The Bounds of Embodied Cognition

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Abstract: This paper explores the relationship between embodied and extended cognition. In particular, I argue against Michael Wheeler's argument that embodied cognition implies extended cognition, given functionalism. I do so by appropriating insights from the related research programme of enactive cognition. I use these insights to show how we can accept embodied cognition and functionalism, while rejecting extended cognition. In doing so, I conclude that the relationship between embodied and extended cognition is not as clear cut as Wheeler, and other proponents of extended cognition, would have us believe.

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Introduction

The Cartesian image of the mind as a disembodied substance has long been in doubt. Yet, classical approaches in the cognitive sciences have often treated cognition as something separate from the body. This can clearly be seen in the computational approach wherein cognition is viewed strictly as an information processing system (Haugeland, 1985; Walmsley, 2012). In this view, cognition is the "software" that runs on top of the "hardware" – the brain (Block, 1995), while the body is viewed as a peripheral system that only makes an impoverished contribution to cognition. However, a recent trend has developed which challenges this conception; under the heading of embodied cognition, this new trend elevates the body's role in cognition (e.g. Varela, Thompson, & Rosch, 1991; Thompson, 2007; Walmsley, 2012). In addition, some scholars have claimed that not only is the body intimately and significantly involved in shaping cognition, some objects in the environment also deserve equal credit. Under the heading of extended cognition, this approach claims that cognition is not limited by the boundaries of the body; rather, it extends to certain objects in the environment (Clark & Chalmers, 1998)[1].

However, both embodied and extended cognition are controversial topics within contemporary debates in philosophy and cognitive science, with the latter being more so than the former. It seems as though people (especially working scientists) are more willing to accept that cognition is embodied than extended. However, there have been few to ask (let alone answer) why this is the case. This leads to an important question: what is the relationship between the two? Michael Wheeler (2011) has recently argued that construing embodiment from a

[1] The original term that Clark & Chalmers used was "extended mind", rather than "extended cognition". However, contemporary debates have focused solely on cognition (memory in particular), although there are those who use both cognition and mind concurrently (e.g. Menary, 2010). As such, for the sake of terminological consistency and simplicity, I will only talk about extended cognition, and say nothing more about extended mind.

functionalist perspective necessarily leads to extended cognition. In this paper, I will argue against Wheeler's argument by showing how a person can accept embodied cognition and functionalism while rejecting extended cognition. My discussion is in four major parts. In section 1, I will begin my discussion by briefly defining embodied cognition and describing a distinction Wheeler makes about two kinds of embodiment. In section 2, I will give a brief summary of the debate surrounding the parity principle, one of the main motivations behind extended cognition. In section 3, I will summarize Wheeler's defense of the parity principle, and its significance for his thesis. Finally, in section 4, I present my critique of Wheeler's argument by drawing on insights from the related research programme of enactive cognition.

1. Embodied Cognition

Over the past two decades, embodied cognition has provided a useful framework for research in cognitive science and psychology (Wheeler, 2011). In brief, embodied cognition is,

> "The theoretical idea that cognitive processes […] are strongly influenced and guided by the fact that we inhabit bodies that interact with the world in certain ways. That is, our bodily interactions with the world are incorporated to how we think about things" (Radvansky, 2011, pg. 354).

Wilson and Foglia (2011) note that there are three different ways embodiment can be realized: as a constraint, distributor, or regulator of cognition. In the first sense the body limits the type of cognitive processes that humans have. The information that we receive from the world will be constrained by our bodies, and the output that is a result of that information will also be constrained by our bodies. If we had, for example, a set of parts that allowed us to expand the visible light spectrum, or if we had the ability to fly, we would be taking in information and using it much differently than we are now. In the second sense, cognitive processing is spread

throughout the body and brain. For example, as children, we may use our hands to help us count and solve simple math problems; instead of doing the entire process in our heads, we use our fingers to "off-load" some of the work. The last sense construes the body as the mediator between cognition and action (e.g. playing tennis - wherein the act of swinging, versus thinking about swinging, the racquet is mediated by the body).

