordance competition hypothesis.

Eisenreich, Akaishi, and Hayden (2017) argue that there are two ways to make sense of control: *modular* and *distributed control*. Modular control assumes that the controller is a module that is external to the controlled process. Importantly, the controller has access to some information or capacities that the controlled process has not. It might have access, for example, to the agent's long-term goals, intentions and monitor whether the controlled process proceeds in agreement with those goals. Such modular approaches to control have a long history in philosophy of mind and cognitive science, both in classically modular approaches to cognition (Fodor 1983) and in connectionist models (Botvinick and Cohen 2014).

Distributed control is a form of control in which the controlled and the controlling process are the same. Control is distributed over the system that is controlled, or, in other words, control is a form of self-organization. A well-known example from the literature is bird flocking. Each individual bird acts on their immediate environment only, for example by avoiding collisions and aligning with neighbors. But the flock as a whole exhibits complex forms of movement that cannot be reduced to individual birds. In the flock of birds, there is control without a controller: the trajectory and shape of the flock is controlled without any of the birds being in charge. In this way, control emerges from the interaction of components. Eisenreich, Akaishi, and Hayden (2017) show how a number of typically cognitive phenomena such as initiation and inhibition, speed-accuracy tradeoffs and conflict resolution can be modeled as distributed control systems. Furthermore, distributed control is introduced in the literature on executive control (the psychological construct that comes closest to intentional control) to explicitly overcome the 'loan of intelligence' taken out by modular approaches (Abrahamse et al. 2016; Braem and Hommel 2019).

Note that we cannot develop a general account of distributed control in the context of a theory of action in this paper (but see Juarrero 1999; Reed 1996; Withagen et al. 2012). What we can say here is that a move to distributed control suggest a change of metaphor for thinking about intentional control in action. From a distributed perspective, control is about being attuned to the particularities of the situation. For example, a surfer that is in control has the perceptual skills to pick out the relevant currents, the speed of the wave, and so on. At the same time, the surfer cannot initiate surfing *at will*. She can only ride the waves.

3. Mental and bodily action

Although McClelland's main motivation lies in the neglect in the literature of affordances for *mental* action, he does not spend a great deal of time introducing the distinction between mental and bodily that is at the heart of his proposal. He does however provide a succinct definition of mental events: 'Mental events can be distinguished from bodily events by their being *covert*: they involve internal changes to our mental states and do not essentially involve any physical movement (Metzinger 2017)' (4). Based on this definition, those mental events that are under intentional control, or intentionally controllable, are mental actions. On a literal reading of McClelland's definition, only a Cartesian dualist could claim there is mental action, for anybody that believes that the mind supervenes on physical processes will have to hold that mental action involves physical movement of some kind, even if only of molecules in the brain. However, as we do not believe McClelland intends to espouse a form of substance dualism, we will read 'physical movement' as 'observable bodily movement' (cf. Levy 2019).[6]

This distinction perhaps seems plausible at first sight: bodily actions, such as climbing a tree or grasping a cup essentially involve bodily movement. If my body doesn't move, I cannot climb a tree. And there are actions that do not essentially involve such movements: I can ascertain that five plus three is eight without moving my body. We will argue however, relying on McClelland's examples of attention, counting, and imagination, that cashing out the distinction between mental and bodily in terms of covert/overt has some unintended consequences, and is at odds with the concept of affordances.

3.1. Attending affordances

We can see how the distinction between mental and bodily action gets put into practice when McClelland discusses affordances for (visually) attending. He describes the situation in which there is a flashing light in your office that, in McClelland terms, is *focally attendable*. While trying to remain focused, the flashing light in the periphery of your vision draws your attention. At the same time, attending often involves bodily movement: we turn our body, move our heads, and squint our

[6]This reading is supported by the fact that McClelland cites Metzinger (2017), who remarks that 'Mental actions belong to the internal, covert output of some information-processing systems' (p. 2) that 'mostly lack overt behavioral correlates' (p. 3).

eyes in order to attend to objects. McClelland considers the question whether these considerations entail that attending is not a mental act:

> But is attending a mental act? Overt attention is the *bodily* activity of directing one's sense organs toward a particular stimulus, property or region. Covert attention is the *mental* act of concentrating on a particular perceived stimulus, property or region. It might be objected that when a stimulus affords attention it only affords *overt* attention, thus the warning light affords the bodily act of directing one's eyes toward it. I would respond that although stimuli can indeed afford overt attention, they *also* afford covert attention so still qualify as mental affordances. After all, what makes the warning light distracting is that it pulls one's *concentration* away from one's work, not just one's eyes. (417, emphasis in original)

While this distinction between overt and covert attention makes conceptual space for the mental act of attending, this discussion of attention is problematic. In particular, the distinction between overt and covert attention, originating from the literature on attention on which McClelland draws, does not support the distinction between bodily and mental action that McClelland makes.

Within the attention literature, the distinction between overt and covert attention was introduced to make a distinction between two kinds of attention. Traditionally, psychologists assumed that a shift in attention was necessarily effectuated by observable orienting behavior, such as eye and head movements. On this view, there could be no shift in attention without bodily movement that shifts the fixation point of the eye to the attended region. Going against accepted wisdom, Posner (1980) introduced the idea of covert attention to refer to the ability to shift attention without observable movements, that is, to the ability to attend to something outside the fixation point of the eyes. The possibility of covert attention 'eliminates the idea that attention and eye movements are identical systems' (Ibid., 13). At the same time, according to Posner, covert attention 'is revealed only under the close experimental control of the laboratory' (Ibid., 9); in everyday attention there is a functional relationship between attention and eye movements, such that they are closely coupled. Overt attention is not introduced as a form of attention that is somehow non-mental: orienting attention, whether it involves movements of the eyes or not, is always and everywhere a 'mental operation' according to Posner (4).

At this point, much hangs on how we should read 'essentially' in McClelland's definition of mental action as not essentially involving bodily movement. McClelland could argue that the possibility of covert

attention shows that bodily movement is not essential for a shift in attention, and that bodily movements are therefore not part of the mental act of attending. In the case where I am distracted by the warning light, my eye movements would thus not be a part of the mental act of attending, but merely an inessential addition to the essentially covert attending act. If McClelland were to take this line, there would be no bodily act of attention at all, as bodily movements would always only be an inessential aspect of a primarily mental act of attending. If the bodily movements are not accompanied by covert attention, such as when one directs one's sense organs when absent-mindedly staring into space, these bodily movements are not properly described as bodily attention. As McClelland rightly remarks, only if directing your sense organs draws your concentration with it, is this observable activity properly described as attending.

Alternatively, McClelland could bite the bullet and claim that there are two kinds of attending acts. One is covert and therefore mental, whereas the other is overt and therefore bodily. But this line of argument runs into another problem: it now becomes an empirical question whether *mental* attention exists at all. In the literature, it has been suggested that microsaccades might be required for covert attention shifts (Barnhart et al. 2019; Engbert and Kliegl 2003; Hafed and Clark 2002; Rolfs 2009; Ryan, Keane, and Wallis 2019; Yuval-Greenberg, Merriam, and Heeger 2014). In this usage, 'covert attention' does not mean a shift in attention without eye movements, as microsaccades *are* eye movements, but instead follows Posner's definition of covert attention as 'attention to a position in visual space other than fixation' (Posner 1980, 3). The debate on the role of these microsaccades in covert attention is far from settled. However, if it would turn out that microsaccades are essential for covert attention, in the sense of attention to a non-fixated position, this would entail that covert attention is not covert in McClelland's sense, for microsaccades *are* bodily movements. This in turn would mean that all (visual) attention would essentially involve bodily movements.[7] Given McClelland's definition, this possible empirical finding would make all (visual) attention non-mental. A strange conclusion indeed.

[7]In this section, we have focussed on visual attention. There is some evidence that microsaccades are involved in non-visual forms of attention as well (Driver and Spence 1998; Braga et al. 2016). Thanks to an anonymous reviewer for pointing this out.

3.2. The embodied mind

Let us take a step back. Affordances are paradigmatically used in explaining bodily activities, such as gripping, climbing, or stepping. McClelland claims that affordances can be fruitfully applied to explain mental actions as well, such as attending, counting, and imagining. We agree. What we object to is the idea that mental actions should be *defined* as being covert. The discussion of attention brings out why this is the case. The distinction between overt and covert attention was never meant to mark a distinction between a bodily activity and a mental activity: even when it includes bodily movements, attention is a mental act according to Posner.

