# Does Cognition Extend Into Our Hands When We Gesture?

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William Edgecomb

## I. Introduction

Evidence is mounting that co-speech gestures not only help listeners understand what a speaker is trying to communicate,[1] but also help to coordinate cognition for the speaker who is producing the gestures.[2] But what about the stronger claim, defended notably by Andy Clark,[3] that cognition literally extends into the hands of a gesturing speaker? Michael Wheeler invites us to consider what would license such a claim.[4] In particular, Wheeler considers and rejects the following proposal, which is an extrapolation of Clark's position: gesture is a partial realizer of cognition in virtue of the fact that gesturing is an instance of *cognitive self-stimulation* (sometimes called *turbo-charged thought),* a process whereby select outputs of a cognitive system are immediately recycled as inputs, which in turn serve to coordinate the next round of cognitive activity.[5] While Wheeler accepts that gesturing is plausibly an instance of cognitive self-stimulation, he denies that the fact of cognitive self-stimulation is sufficient to countenance the extra-brain elements involved as partial realizers of cognition. This is true, he claims, even if the self-stimulating loop is the product of *design* by a process such as natural selection.

In this paper, I will argue for the following: plausibly, for some extra-cranial factor to count as a partial realizer of cognition, it is not enough merely that it subserves a cognitive self-

[1] See for instance Kendon (2004).
[2] For discussion, see Kita (2000).
[3] Clark (2011) and (2013).
[4] Wheeler (2013)
[5] See also Dennett (1991)

stimulation process. That is, it is not enough for it to merely coordinate thought or other cognitive processes by way of repackaging outputs of a cognitive system into inputs. However, it is my contention that, *pace* Wheeler, when we add the condition that a process of cognitive self-stimulation should also be the product of evolutionary design, the case for gesture as an extra-cranial realizer of cognition (henceforth just *external realizer*, and *external cognition* for the phenomenon generally[6]) is significantly bolstered. That is because the best reasons for denying cognitive self-stimulation as sufficient for external cognition tend not to apply for self-stimulating cognitive loops that are specifically the product of evolutionary design, of which gesturing seems to be a prime example.

The structure of the paper is as follows: In Section II, I will elaborate on how gesturing is a case of cognitive self-stimulation, and explore Wheeler's motive for denying cognitive self-stimulation as sufficient for external cognition to obtain. Put simply, he finds this criterion to be too permissive—it classifies entities as external realizers that clearly should not count. While I note some minor worries about the alleged counterexample he appeals to, I do not dispute Wheeler's overall claim here. Section III is where I take my departure from Wheeler, and argue against his claim that it is irrelevant whether or not a cognitive self-stimulation process is the product of evolutionary design. As I will argue, the criterion of design makes a world of difference as to whether we are justified in calling an extra-cranial factor (namely gesture) a genuine external realizer. In Section IV, the final section, I will take up objections and give replies.

[6] This terminology is untraditional. I use it so as to have categories that are neutral about whether cognition extends beyond the brain but not beyond the body proper, or whether cognition also extends beyond the body into elements of the environment.

## II. Is cognitive self-stimulation a mark of the cognitive?

Notably, Wheeler has claimed elsewhere that it is ultimately defensible to suppose that (using my terminology) the phenomenon of external cognition obtains.[7] But he does not count gestures among the likely external realizers. Why not? The way he sees it, the onus is on defenders of external cognition to articulate and defend some *mark of the cognitive*[8]—a scientifically-informed account of what it takes to be a proper realizer of cognition, which, so as not to beg the question at issue, must not set any *a priori* specifications on where amongst the brain, body, and environment cognition is to be located. So in his view, if one proposes some mark of the cognitive that is theoretically well-grounded, which in turn classifies some extra-cranial factor as a proper realizer of cognition, then one has provided strong support for a case of external cognition.[9] But if, given some putative external realizer, there is no such theoretically well-grounded mark of the cognitive to classify it as such, Wheeler thinks there is a default view we should maintain. Namely, he thinks we should treat the extra-cranial factor in question as fundamentally separate from cognition, even if it plays an important causal role in facilitating cognition. Regarding gestures then, Wheeler's position is basically this: there is yet no candidate for a mark of the cognitive that is both theoretically well-grounded, and classifies gestures among the external realizers. And, while a promising candidate appeals to the fact that gestures are the recycled outputs of a self-stimulating cognitive loop, such a criterion is ultimately too permissive, letting entities pass for cognitive that obviously should not.