Evidence for embodied cognition can be illustrated by looking at the role of gesturing in memory. In one study, adults and children were instructed to explain how to solve a math problem while memorizing a list of words. In one group, the participants were not allowed to gesture while explaining the math problem. In the other group they were allowed. The results showed that the second group remembered significantly more items in the list of words compared to the first. The researchers concluded that gesturing lifted some of the cognitive load of explaining the math problem such that the participants had more cognitive resources to allocate to remembering the items on the list (Goldin-Meadow, Nusbaum, Kelly, and Wagner, 2001). Notice how the act of gesturing constrains (if our hands were shaped differently, we may not be able to do this, or even do it better), distributes (by off-loading some of the cognitive work), and regulates (the action of gesturing) cognitive processing.

1.1 Two Kinds of Embodiment

In light of the examples given above, Wheeler asks how, "[…] in general terms, are we [to] conceptualize the fundamental contribution of the body to cognitive phenomena?" (pg. 226). In order to answer this question, Wheeler appropriates Clark's (2008) distinction between two kinds of embodiment.

> "One […] depicts the body as intrinsically special, and the details of a creature's embodiment as a major and abiding constraint on the nature of its mind: a kind of new-

> wave body-centrism. The other depicts the body as just one element in a kind of equal-partners dance between brain, body and world, with the nature of the mind fixed by the overall balance thus achieved: a kind of extended functionalism (now with an even broader canvas for multiple realizability than ever before)." (Clark, 2008, pg. 56 – 57)

For the purposes of his argument, Wheeler makes his own distinction between two kinds of materiality. *Vital materiality* is the claim that that there are some physical objects in the world such that their composition and role is significantly important (to whatever function they happen to be a part of) and could not be replaced under any circumstance. *Implementational materiality*, on the other hand, is the claim that there are physical objects in the world that are merely placeholders such that, given the right circumstance and object, they could be replaced without terminating whatever function they happen to be a part of. In regards to embodiment, vital materiality is supposed to align with Clark's first distinction, while implementational materiality with the second. However, to fully understand the relevance of this distinction we must first go over the theory of *functionalism*, for as we will see later, functionalism will be the lynchpin Wheeler uses in his transition from embodiment to extension.

1.2 Functionalism and Embodiment

In general terms, functionalism is the claim that what makes something the type that it is has less to do with the material of its physical constitution and more to do with the function it plays (Dennett, 1996). For example, a soda dispenser machine is the type that it is (a machine that dispenses soda) not because of the material of the physical constitution that it has (usually of metals and plastics); rather, it is due to the function that it plays (dispensing soda). We can easily imagine a scenario wherein a soda dispenser machine is built out of wood instead of metals and plastics. This new machine would still be of the same type as the previous machine by virtue of

the fact that its function is the same. The fact that it is made out of wood is irrelevant. In philosophical jargon, functionalists often state that such objects (with the ability to be realized by different materials) admit *multiple realizations* (Dennett, 1996)[2]. Important to note is the fact that functionalism implies multiple realizability (in principle)[3] and vice versa. Furthermore, Wheeler notes that the type of functionalism that he uses is not the sort that is usually used in philosophy; that is to say, he is not interested in personal-level explanations, which is "[…] concerned with the identification and clarification of agency" (pg. 226). Instead, he uses functionalism in regards to sub-personal explanations, which is "[…] concerned with mapping out the states and mechanisms (the parts of agents, as it were) that causally enable personal-level phenomena" (pg. 227). For example, a belief is a personal-level phenomenon, while the various neural processes (and potentially other factors) that cause the belief are sub-personal level phenomena.

Wheeler argues that there is a strong connection between functionalism and implementational materiality. To see this, recall that implementational materiality states that there are physical objects in the world which are contingent placeholders for functions. Notice how similar this sounds to the idea of multiple realizability, wherein a specific type admits multiple realizations if it can be realized by different materials/objects. Given this similarity, Wheeler concludes that implementational materiality implies multiple realizability and vice versa. Given that multiple realizability implies functionalism, it follows that implementational materiality also implies functionalism. Therefore, taking an implementational view on the body necessarily takes a functionalist view as well. In other words, the body, as per multiple

[2] This was not meant to be an exhaustive summary of functionalism; rather, I have described functionalism in the sense that Wheeler uses for his argument.

[3] It is possible that functionalism does not imply multiple realizability about a specific type, given that, as a matter of contingent fact about the physical world, the type's functions can only be implemented by a specific object with a specific physical composition. However, in principle (given that the laws of the universe were different) it would still be possible for multiple realizability to occur.

realizability, is only partly implementing certain cognitive states and processes, such that it could (in principle) be replaced by other materials/objects given that such materials/objects can implement the same functions.