An analogy arises here between McClelland's account of action selection discussed in the previous Section, and his distinction between bodily and mental action. Both seem to express a latent Cartesianism. In the case of action selection, this was evident in the idea that selection occurs by a selecting subject on the basis of the outputs of perceptual processes – McClelland's menu metaphor. In the case of the distinction between bodily and mental action, Cartesianism resurfaces as the idea that mental action is tucked away in the head, invisible to outside observers.

While discussing action selection, we argued that Cisek and Kalaska's affordance competition hypothesis is best understood in term of the distributed competition of neural patterns, thus dissolving the distinction between processes of perception and selection in the brain. In the case of the distinction of the body and the mind, a similar dissolution of the distinction is warranted. Dennett (2001, 225–226) explains, based on the seminal work of Susan Hurley:

> Hurley (1998) makes a persuasive case for taking the Hard Question seriously in somewhat different terms: the Self (and its surrogates, the Cartesian *res cogitans*, the Kantian transcendental ego, among others) is not to be located by subtraction, by peeling off the various layers of perceptual and motor 'interface' between Self and World. We must reject the traditional 'sandwich' in which the Self is isolated from the outside world by layers of 'input' and 'output'. On the contrary, the Self is large, concrete, and visible in the world, not just 'distributed' in the brain but spread out into the world.

In other words, Hurley and Dennett urge us to reconsider the Cartesian picture: instead of thinking of the mind as a covert 'thing', modeled on the Cartesian idea of a non-extended *res cogitans*, only connected to the outside world by perceptual inputs and motor outputs, they propose a view in which the self is distributed in space and time,

spread out beyond the body and brain into the world. Overcoming the distinction between body and mind is exemplified in the name of the research program in which the study of affordances is usually located: embodied cognition.

For an embodied alternative to McClelland's analysis of attention, we can turn to Ryle (1949, 119ff). Suppose there are two different people: the first attentively moves his eyes to the flashing warning light, whereas the second is trying to remember something and absently mindedly stares into space, in such a way that he accidentally looks in the general direction of the flashing warning light. This distinction can be described, as we have just done, in adverbial terms. *Absent-mindedly* and *attentively* are *ways* of moving your eyes that have a different dispositional profile.

This dispositional profile is crucial for distinguishing between someone who is paying attention and someone who is not. Ryle argues (1949, 124) that saying of someone that she is paying attention to something means to say that she is ready to engage in a variety of associated tasks, as well as the task she is currently engaged in. In the case at hand, the 'task' involved in attending to the light is not very clearly described, something which is very often the case in our day-to-day behavior. Yet, we can formulate plausible predictions for the two cases. If the alarm light, for example, stopped flashing, we would expect the person attending to notice this and be relieved. *Back to work*. The person whose eyes absent-mindedly wandered on the flashing light might not even notice that it stopped flashing, as their attention is focused on their remembering.

We could also ask the person what they were just looking at. In the case where their eyes absent-mindedly wandered they would presumably answer 'nothing, I was just trying to remember something', whereas in the case they were attending the flashing light, they would know that it was the flashing light that caused them to be distracted from their work. In fact, it was only possible for Posner (1980) to investigate covert attention by relying on participants reporting on consciously detecting certain events.

Note that in foregrounding behavioral criteria we do not mean to say that there are no important differences between the two cases in terms of 'covert' factors such as neural activity. In fact, explaining the difference in dispositional profile between the attentive and absent-minded case presumably involves reference to neural factors. But these 'covert' processes cannot be *criteria* for deciding whether someone is indeed attending. Suppose we find some neural process that is always present in people

that are paying attention. If we then detect that neural process in a person who has directed their eyes at the flashing light, but find out that she is unable to report on what she is looking at, is irresponsive to perceivable changes in the attending thing, and so on, we would not say of that person that she is paying attention.