In order to evaluate it as a potential a mark of external realizers, it will be useful to say a little more about what cognitive self-stimulation amounts to. I submit, however, that there is at

[7] See Wheeler (2010).
[8] This notion is developed in Adams in Aizawa (2001).
[9] See Wheeler (2010) for discussion.

present no robust account in the literature. Let's start with how Andy Clark describes it: "These are the cases when we confront a recognizably cognitive process, running in some agent, that creates outputs (speech, gesture, expressive movements, written words) that, recycled as inputs, drive the cognitive process along."[10] We also have Daniel Dennett's example of the *self-spitting robot*.[11] Here, we are to imagine a robot that spits water at a plate on its body at a regular rhythm, and utilizes the sound of the splashing water as a "virtual wire" in order to coordinate the timing of its internal cognitive processes.

I would like to emphasize two points about cognitive self-stimulation that are not made explicit by Clark. One, in saying that self-stimulating cognitive loops drive "recognizably cognitive processes," Clark is (I take it) not saying that all elements of the system, including the those responsible for recycling outputs, need be obviously recognizable as realizers of cognition. The cognitive status of the external bits is, after all, precisely what is at issue. Rather, what Clark is saying is only that the overall *process* need be recognizably cognitive, which, it seems, can be the case even some of the realizers of the process are not realizers of cognition. Of course, Clark does want to insist that the parts that recycle outputs are genuine realizers of cognition. My point here is just that, on a first pass, they need not be obviously recognizable as such.

The second point I want to make is that ordinary feedback loops should not be counted as instances of cognitive self-stimulation. Consider, for example, what happens when I reach for my mug. Putting it crudely, the process goes like this: an initial motor command is generated, which is an *output* of my cognition. This output, by stimulating the right muscles, causes my arm to move toward the mug. And as my arm moves, proprioceptors in my arm are stimulated, resulting

[10] Andy Clark, *Supersizing the Mind: Embodiment, Action, and Cognitive Extension*, (New York: Oxford University Press, 2011): 131.
[11] Dennett (1991).

in information about my arm's position being fed back to my brain. That proprioceptive input in turn influences further cognitive processes. Namely, it affects the process by which motor commands are generated, providing the information necessary to make appropriate adjustments to my arm's position in the next round of motor outputs (this overall process is sometimes called the *on-line guidance of action*). And, since the content of a particular motor output to a large extent determines the content of the returning proprioceptive input, this is plausibly a case in which we can say that the outputs of a system are fed back to the system as inputs. Intuitively though, this is not a case of cognitive self-stimulation. But what is the relevant difference? At a first approximation, it seems to be this: in the mug-reaching case and similar cases of ordinary feedback, the information carried by returning inputs is of *immediate* value for subsequent cognitive processing—that is, no special interpretation is required. So for instance, proprioceptive input carries information about the position of the body, which is of immediate value for subsequent motor planning because motor planning processes trade directly in bodily-kinesthetic information. This is quite unlike the self-spitting robot. There, the returning auditory information is not valuable to subsequent cognitive processing *qua* auditory information. It is valuable rather because the system is designed to (speaking loosely) interpret or decode that information to extract its special significance as a temporal reference point.

This point will become clearer as we turn to look at why gesturing should be considered a case of cognitive self-stimulation. To see why, let us start by looking at the empirically measurable influence that gesturing has on cognition. In one kind of experiment, participants allow their hands to be immobilized while performing some task, and their performance is measured against a control group that is free to gesture. Interestingly, in a variety of tasks, subjects with their hands immobilized are outperformed by the freely gesturing control subjects.[12, 13] For example, in one study,[14] participants were asked to describe motor events such as tying one's shoes or changing a car tire. The key findings were that those free to gesture, compared to a control group, tended to use more semantically rich verbs (e.g. "cross" instead of "put") and start fewer sentences with the word "and." In another study,[15] children were asked to remember a list of letters or words while they explained how they solved an algebra problem. Those allowed to gesture during their explanations remembered significantly more items than those instructed to keep their hands still on a tabletop.