Vital materiality is opposed to implementational materiality, and as such, it is opposed to functionalism as well. For Wheeler's argument to work, implementational materiality must be true. However, as Wheeler notes, the empirical evidence used in support of embodied cognition puts vital and implementational materiality on equal footing.[4] To escape this impasse, Wheeler suggests that, "[…] we have no option right now but to look beyond the thought that the understanding we seek may be directly read off from the available science" (pg. 229). Instead, Wheeler argues that we can attain the soundness of implementational materiality by defending a common argument for extended cognition – the *parity principle*.

2. Extended Cognition

A complete understanding of Wheeler's defense of the parity principle requires knowledge of the debate surrounding it. As such, in this section I will give a brief summary of Clark & Chalmers' original argument for extended cognition, along with some relevant criticisms.

2.1 The Parity Principle

Just like with many other positions in philosophy, the theory of extended cognition is motivated by a central thought experiment. Clark & Chalmers asks us to imagine two individuals, Otto and Inga. Otto carries around a notebook which effectively acts as his long term memory storage. Otto does so as a result of being afflicted with a form of Alzheimer which prevents him from remembering crucial information. Inga on the other hand is a normally

[4] Wheeler provides an argument for this claim in his paper (pg. 228 – 229); however, the truth of his claim does not concern us here and, as such, will be assumed as correct for the sake of argument.

functioning human being whose long term memory processing occurs in her brain. Now imagine Otto and Inga are walking down a street in New York where they happen to come by a poster advertising a new exhibit at the Museum of Modern Art. Supposing both are avid modern art enthusiasts and have a desire to see the exhibit that same day, how would they go about remembering the address of the museum? Inga, just like most of us, would think about it, and then remember that the museum is on 53rd street and be on her way. Otto on the other hand does not have that luxury. Instead, Otto consults his handy notebook where he will find the sentence: "The Museum of Modern Art is on 53rd street" written, and then be on his way.

As such, it could properly be said that Otto's belief was partly, and significantly, caused by the notebook. Therefore, since beliefs are archetypical properties of minds, Otto's mind (or at the very least, his cognitive apparatus) is extended to his notebook. The conclusion of this thought experiment can be succinctly described by, what Clark & Chalmers call, the parity principle:

> "If, as we confront some task, 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." (Clark & Chalmers, 1998, pg. 8)

In other words, Otto's notebook is playing the same functional role that Otto's memory system would have played if it was intact. Clark & Chalmers conclude that there is no good reason to privilege the internal memory system over Otto's external notebook.

2.2 Parity Problems

Critics have been quick to point out the myriad of differences between notebooks (and other external objects) and internal neural mechanisms. Rupert (2004) and Adams & Aizawa

(2001, 2010), two of the more prominent opponents of extended cognition (so called "internalists"), point out that memory, as a cognitive process, shows certain regularities which cognitive psychologists have discovered; for example, primacy and recency effects, chunking effects, task sensitivity, and others (Gluck, Mercado, & Myers, 2008). Furthermore, there are certain parts of the brain that seem to be central to the function of certain types of memory like for faces and objects (Radvansky, 2011). These types of regularities seem to generalize to other cognitive processes like language, perception, and problem solving. Now imagine the large number of objects that could possibly count as a part of a person's cognitive apparatus – notebooks, calculators, phones, computers, tablets, watches, etc. Given this, Rupert and Adams & Aizawa argue that finding cognitive regularities in the overall relationship between external objects and internal neural mechanisms is unlikely. As such, the parity principle is refuted on the grounds that internal neural mechanisms are significantly distinct from external objects like notebooks. One cannot simply replace one for the other and expect the cognitive function to work the same (or at all).

Di Paulo (2009) makes a similar criticism. He argues that as long as the only criterion we have for determining the cognitive status of an object is whether or not it would be intuitively considered as such if it were located in the head, then extended cognition is doomed to fail. After all, if special cognitive privileges should not be given in virtue of being inside the skull (as the parity principle espouses), then it is a bit odd to then use it as the standard in which to test whether or not something is cognitive. As an example, Di Paulo asks us to imagine a scenario wherein an extended cognition researcher is attempting to determine whether some external object is a part of a person's cognitive apparatus. The researcher, convinced about the truth of the

parity principle, believes that the skull boundary makes no sense as a criterion for cognition. However, given the parity principle, the only criterion he has is the very one that he now denies.

