Why the extended mind?

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WHY THE EXTENDED MIND?

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Abstract

The goal of the paper is to determine what could provide grounds for the idea that mind could be partly realized by environmental items. In this respect, it analyses the now classical arguments put forward by Clark and Chalmers, and shows that both the thought experiments and the parity approach they devise fail to substantiate the claim that cognitive processes extend beyond skin and skull. Yet, the paper concludes that we should not discard the idea of a mind that extends into the environment, as it can extract its credentials from life sciences.

Keywords: extended mind, Clark, Sterelny, Dawkins, extended phenotype.

Introduction

What is the realization base of the mind? One of the most radical proposals here, notoriously defended by Clark and Chalmers[2], is that mind is not confined between the traditional boundaries of skin and skull. Instead, mental processes and states should be considered as partly realized by external elements. At the core of their approach lies the more commonsensical idea that the external resources with which the individual interacts play an essential role in driving cognition. For instance, it is quite obvious that we cannot perform complex calculations without pen and paper or without the aid of a computer, for instance. The human organism comes to be linked through an array of reciprocal causal interactions such external entities that serve cognition, creating a "coupled system", which can be seen as implementing cognition, as a whole. Thus, they contend, the external entities themselves come to participate in realizing mental states and processes.

During the last decade the debate evolved and ramified considerably. Nevertheless there is a consistent thread that runs across the discussion, provided by the original arguments that Clark and Chalmers put forward for their ontological claim. Both for the friends and for the foes of the extended

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[2] Andy Clark and David J. Chalmers, "The extended mind," *Analysis* 58 (1998): 7-19.

mind, these arguments act as a reference point, around which much of the discussion still revolves, even after more than a decade since they were presented to the philosophical community. What this paper will be arguing is that, in spite of the attention they managed to attract and the structuring role they played for the field they inaugurated, these arguments fail to be conclusive. More generally, what I will try to demonstrate is that any argument based on the idea of parity is bound to fail. Nevertheless, as I shall attempt to show, that isn't a death spell for the extended mind, as it can find better grounds elsewhere.

The Thought Experiments

The backbone of the original argumentation in favor of the extended mind idea was given by two thought experiments and a certain principle, that invites rational assent. Let us concentrate first on the thought experiments.

In one of them, Clark and Chalmers invite us to think at three cases of Tetris players:

(1) one of the players rotates the falling blocks "in the head", using only his biological resources;
(2) another physically rotates them on the computer display, by pressing some keys;
(3) a "cyberpunk", which has a neural implant, designed to compute such rotations. This enables him, to use at will not only the normal human mental resources, but also the output of the implant.[3]

According to Clark and Chalmers all three situations should be counted as instantiating cognitive processes, in spite of the location of some of the resources involved. Case (1) is a clear example of cognition, and case (3) seems to be on the par with it. Case (2), where the non-biological cognitive resource is situated outside the body shares the same computational structure with (3), so we must consider it too as exemplifying cognition. Therefore the mechanisms performing rotations can be located anywhere, and are not confined to the usual inner equipment of humans. We should conclude that cognitive processes can sometimes span outside the body.

One problem arises from the fact that the cyberpunk argument assumes something that is far from being unproblematic, namely that the mereological sum of the implantee and his chip (i.e. the cyberpunk) exemplifies a system that can be said to perform cognitive tasks, in the same way a person can be said to perform mental rotations or play Tetris. It is not at all clear that (1) and (3) are

[3] Clark and Chalmers, "The Extended Mind," 12-14.

on par. Attributing the completion of task to the ensemble formed by a man and the artifacts he uses is far from being straightforward.