At this point, it might be objected that the impact of gesture on cognition might be too general to support the view that gesturing is a case of cognitive self-stimulation. Perhaps moving one's arms and hands about simply greases the wheels for cognition, resulting in positive effects on task performance across the board. Maybe mild exercise would have a similar effect. And so, it seems that the hypothesis that gesturing is cognitive self-stimulation is in need of a more detailed explanation as to what special role gesture plays in cognition. There are a number of possibilities, which for the most part are not mutually exclusive.[16] I will describe two basic categories of hypotheses.

On one sort of view, gesture acts as a buffer for freeing up cognitive resources.[17] The basic idea is that certain cognitive faculties can reduce their processing load by temporarily offloading information into the hand and arm, information which, through visual or proprioceptive feedback, can be fed back to the brain and re-integrated as needed (within a short

[12] See Goldin-Meadow et al. (2001), Chu and Kita (2012), Wagner Cook et al. (2008), and Hotstetter et al. (2007).
[13] A potential confound in these studies is that having one's hands immobilized may be a distraction that negatively impacts performance. Goldin-Meadow et al. (2001) were able to control for this possibility, as it just so happened that some participants who were free to gesture, for whatever reason, did not do so. These subjects performed comparably to those whose hands were immobilized.
[14] Hotsetter et. al. (2007).
[15] Goldin-Smith (2001).
[16] See Kita (2000) for discussion.
[17] Goldin-Meadow et al. (2001), Wagner et al. (2004).

duration). With some amount of cognitive resources thus freed up by gesturing, this hypothesis predicts that gesturing will confer benefits in a number of task domains. On the other main type of view, the role of gesture is to provide an intermediary by which separate processing centers in the brain can share information. One important finding that supports this view is that gesture often conveys information not found in speech.[18] More significantly, information conveyed in gesture can, at times, both remain *completely unavailable* to speech, and predict future improvements on task performance.[19] It may be the case then that part of what gesture is for is to distribute information that, temporarily at least, eludes our awareness.

On either type of view then, gesture is part of a self-stimulating cognitive loop: motor information is delivered from brain to hand, where it is then repackaged as proprioceptive input and delivered back to the brain to coordinate further cognitive processing. And importantly, unlike our earlier example of reaching for a mug, gesturing is not an ordinary case of bodily feedback. For, the value of the information represented in gesture is not immediate—information destined for the hands needs to first be converted into an appropriate motor command, and information returning from the hands will only be significant for those faculties set up to interpret the message. To put it differently, the value of information conveyed by gesture is not the bodily-kinesthetic information *per se*, but rather is derivative, based on what the bodily-kinesthetic message encodes. If you are not convinced, consider that some of the cognitive faculties most thought to benefit from gesture are those involved in speech-production.[20] Surely, if gesture is utilized by the speech-production system, it is not because the speech production system has a direct interest in monitoring the motion of the hands.

[18] Melinger and Kita (2004), Kita, S. and Özyürek, A. (2003).
[19] See Goldin-Meadow and Wagner (2005).
[20] See Kita (2000).

Although I have only scratched the surface of the literature, I will now set aside our discussion of the relevant empirical research on gesture. After all, Wheeler is congenial to the claim that gesturing may be a case of cognitive self-stimulation. In his words, “Clark’s compelling image of self-generated bodily movements acting as components in cognitively self-stimulating loops nicely captures what is distinctive about the kinds of gestures that, as we saw earlier, may plausibly enable the reallocation of neural resources, by soaking up some of the overall processing load, or may encode verbally inexpressible problem-solving strategies in ways that promote future learning.”[21] He also admits, “What seems clear, then, is that gestures may act as self-generated aids that enhance thought in subtle and powerful ways.”[22]

But while Wheeler is prepared to countenance gesturing as a process of cognitive self-stimulation, he does not think this is sufficient to license the claim that cognition literally extends into the hands. He thinks rather that, gestures may exert a *causal* influence on thought without thereby also being a vehicle that *realizes* thought. As he puts it, “the turbo-charging mechanism at issue may very well be a hybrid system of cognitive and non-cognitive elements that interact causally so as to enhance overall psychological performance.”[23]

Why does Wheeler not think cognitive self-stimulation is a sufficient condition for external cognition? The thrust of his case falls on the following alleged counterexample, which Wheeler claims is a non-cognitive case of self-stimulation, but is analogous in all relevant ways to specifically *cognitive* self-stimulation. We are to picture an athlete on a specially designed indoor rowing machine that visually displays real-time feedback (i.e. “data”) to the rower about her technique (these machines really exist by the way). That feedback, in turn, helps the rower to