Instead of taking the mental act of attending as a covert process, we can say, with the embodied cognition theorists and Ryle, that paying attention is an embodied way of relating to the world. On this alternative perspective, body and mind are not two distinct things; rather, our embodied activity is minded, which means that our behavior has a certain organization that can be identified by its dispositional profile. With this embodied perspective, let us look at the second example of mental affordance discussed by McClelland, affordances for counting.

3.3. Counting on affordances

Like in the case of attention, counting is often accompanied by bodily movements, such as pointing at objects, producing vocalizations, and so on. In order to substantiate his claim that we perceive affordances for counting, McClelland discusses the phenomenon of utilization behavior, in which patients are compelled to count out loud. In a footnote, McClelland (2020, fn. 10, emphasis added) remarks the following:

> One might claim that it is this bodily act [counting out loud] that is afforded rather than the mental act of counting. However, the burden of proof would be on the objector to say why this is so. *Ordinary subjects perform these bodily acts to assist a mental act of determining how many of something there are, and there is no obvious reason to doubt that the patient is doing the same.* Put another way, the patient is most likely compelled to make bodily gestures that aid counting precisely because she is compelled to perform the mental act of counting.

There is, of course, an obvious reason why patients with utilization behavior might not do the same as ordinary subjects. Their actions are out of sync with their concerns, the context and involves the most stereotypical response to a given affordance (Rietveld 2012). If a patient is compelled to count, it is precisely *not* obvious that her counting is assisting the mental act of figuring out how many of something there are. Regardless, McClelland presents counting as a mental action that consists only of covert processes. For him, observable bodily movements, such as gestures and vocalizing numbers, are not an essential part of this action, they are merely assisting the actual counting that is taken place behind the scenes.

McClelland's definition of counting as covert action seems difficult to maintain in the light of developmental considerations. For a child that is just learning to count, bodily movements are essential for counting. If the child cannot use their fingers, they are unable to count. If we were to follow McClelland's definitions, this would mean that counting starts out as a bodily action, only to become a mental action once a child is capable of counting without using their fingers. A strange conclusion indeed.

This developmental argument can be extended to other mental actions of adults. Compare the multiplications '7×9' and '17634×4321'. Both inscriptions afford an arithmetic action. The first can be performed by most people without moving their bodies. At the same time, many people will only be able to solve the latter multiplication if they can make use of pen and paper or other tools. Again, we can wonder whether this means that only solving the first multiplication should count as a mental action, whereas solving the latter multiplication is a bodily action.

In support of his view of counting as a mental action, McClelland cites the idea that we have a special brain region that only deals with arithmetic without being implicated in bodily acts (Dehaene et al. 2004).[8] Here McClelland builds on the idea that the brain is organized in a modular fashion, with special modules that are responsible for arithmetic, language, and so on. This modular view of the brain is in line with McClelland's distinction between automatic and deliberate brain processes discussed earlier. Perception and motor control, on a modular view, are oftentimes portrayed as peripheral modules, whereas deliberate cognitive actions such as using language and making calculations are thought to depend on central modules that are independent of our sensorimotor interaction with the environment (Fodor 1983).

It is however an open question whether the brain is indeed organized in such a modular fashion. While it goes too far to discuss the empirical evidence with respect to this question, we want to briefly introduce an alternative neurocognitive framework that, like the affordance competition hypothesis, is deeply rooted in ecological psychology.[9] According to the neural reuse hypothesis (Anderson 2014), 'higher' cognitive functions, such as using language and doing arithmetic, depend on functional coalitions of the very same circuits that initially evolved for sensorimotor

[8]It must be noted here that counting and arithmetic are distinct abilities.
[9]Anderson (2016) takes the neural reuse hypothesis to be compatible with the affordance competition hypothesis.

interaction. Hence, it is not the case that 'higher' cognitive functions and more basic sensorimotor functions are located in different areas in the brain. Instead, higher cognitive functions reuse neural circuitry involved in sensorimotor interaction.

McClelland's discussion of imagination has affinities with the neural reuse hypothesis. He presents imagined bodily acts as ''offline performances' of bodily acts' (419). Just as perceived situations can potentiate bodily actions, they can similarly potentiate imagined bodily actions. The question is how we should think about the potentiation of imagined bodily actions. One obvious and parsimonious hypothesis, supported by both developmental and neural evidence, is that the motor pattern that is potentiated for *covert* action is the same motor pattern that would have been potentiated if the action were overt. In this way, imagination of bodily action reuses the neural circuitry involved in potentiation and execution of the imagined action. This implies an intimate connection between the bodily and the mental action: the mental act of covert counting is dependent on the bodily act itself.