Thus, there are clear cases when carrying out the task is attributable to the person involved, who is merely said to use those objects. It would be strange, at least, to say that eating is something me and my fork do or that me and my plate ate a large pie last night. It is me who has a dinner, that is, the activity said to be performed by me. The fork is just a mean I use to further my goal. It is not a component of me, so that the attribution could be said to be about the hybrid formed by a person and his fork, although the latter has a definite causal contribution to the whole process, even externalizing a process that otherwise would have been performed using our biological apparatus, like picking up and holding food. Likewise, to apply our reasoning to the classic Rumelhartian example, saying that me and my pen perform calculations, does not conform to the usual attributive practices. The standard way to put it is to say that I perform calculations using a pen, a computer or an abacus, which, from this standpoint are merely instrumental to who is truly performing the task, namely the human. It is me that calculates, not the aggregate composed of me and my pen. Whatever their role, we usually regard artifacts as not being constitutive to whatever carries out a cognitive task, or, in other words, to what implements the cognitive processes proper, as otherwise we would have no problem attributing collectively the carrying out of the task.[4]

Of course, we might need to revise our naive idea about what is performing cognitive tasks, and grant this sort of "cognitive agency" to hybrid systems, formed by man and its implements, which, as a whole, should be considered to carry out the task. I shall actually plead for taking that route. But we should not assume that from the outset, as it is not at all uncontroversial. Moreover, even if we grant that possibility, we must prove that such is the case with the cyberpunk, and that we are not dealing with an ensemble that cannot be considered to perform any rotations, the same way as me and my plate, taken collectively, cannot be said to eat.

Also, please note that the case of the cyberpunk cannot be straightforwardly assimilated to that of a Martian whose natural cognitive equipment includes such a microchip. Clark tries to beef up his thought experiment this way, holding that the Martian, which allegedly nothing relevant distinguishes from the cyberpunk, would be considered performing mental rotations[5]. Such a Martian is a system performing cognitive tasks. But, ex hypothesi, he does not employ artifacts designed to help him, relying only on the structures he was

[4] For an excellent treatment of the instrumental-constitutive difference and the various types of assemblages one can have, see Susan Hurley, "The Varieties of Externalism", in *The Extended Mind*, ed. Richard Menary (Cambridge, Mass: MIT Press, A Bradford Book, 2010).

[5] Andy Clark, "Memento's revenge", in *The Extended Mind*, ed. Richard Menary (Cambridge, Mass: MIT Press, A Bradford Book, 2010), 44.

born with. What would have been needed, is rather a case where not all parts are there by nature, as it is precisely the tool use that poses problems.

The second thought experiment involves two characters, Inga and Otto. While Inga stores the information that the Museum of Modern Art is on the 53rd street in her internal memory, Otto, who has Alzheimer's, wrote that piece of information in a notebook, which he checks when he wants to visit the museum. We could explain why they head to the 53rd street by pointing out that both want to go to the museum and that they think that it was located on the 53rd street, therefore ascribing both the same opinion. Thus, we can attribute non-occurrent beliefs to Otto, even if the information is stored outside his central nervous system.

As regards Otto, attributing him extended mental states would lead straight to inconsistency. One of the familiar explanations of his behavior, which involves consulting his notebook, would be to assert that has no idea where the address of the Museum of Modern Art. Unfortunately, ascribing him beliefs about the location of the museum would yield contradictory psychological attributions. Were the thought experiment of Clark and Chalmers conclusive, we would have to predicate of Otto both that he thinks that the museum is located on the 53rd street and that he lacks such an opinion. As Preston[6] remarked, being incapable to say without the help of a notebook where the museum is precisely what we qualify as failure to remember.

The Parity Principle

The intuitions at play in these experiments exemplify situations that fall under the "parity principle", which states that

> 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 part of the cognitive process[7]

Before proceeding, a few clarifications are required. There is a persistent ambiguity with regard to the parity principle, which hasn't escaped its critics[8] namely, with regard to the degree of functional isomorphism required between the regular internal cognitive processes and the external components.

Thus, some – both friends and adversaries of the hypothesis of extended cognition – have read the parity principle as presupposing some form of

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[6] J. Preston, *Belief and Epistemic Credit*, in *The Extended Mind*, ed. Richard Menary (Cambridge, Mass: MIT Press, A Bradford Book, 2010), 262.