[21] Michael Wheeler, "Is Cognition Embedded or Extended? The Case of Gestures," In *The Hand, an Organ of the Mind*, edited by Zdravko Radman, 269-301 (Cambridge, MA: MIT Press, 2013): 285.
[22] *Ibid*., 288.
[23] *Ibid*., 291.

fine-tune her technique via bodily adaptation, with the goal of eventually achieving better performance on the water. This process, according to Wheeler, while analogous to cognitive self-stimulation, undermines cognitive self-stimulation as a sufficient condition for external cognition. Why? Because one, intuitively, the visual feedback the rower reads off the rowing machine is not a realizer of bodily adaptation. As he says, "there is presumably little temptation to categorize those inputs as *realizers* of the observed adaptation, as opposed to elements that have a *critical causal impact* on that adaptation [emphasis his]."[24] And because two, there is no obvious disanalogy here, such that the recycled outputs of self-stimulating loops must be genuine realizers of the system when specifically *cognition* is at issue, as compared to bodily adaptation. In his words, "it is not at all obvious why things should carve up any differently when the focus of attention is a self-stimulating loop that enhances thought."[25]

I am mostly sympathetic to Wheeler's argument here. However, we should take note of two possible difficulties with his counterexample. One, Wheeler claims the process of bodily adaptation to be non-cognitive, yet arguably, cognition is integral to the process. It seems clear that in between the visually displayed feedback being perceived by the rower and the subsequent tuning of the body and motor system, some amount of cognitive processing takes place. I do not take this to be too worrying though. Perhaps we could reimagine the case with some uncontroversially non-cognitive robot that, using some machine that gives the robot feedback about its movement, entrains its motor dispositions in like manner to the rower. In that case, it seems perhaps less clear, but still plausible that the feedback-giving machine is not a realizer of the robot's motor adaptation.

[24] *Ibid.*, 292.
[25] *Ibid., 292*.

The second worry is that the example is too much like processes involving ordinary bodily feedback, such as the on-line guidance of action, which, as I have already argued, should not count as cognitive self-stimulation. Yet this worry too is not decisive, for the visual percepts inputted to the rower are quite unlike the usual format of inputs that aid bodily adaptation. It seems clear that the visual inputs to the rower require substantial "decoding," presumably requiring conversion into a bodily-kinesthetic format before they can effect change to the bodily-motor system. In all likelihood, this requires the rower to consciously attend to the visual display, and to construct—perhaps with little or no conscious awareness required—some sort of bodily-kinesthetic model on the basis of the data displayed on the screen. Perhaps this bodily-kinesthetic model is implicitly compared to a mental model of "ideal" rowing technique, and on that basis fine adjustments are made to her body and motor system, enhancing future performance.

Whatever the specifics about how the rowing machine supports bodily adaptation, I am at least congenial to Wheeler's claim that this is a case of self-stimulation. I would even go beyond Wheeler and classify it as a case of *cognitive* self-stimulation. But do I also side with Wheeler in denying that the displays of data on the rowing machine are literally realizers of bodily adaptation (or cognition)? Yes, I do. At least, I think the claim here his quite plausible. More generally then, I tend to agree with Wheeler that playing the output-to-input recycling role in a self-stimulating cognitive loop is not a mark of the cognitive. My reasons for thinking so will become clear in the next section. I will also argue in the next section that when we add the condition that a cognitive self-stimulating loop is a feature of design by natural selection, we get a very robust candidate for a mark of the cognitive, and one that would clearly count gestures among the realizers of cognition.

## III. Adding the criterion of evolutionary design

As mentioned earlier, Wheeler is not categorically opposed to claims of external cognition. Indeed, he thinks they can be defensible. The key for Wheeler, to remind you, is that a claim of external cognition need be licensed by a theoretically well-grounded mark of the cognitive. But notably, Wheeler's objection to cognitive self-stimulation as a mark of the cognitive rests principally on an appeal to intuition about how we should treat a single alleged counterexample. He does not provide a principled reason why cognitive self-stimulation is not a mark of the cognitive. We can infer he does think there is such a reason, but he does not provide one.[26]