3. Wheeler's Defense of the Parity Principle

Given the criticisms thus far presented, the soundness of the parity principle looks bleak. However, Wheeler argues that the internalists have misconstrued the parity principle. To make this explicit, Wheeler quotes Richard Menary (2007), another prolific proponent of extended cognition, as stating that,

> "Only at the grossest level of functional description can [the claim of equivalence] be said to be true. Otto and his notebook do not really function in the same kind of way that Inga does when she has immediate recall from biological memory. There are genuine and important differences in the way that memories are stored internally and externally and these differences matter to how the memories are processed." (pg. 59)

Both Menary and Wheeler argue that the parity principle is not meant to be an argument for the truth of extended cognition; rather, it is supposed to be an intuition pump that challenges our (unscrutinized) traditional beliefs of what counts as a part of cognition. In other words, the parity principle is a negative argument against traditional beliefs about the boundaries of cognition, rather than a positive argument for extended cognition. At its most minimal use, the parity principle ought to convince us to be agnostic in regards to the status of what counts as a part of cognition. In addition, notice how this reading of the parity principle does not use the internal as the standard in which to judge the external (thereby addressing Di Paulo's criticism).

This may not be clear from the Otto example since it seems as though Clark & Chalmers are attempting to convince us that the notebook is *actually* functionally equivalent to some internal neural mechanism. Given research in cognitive psychology, it is unlikely that there is

anything like looking at a notebook occurring in memory (Radvansky, 2011). However, what Clark & Chalmers were trying to achieve, given Menary and Wheeler's clarification, is that *given* that the notebook is functionally equivalent to some internal mechanism (which has stopped working due to Otto's Alzheimer), and *assuming* we count the internal mechanism as a part of cognition, it follows that Otto's notebook ought to count as a part of his cognitive apparatus. However, one might wonder if such external objects, that can implement the same functions as certain internal structures, exists in the real world (certainly no one doubts that, in principle, extended cognition is logically possible; the question is whether or not it is physically possible). I will return to this point in my critique of Wheeler's argument (see section 4.2).

3.1 From Parity to Functionalism

Recall that Wheeler's defense of the parity principle is meant to provide confidence in the soundness of functionalism. Wheeler does so by explicating a connection between parity and functionalism. As described above, for the parity principle to work, there must be functional equivalence between the internal and external. As described in section 1.2, a function is independent from the physical realization that is implementing it. To clarify this point, it may be helpful to invert Clark & Chalmers' thought experiment: instead of asking whether some external object would be considered a part of cognition were it in the head, we ask whether some internal structure would be considered non-cognitive were it moved outside of the head. As such, let us take the hippocampus, a structure in the brain closely related to memory processing (Radvansky, 2011), as an example of this reversed scenario.

Imagine in the near future we are able to create an artificial hippocampus made up of metals and plastic. If we replaced a person's biological hippocampus with the artificial one, assuming exact accuracy, functionalism dictates that there should be no significant differences in

the person's memory processing abilities *ceteris paribus*. Now imagine that instead of implanting the artificial hippocampus into the brain, we leave it outside of the body. Furthermore, the connections left over from the lesion are connected wirelessly to the external artificial hippocampus in some way. Again, functionalism dictates that there should be no significant differences in the person's memory processing abilities *ceteris paribus*; furthermore, the parity principle now kicks in: given that the external artificial hippocampus is functionally equivalent to the (now removed) internal biological hippocampus, and assuming we count the latter as a part of the cognition, then we ought to count the former as well.

Notice how the parity principle necessarily implies multiple realizability. Given that multiple realizability implies functionalism, the parity principle also implies functionalism. As such, if Wheeler's defense of the parity principle is sound, then it counts favorably towards the soundness of multiple realizability and, thereby, functionalism.

3.2 From Embodiment to Extension

Recall that Wheeler's thesis is to show the transition from cognitive embodiment to extension. In his own words,

> "I shall endeavor to cast light on a specific issue which lies at the very heart of the contemporary debate, namely the character of, and the argument for, the transition from embodied cognition to cognitive extension […]" (pg. 222)

Given his defense of the parity principle and its implication of functionalism, he can now make the move from embodiment to extension. His argument can be summed up by the following:

> P1: Implementational materiality (IM) about embodiment implies that the body admits multiple realizations (MR).
>
> P2: MR implies functionalism.

C1: As such, IM about embodiment implies a functionalist approach to embodied cognition.

P3: Functionalism implies MR (in principle).