This view of imagination can be used to understand a wider class of mental activities. For example, covert acts of counting can be understood as relying on the motor patterns involved in overt counting. Evidence for this hypothesis can be found in the literature on counting. For example, people who start counting on their left hand show activation in the right hemisphere when presented with small digits, despite the absence of overt finger movements, whereas the reverse holds for right-hand starters (Tschentscher et al. 2012). The relationship between mental action and finger movements extends beyond counting to arithmetic abilities. For example, *finger gnosis* (the ability to recognize and localize one's fingers) is a predictor of math performance both in children (Costa et al. 2011) and in adults (Penner-Wilger and Anderson 2013).

McClelland's conception of the mental as covert makes sense on a modular understanding of the brain. On this view, arithmetic occurs in the arithmetic module, and the bodily movements are merely inessential additions. According to neural reuse, arithmetic does not happen in a specialized module. Instead, our abilities for doing arithmetic are structured and sculpted from basic sensorimotor abilities (Anderson 2014, 232ff; Myin and van den Herik 2020). Thus, the rationale for equating the mental with covert disappears: the functional coalitions that are involved in counting may or may not involve extra-neural partners, including states of the body (such as finger movements) and of the environment (such as pen and paper).

To sum up: the neural reuse account denies that there are two separate acts instrumentally related to each other, such that a bodily acts assists a mental act. Instead, it shows how paradigmatic mental acts such as imagination, counting, and arithmetic are dependent on sensorimotor interaction with an affording environment. Rather than make a clear distinction between bodily and mental action, neural reuse highlights the embodied nature of our mental action.

4. Conclusion

There is something deeply right about McClelland's claim that 'we are sensitive to affordances for mental action in much the same way as we are sensitive to affordances for bodily action' (401). The concept of affordance was introduced by James Gibson in order to radically rethink the nature of mind. Minds are not cut off from the world, tucked away behind the sense organs, but are 'large, concrete, and visible in the world' (Dennett 2001, 226). In this paper we have argued that this radical insight should be preserved when considering affordances for mental action.

The paradigm of embodied cognition aims to furnish us with a naturalistic understanding of mind. By understanding the mind as embodied, we can show how complex human forms of cognition have gradually evolved out of more basic sensorimotor interactions with the environment. In telling this story, there is no place for a qualitative dichotomy between the bodily and the mental. *Natura non facit saltus*. Instead, our mind emerges from, and is continuous with, our embodied interactions with the world. Only when we can provide this continuous story will we be able to give a parsimonious explanation of mind without taking out loans of intelligence.

These considerations hold also in the case of thinking about the role of the brain. We argued that if we want to start from the Affordance Competition Hypothesis, we need to rethink the notion of control as being distributed across the brain – and perhaps even beyond the brain into the body and environment. Writing about the assumption that motor control and cognition involve different kinds of brain processes, Patricia Churchland (1986, 451) remarks that if 'we look at matters from an evolutionary and neurobiological point of view, the assumption is not only naive, it in fact trammels the theoretical imagination.' We wholeheartedly agree.

At this point in time, it is an open question whether an embodied perspective on mind that builds on the notion of affordances will be able to

account for all human forms of cognition. It will require considerable theoretical imagination and empirical work to tell this story in its entirety. In this paper we have argued that if this story is to be successful, it should refrain from reintroducing the very distinctions that embodied cognition was supposed to overcome.

Acknowledgements

We would like to thank Ludger van Dijk, Regina Fabry, Max Jones, Julian Kiverstein, Richard Menary, Erik Rietveld, Tom Schoonen, Mark Slors and Maarten van Westen as well as an anonymous reviewer for providing feedback on an earlier draft of this paper.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

Both Jelle Bruineberg and Jasper van den Herik were supported by the European Research Council (ERC Starting Grant, 679190, awarded to Erik Rietveld). In addition, Jelle Bruineberg was supported by a Macquarie Research Fellowship.

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