So there is an outstanding question: what is the relevant difference between the rower-rowing machine process of bodily adaptation, and run-of-the-mill brain processes, such that the brain is a realizer of cognition while the rowing machine is not? The following strike me as the most promising candidates for the relevant disanalogy: one, the rowing machine is not reliably coupled to the rower, such that it can potentially aid bodily adaptation wherever the rower goes. Two, in order for the rowing machine to be effectual, conscious attention must be paid to the machine's visual display. And three, utilizing the rowing machine to benefit bodily-adaptation is a skill that requires explicit learning. I will argue that, in virtue of an extra condition (beyond cognitive self-stimulation) that Wheeler thinks is irrelevant, these differences do not obtain in the case of gesture, and that gesture should qualify as an instance of external cognition as a result. That extra criterion is evolutionary design.

Let us now take a look at what Wheeler says about the criterion of design. He says:

[26] Perhaps what he would provide as a principled reason can be inferred from his other works. It is at least not clear from Wheeler (2013) alone.

> it seems reasonable to give serious consideration to the following thought: If the bare fact of cognitive self-stimulation isn't enough to guarantee ExC ["ExC" is equivalent to my use of "external cognition," roughly] perhaps the recognition that cognitive self-stimulation will standardly be a product of design (by evolution, development, or learning) is. A moment's reflection, however, reveals a serious difficulty with this proposal, namely that *having been designed is not a robust mark of the cognitive* [emphasis his]. For example, the heart has been designed by natural selection to pump blood around the body, but its designed character does not in any way make it a realizer of cognitive states or processes…What is still missing is an account of why the designed function of interest counts as a cognitive function…simply adding the thought that the loop and its components are designed features is of no relevant consequence.[27]

That is about all Wheeler has to say on the subject of design. His remarks, it seems to me, are clearly inadequate. The example about the heart does not get us anywhere, since Wheeler has not made it clear that the heart, in addition to being a product of design, is part of self-stimulating cognitive loop that is *itself* the product of the design.[28] And apart from this supposed counterexample, Wheeler leaves us with little but an appeal to intuition. At best, his remarks here constitute a challenge, a challenge to say why it should matter that a cognitive self-stimulation process is the product of design.

Part of my contribution to the debate is to respond to this challenge. To begin, let us turn to a notion that has come to be called the *parity principle*. The idea of the parity principle is that, in determining whether something is a realizer of cognition, there should be no prejudice as to whether that something is inside or outside the head. That is, extra-cranial parts should just as well be able to realize cognition as can parts of brain, so long as the function performed by an extra-cranial part would obviously count as cognitive were that same function to occur in the

[27] *Ibid*., 293.

[28] It is worth noting that quite plausibly, the heart *is* part of a self-stimulating cognitive loop designed by natural selection, specifically, a loop designed to distribute emotionally relevant information through the body and back to the brain. See Prinz (2006) for discussion. If this is right, my response would be that as with gestures, we can count the heart as a realizer of cognition.

head. Here is how Andy Clark and David Chalmers put it in their seminal paper, *The Extended Mind*: "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 it as part of the cognitive process, then that part of the world *is* part of the cognitive process [emphasis theirs]."[29] The parity principle strikes me as eminently plausible. Denying it, it would seem, is to embrace the view that by fiat, cognition must take place only inside the cranium. Notably, even some staunch critics of Clark and Chalmers accept the parity principle—they simply deny that we have yet confronted any environmental factors that satisfy functional or causal roles equivalent to those found in the head.[30]

The parity principle helps us to see why the rowing machine in Wheeler's example is plausibly not a realizer of cognition. Why? Firstly, because a process with the functional profile of the rowing machine could not likely take place in the head. This is due, I claim, to the first characteristic of the athlete-machine interaction mentioned earlier: the machine is not reliably coupled to the athlete. Unless she is sitting in the rowing machine, which surely is not the case most of the time, the machine has no capacity to influence bodily adaptation. There is of course no analogous difficulty for processes that occur within the skull. Wherever the skull goes, *all* the cognitive bits inside go too, thus retaining all the time their capacity to influence each other, and to influence cognition overall.