P4: MR implies the parity principle.

C2: As such, Functionalism implies the parity principle.

C3: Therefore, a functionalist approach to embodied cognition necessarily leads to support of the parity principle (and extended cognition).

This argument might not seem obvious given Wheeler's narrative of why we should believe implementational over vital materiality. He argues that the former is more plausible than the latter because of the soundness of the parity principle. As such, it seems as though his argument is actually going backwards:

Soundness of Parity Principle → Soundness of Functionalism → Soundness of Implementational Materiality

His entire argument depends on the soundness of the parity principle. However, I think that, while the narrative of his argument leads to this odd scenario, the implication is that the arrows can go either way. One can transition from embodiment to extension and vice versa. It just so happens to be the case that, according to him, we have no way of choosing between vital and implementational materiality without appealing to functionalism and the parity principle.

4. A Third Way

Now that Wheeler's argument has been explicated, the rest of this paper will be devoted to critiquing his argument. It may be tempting to do so by arguing against functionalism; after all, it is the bridge that connects embodied and extended cognition. However, I want to make a stronger case by showing how we can accept embodied cognition and functionalism, while

rejecting extended cognition. I will do this by drawing on insights from the related, but significantly different, research area of *enactive cognition*. In doing so, I will show why Wheeler's dichotomy, between vital and implementational materiality, is false, and that a third option is available. By providing the possibility of this third option, I will illustrate how, even while accepting Wheeler's arguments for parity and functionalism and the like, we can reject Wheeler's thesis.

4.1 Adaptive Autonomous Systems

Enactive cognition, or enactivism, is a research programme that intertwines cognitive science, phenomenology, biology and psychology in an attempt to describe and understand cognition. Classical cognitive science and psychology have often defined cognition as information processing systems. The system takes in an input, which gets transformed in some way, and then an output is processed as a result. For Wheeler (and other proponents of extended cognition), cognition, while embodied and extended, is still an information processing system. Specifically, he proposes that cognition is best defined as a physical symbol system (a la Newel & Simon, 1976). A physical symbol system is,

> "[…] (roughly) a classical computational system instantiated in the physical world, where a classical computational system is (roughly) a system in which atomic symbols are combined and manipulated by structure sensitive processes in accordance with a language-like combinatorial syntax and semantics." (Wheeler, 2011, pg. 234)

Enactivism takes a different approach. For enactivism, two things are necessary, and jointly sufficient, for the existence of cognition: *autonomy* and *adaptation* (Thompson, 2007; Thompson & Stapleton, 2009).

According to Thompson & Stapleton (2009), autonomy is an attribute of a system given that the system's constituent processes meet the following conditions:

> "1) [They] recursively depend on each other for their generation and their realization as a network; (2) constitute the system as a unity in whatever domain they exist; and (3) determine a domain of possible interactions with the world" (pg. 24)

The example they give is the living cell. A cell's constitutive system is a self-producing metabolic network, which is recursively interdependent on both the parts that make it up and the semipermeable boundary it creates. Furthermore, this network constitutes a unified system in the biochemical domain, and determines the cell's domain of possible interactions with the world.

However, autonomy on its own is not enough – adaptation needs to be added to the mix. To see this, Thompson & Stapleton give the example of a motile bacteria swimming up a sugar gradient (which it uses as a food source). The bacteria stumbles about until it hits a concentrated source of sugar, and then follows that source as it takes in the sugar. Notice that there is nothing intrinsic about the sugar such that it ought to be labelled "food". Rather, it is treated as such in terms of its relation to the bacteria as an autonomous system (which needs the sugar in order to retain its recursively interdependent network). Thompson & Stapleton use this example as an illustration that,

> "[…] even the simplest organisms regulate their interactions with the world in such a way that they transform the world into a place of salience, meaning, and value—into an environment (Umwelt) in the proper biological sense of the term. This transformation of the world into an environment happens through the organism's sense-making activity." (pg. 25)

This idea of "sense-making" is important because an autonomous system on its own is only interested in the "[…] all-or-nothing conservation of identity through material turnover and external perturbations to the system, but not the active regulation of interactions with the outside world" (pg. 25); in other words, it is not capable of sense-making. This is where adaptation comes into play. The motile bacterium is interested in survival and reproduction and, as such, will regulate its activity based on environmental factors. This means that *adaptive autonomous systems* (like the motile bacterium) are that which can regulate their internal conditions with respect to their environmental conditions, thereby giving them the ability to modify their environment based on the norms (i.e. what counts as food) of its internal activity.