Secondly, even if we ignore this problem of unreliable coupling, it is questionable that we would grant a process like the one contributed by the rowing machine status as cognitive even if it occurred inside the head. This brings us to the other two worrying characteristics of the athlete-machine interaction. One is, to remind you, that for the rowing machine to facilitate bodily

[29] Andy Clark and David Chalmers, "The Extended Mind," *Analysis*, 58 (1998): 8.
[30] See, for example, Adams and Aizawa (2009).

adaptation, it seems the rower must pay conscious attention to the machine's display of visual feedback. That is, the mere presence of "data" in the rower's visual field, without her consciously attending to it, is not likely to be appropriately processed *as* bodily feedback. In all likelihood, it will be processed only as some lower-level category, such as *a series of digits*. The other worrying characteristic is that, in all likelihood, there must be a significant period of explicit learning in order for the rower to make proper use of the machine's feedback. That is, only with substantial, deliberate practice will the rower's bodily-motor system become appropriately sensitive to the information displayed on the machine, such that the feedback will actually facilitate bodily adaptation.

Now, to test for parity, let us imagine the following scenario: you volunteer for an experimental surgery in which a special device, designed to facilitate bodily adaptation, is implanted inside your skull. The device works by copying outgoing motor commands from your brain stem, converting that information into a visual format, and then integrating it into your visual phenomenology as a continuously changing, consciously accessible image (like the original case, an image of "data," say). However, the device only works to facilitate bodily adaptation if you consciously attend to that image. Furthermore, it takes deliberate practice. You will not be successful in utilizing the device's feedback right off the bat, but only after a substantial learning period. Now let's ask, do we think this intra-cranial device is a realizer of cognition? Intuitively, it is far from clear. In this case, we have reproduced the functional profile of the original rowing machine with an implant inside the head. But even still, it is natural to conceptualize the overall process as one genuinely cognitive system interacting in a looping process with a non-cognitive *tool*. It is just that this tool connects, within the skull, the brain's motor outputs with mid-to-late-level visual processing. What remains the case is that to properly utilize the device, conscious attention to the visual feedback is required, as well as an initial learning process. Thus, it seems, one has much the same relationship to the implanted device as our original rower has with her machine.

Now let us consider specifically those cognitive self-stimulation processes that are the product of evolutionary design. In saying that such a process is the product of design, what I have in mind is, roughly, that it is *innate* and an *adaptation*. It is innate in the sense of being a species-universal trait that develops along a robust (ontogenetic) developmental trajectory, canalized against environmental variability. And it is an adaptation in the sense of having a *function*, a function which, for one's ancestors at least, conferred a fitness advantage. Importantly, gesturing seems clearly to be innate in this sense—it is a trait that reliably develops across cultures, and one that confers a measurable benefit to the organism. But the point I want to focus on is this: there will at least be a very strong tendency for evolutionarily designed self-stimulating cognitive loops to not be characterized by unreliable coupling, required conscious attention to a percept, and a necessary learning period. As such, for these evolutionarily designed loops, the most worrying reasons for thinking that cognitive self-stimulation does not establish external cognition do not apply.

Let's start with the first characteristic. Will evolutionarily designed processes of cognitive self-stimulation tend not to involve constituents that are unreliably coupled? Or to put it the other way around, does it seem unlikely that processes of cognitive self-stimulation with unreliably coupled elements will be the product of evolutionary design? It seems extremely plausible to me that the answer is yes. For presumably, in order for a cognitive self-stimulating loop to reliably develop across individuals in a species, the extra-cranial element will need to be present at at least semi-predictable intervals over the course of development. Perhaps more importantly, an unreliably coupled extra-cranial element would be of limited fitness value, since it can only confer its benefit to cognition when it is present. Thus, so as not to put the organism at risk of being separated from any parts that confer a crucial contribution to cognition, we should expect evolution to favor the selection of cognitive processes that utilize reliably coupled elements.

Let us turn next to the conscious attention. Will evolutionarily designed self-stimulating cognitive loops tend not to require conscious attention to the inputs feeding back through the system? This also seems quite plausible. Under the assumption that conscious attention is a limited resource, natural selection should tend to favor cognitive loops that can perform their function without mediation by conscious attention, because then conscious attention can be freed up for more pressing demands. We can say something similar about why evolutionarily designed cognitive self-stimulation processes should not be expected to require an explicit learning period. All things considered, looping processes that can develop without mediation by a learning period that requires deliberate, attentive practice will leave more cognitive resources available for other demands over the course of development, and thus should be favored by natural selection.

I admit that these points are somewhat speculative, and it might be reasonably disputed to what extent evolutionarily designed cognitive self-stimulation processes tend to lack the characteristics we have been discussing. However, it seems clear at least that *gestural* cognitive self-stimulating loops lack these characteristics. Gestures are reliably coupled with the organism and the brain, they confer their benefits to cognition without demanding conscious attention, and one can become proficient at producing them without ever engaging in deliberate practice. These, I claim, are reasons for thinking that cognition literally extends into our hands when we gesture.

As a final test, let us see how gestures fare with respect to the parity principle. Please imagine the following scenario: there is a parallel universe in which humans do not gesture. They still have arms and hands and use them in much the same way that we do. They just do not use them to gesture. However, there is a module in their brain that, when these beings talk, *simulates* gesturing. That is, when they talk, this module produces a mental model of gesturing hands churning away, each gesture well-timed and appropriate for the corresponding outgoing speech. And all this occurs without causing any actual movements in the hands or arms. Importantly, this gesture-simulation module does not do its work in total isolation. It receives input from various other systems in the brain, such as those responsible for speech-production and visuospatial reasoning. Furthermore, the outputs of this model feed into the incoming proprioceptive sensory stream. With this connectivity in place, the gesture-simulation module is able to reproduce the functional profile of ordinary human gesturing. Namely, the module helps to free up cognitive resources, and to distribute information between various brain areas. In addition, gesture simulation takes place largely outside of conscious awareness, and its development as a trait does not depend on deliberate practice.

Now we must ask, should we allow that the gesture-simulation module is a realizer of cognition? It seems to me the answer is clearly yes. The alternative point of view, that the module is a non-cognitive element that simply *facilitates* cognition, seems quite unnatural. Next, let's ask if there are any relevant disanalogies with the case, such that the gesture-simulation module is a realizer of cognition, but ordinary gestures are not. In this section, I have tried to show that because gesture is designed by natural selection, the usual suspects for disanalogy claims are not available to appeal to. Gestures are not unreliably coupled with the brain and body, and they do not require conscious attention or an explicit learning period. Thus, we have very strong grounds for claiming that gestures are literally realizers of cognition. And more generally, we have strong reason to think that, *pace* Wheeler, it is a mark of the cognitive to play the output-to-input recycling role in a self-stimulating cognitive loop *if* that loop is the product of evolutionary design.

## IV. Objections and replies

Here is what I take to be the strongest objection to my view: if being unreliably coupled to the brain is a good reason to doubt that an extra-cranial factor is a genuine external realizer, then this is a worry that very much applies to gesture. While it is true no doubt that our hands and arms are never far away from or disconnected from the brain (except in cases of amputation, of course), it is not the case that they are reliably available *qua* implements for gesturing, because our hands are often occupied with other things. For example, at times we might be carrying something heavy, or working with some hand-held tool or another. By my reasoning, there should then be an evolutionary impetus for the brain to make do without gesture playing any crucial role in its affairs. Indeed, cognition does seem to perform adequately without gesture—according to the empirical literature, gesture's benefit to cognition is statistically significant, not huge. On this way of looking at things then, it does not sound so implausible to think of gesturing as a special case of using a non-cognitive tool. When our hands are available, we use them as aids to enhance cognition. But gesturing is not inextricably coupled with other processes that are clearly cognitive, and this gives us good reason to doubt it has cognitive status.

I think this is an excellent objection. Part of my response is to suggest that the requirement of highly reliable coupling is something we may be able to give up. After all, just as our hands can be occupied at any given moment, so too this may be the case for various elements in our brain. Consider: if some greater network in the brain *A* is unable to achieve ideal performance because some node *x* of network *A* is currently tied up performing a function for some other network *B*, presumably, we wouldn't say that *x* is not a realizer of *A*.

To settle this matter of how important is reliable coupling, it will be helpful to explore the implications of loosening the coupling requirement. If loosening the requirement makes it so that many, many extra-cranial factors thereby qualify as realizers of cognition, then maybe the requirement will have to remain stringent, and gesture's status as cognitive will be more precarious. If, on the other hand, loosening the requirement only lets in a minimal number of such factors as cognitive, factors which are otherwise theoretically plausible candidates to be external realizers, then maybe we can leave the requirement loose, allowing gesture's fate as cognitive to remain secure.