4.2 The Significance of Embodiment

The relationship between embodiment and adaptive autonomous systems is straightforward: instead of the brain, body, and world being equal dance partners in the realization of cognition (to use Clark's analogy, see above), the brain and body is *leading the dance*. To see this we need to construe the body (including the brain) as an adaptive autonomous system. In this way, the body actively regulates its internal conditions with respect to its environmental conditions; thereby giving it the ability to modify the environment to suit its needs (e.g. tool use). Of course, the body is much more complicated than the motile bacterium. It is probably the case that the body is made up of smaller systems (which in turn could be made up of even smaller systems). As such, could it be possible that objects in the external world, if coupled appropriately to the body, create an even larger system? According to Thompson & Stapleton, the answer is (in principle) yes. However, they are stringent on what instances can count as true cases of extended cognition.

For Thompson & Stapleton, the difference between *mere extension*, wherein the body uses tools (like scissors, pencils, erasers, etc.) in the environment, and *true extension*, wherein external objects create a larger adaptive autonomous system with the body, is whether or not the object becomes *transparent*. Following the phenomenological tradition, they make a distinction between *body-as-subject* and *body-as-object:*

> "The body-as-object is the body perceived and recognized as mine (e.g., ''these are my hands.''). The body-as-subject is a structure of experience; it is that through which the world is experienced." (pg. 29)

As such, an external object becomes transparent when the person ceases to experience the object as an object, and instead experiences the world through the object. To illustrate this point, they describe a blind man using his cane to move about. In this case the man is experiencing the world through his cane, rather than experiencing his cane as an object.

However, Thompson & Stapleton note a major constraint of this transparency is that the object must be constrained by the active regulation of the body. As such, the body is always leading the dance. In regards to Otto and his notebook, Thompson & Stapleton state that the questions we need to ask are the following:

> "To what degree does Otto experience his notebook as an object and to what degree does the notebook function transparently as a way for him to experience himself in the world? To what degree has Otto's body schema incorporated his notebook? Has Otto's sense of body ownership extended to include the notebook?" (pg. 29)

The problem with this thought experiment, however, is that it is impossible to tell the phenomenological state of Otto and his notebook.

Wheeler may argue that this constraint is specifically for personal level phenomena, rather than the sub-personal level phenomena he is talking about (after all, it is doubtful that neurons have phenomenology). However, this construes transparency as a cause rather than as a result of extension. The sub-personal level phenomenon that causes transparency to occur is precisely the adaptive autonomy that has been described. In these cases, the constituent parts which contribute to cognition and sense-making are necessarily transparent.

Given everything discussed so far, we can now describe a way in which to accept embodied cognition while rejecting extended cognition. We can do this by construing the body (including the brain) as an adaptive autonomous system, wherein cognition/sense-making arises as a result. Notice that we do not need to reject functionalism in this case. The body can be made up of different material as long as it still forms an adaptive autonomous system. As such, Wheeler's dichotomy between vital and implementational materiality can be rejected. Furthermore, we can reject extended cognition by pointing to the fact that its proponents have not shown an instance wherein an external object becomes a part of a larger adaptive autonomous system with the body. Of course, it is, in principle, possible for this to occur. Take the example of the artificial hippocampus described above (section 3.1). Surely in that case the external artificial hippocampus would count as a part of a larger adaptive autonomous system which the body actively regulates. However, these sorts of examples are trivial, since it is doubtful that anyone would disagree with extended cognition given that the external object is literally a copy of some internal structure (although it may be doubtful whether or not the connections can truly be made). What makes extended cognition interesting are cases where objects like calculators, computers, notebooks, etc. are claimed to be a part of cognition.

As such, it may be more appropriate to describe this position as, what Adams & Aizawa have dubbed, *contingent intracranialism*.

> "Our view is that, as a matter of contingent empirical fact, in all actual cases of human tool use brain-bound cognitive processes interact with non-cognitive processes in the extracranial world." (Adams & Aizawa, 2001, pg. 46)

Although they limit themselves to the boundaries of the brain, we can appropriate their term by positing that, as a matter of contingent fact, it so happens to be the case that cognition is *body-bound*. With this clarification in mind, we can now conclude that embodied cognition does not lead to extended cognition. Furthermore, it is a matter of empirical fact whether or not it ever will.

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