My other response to this objection is less concessive, but more speculative: while the hands and arms specifically are not extremely reliably available for gestural expression, perhaps their unavailability can, to a large extend, be compensated for by gestural expressions produced by other parts of the body. The face, head, torso, shoulders—to a lesser extent the legs—all these could potentially take up some of the burden of gestural communication when the hands are unavailable. This would be a fascinating subject for future research. And if the results pan out as I have suggested they might, my response to this objection would be essentially be this: the parts of the body that produce gestures are genuine realizers of cognition, and are, taken together, reliably coupled to the brain. It just so happens that gesturing is not exclusively a phenomenon of the hands and arms.

Let's now turn to another objection. In my argument, I identified several plausible reasons for denying cognitive self-stimulation as sufficient to ground claims of external cognition. Perhaps there is another reason I overlooked, and perhaps one that would undermine my claim that through gestures, hands can be external realizers. For example, Fred Adams and Ken Aizawa suggest that extra-cranial factors should (except under extremely unusual circumstances) be considered non-cognitive on account of their having very different properties from paradigmatic realizers of cognition. As they put it, "the causal processes in the brain appear to be nothing like the firing of electrons at a phosphorescing screen, generating marks on a paper through friction with a graphite shaft, generating marks on a paper with a ball point pen, rotating cards in a rolodex, moving beads up and down in an abacus, or pressing buttons on an electronic calculator."[31] So too, perhaps, a fan of this response might say that the causal processes underlying movements of the hands and arms are too unlike brain processes for gestures to count as realizers of cognition.

My response is twofold: one, with respect to the elements of cognitive self-stimulating loops that recycle outputs into inputs, most of their properties do not seem to matter from a functional standpoint. What matters most is that the message delivered to them is received, and is returned in the proper form at the proper time. The intermediate details are of little significance. Second, if there is a strong case to be made that gestures are realizers of cognition, then there is also a strong case to be made that many elements in the body are realizers of cognition. Indeed, there is a growing literature suggesting that the autonomic nervous system, the endocrine system, bodily posture, head-nodding, facial expression (and more) are involved in cognition in a similar way as gesture—that is, by subserving cognitive self-stimulating loops.[32] If this is right, the claim that gestures are just too different from other cognitive processes loses its force for two

[31] Fred Adams and Kenneth Aizawa, "The Bounds of Cognition." *Philosophical Psychology*¸ 14.1 (2001): 57.

[32] For examples and discussion, see Critchley et al. (2013), Buchanan and Lovallo (2001), and Reimann et al. (2012).

reasons. One, if cognitive self-stimulating loops through the body are the norm, then it might not make sense to invoke processes of the brain *per se* as the quintessential cognitive processes. For, most brain processes may be radically dependent on information that is being recycled through the body. And so the quintessential cognitive processes may after all be brain-body loops. Second, if we at once countenance many bodily elements as external realizers, they will likely share in a common cluster of properties. There will then be no outliers which we can identify as having causal properties radically unlike everything else we recognize as cognitive.

## V. Conclusion

I have argued here that we have good reason to suppose that when we gesture, our hands are literally realizers of cognition. Part of the reason is that gestures are part of *self-stimulating cognitive loops*. Through gesture, our hands receive motor outputs, repackage those outputs into proprioceptive inputs, and in doing so serve to free up cognitive resources, or perhaps to exchange information between areas in the brain. That gestures have this function is supported by a wealth of scientific research. Nonetheless, following Michael Wheeler, I do not take the fact of cognitive self-stimulation to be a sufficient reason for countenancing the hands as realizers of cognition. Sometimes, an element that forms part of a self-stimulating loop is best treated a non-cognitive tool that merely *facilitates* cognition. For Wheeler's part, he does not see any obvious conditions that once added to the fact of cognitive self-stimulation, would be sufficient to justify claims of external cognition. One condition he considers is that of being designed by natural selection, which he quickly rejects as irrelevant. I have argued to the contrary that being designed by natural selection is extremely relevant to claims of external cognition—it is exactly the extra condition needed to make for a plausible *mark of the cognitive*. For, when we limit the discussion to self-stimulating cognitive loops where this extra condition obtains, such as gestural loops, the usual reasons for claiming that the extra-cranial elements are not external realizers (i.e. unreliable coupling, mandatory conscious attention, and mandatory learning period) do not apply.

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