[7] Clark and Chalmers, "The extended mind", 8.

[8] See Frank Adams and Kenneth Aizawa, *The Bounds of Cognition* (Malden, MA: Blackwell Pub., 2008), 133-136.

functional isomorphism between what happens within the wider coupled system and the regular intracranial processes. To take Wheeler's words, the interpretation was that "the parity principle states that if there is functional equality with respect to governing behavior, between the causal contribution of certain internal elements and the causal contribution of certain external elements, and if the internal elements concerned qualify as the proper parts of a cognitive trait, then there is no good reason to deny equivalent status – that is, cognitive status – to the relevant external elements."[9]

Nevertheless, more recently Clark felt the need to return on what the parity principle was meant to require, making a few clarifications about how it should be interpreted. Thus, he emphasized what some have subsequently described as a form of "complementarity" between the inner and the outer.[10] According to Clark, the parity principle should not be taken to require some sort of functional identity or similarity between the regular psychological processes implemented by the brain and those unfolding outside the body.[11] The part of the coupled system that lies outside the head can even assume roles which are highly dissimilar to those usually assumed by the nervous system, and contribute differently to behavior.[12] The parity principle should be taken as a mere invitation to avoid chauvinism, and offer equal opportunities to internal and external elements when ascertaining whether they realize a mental process or not.[13]

Nevertheless, Clark does not wish to step outside functionalism.[14] So how can this position accommodate different architectures? Well, the option left is to disregard how the structures at play are internally organized, and appeal to the functional relations with the overall input and output. Thus, Clark emphasizes that what truly matters is "systemic role" each mechanism plays in guiding current responses[15], their contribution to the functional poise of the system, and not how much they mimic what actually happens in the brain.[16]

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[9] John Wheleer, *"*In Defense of Extended Functionalism", in *The Extended Mind*, ed. Richard Menary (Cambridge, Mass: MIT Press, A Bradford Book, 2010), 248.

[10] See John Sutton, "Exograms, interdisciplinarity and the cognitive life of things," in *The Extended Mind*, ed. Richard Menary (Cambridge, Mass: MIT Press, A Bradford Book, 2010), 194; Andy Clark, *Supersizing the mind, Embodiment, Action, and Cognitive Extension* (New York: Oxford University Press, 2008), 115. At some point, Clark described the attempt to find such a homology as "an all too common misreading of the parity principle" (Julian Kiverstein and Andy Clark, "Mind Embodied, Embedded, Enacted: One Church or Many?", *Topoi* 28 (2009), 3; see also A. Clark, "Curing cognitive hiccups: a defense of the extended mind", *The Journal of Philosophy*, vol. CIV, no. 4 (2007), 166).

[11] Andy Clark, "Memento's revenge", in *The Extended Mind*, ed. Richard Menary (Cambridge, Mass: MIT Press, A Bradford Book, 2010), 52.

[12] Kiverstein and Clark, "Mind Embodied, Embedded, Enacted" 3.

[13] Clark, *Supersizing the mind*, 104.

[14] Clark, *Supersizing the mind*, 96.

[15] Clark, "Memento's revenge" 52.

[16] Kiverstein and Clark, "Mind Embodied, Embedded, Enacted," 3.

Nevertheless, although the parity principle does not require functional identity, functional identity leads to parity, especially if we want to stay functionalists. Being liberal to what can constitute cognition and allowing into the cognitive realm components that have wildly different architectures, and consequently might have varying behavioral effects, does not mean that the functionally identical architectures do not stay cognitive, even in this permissive interpretation of parity. Actually, as perfect replicas, they are bound to have an identical output with what goes on in the head, which might control in the same way the behavior, and as such would have the same contribution to the poise of the system. Such an identical shaping of behavior coming from functionally identical structures is an example of parity, according to Clark's requirements. Moreover, were we to find somewhere processes isomorphic to those in my head they should be counted as cognitive, according to functionalism. The isomorphic mechanisms instantiate actually the simplest and neatest cases of parity, and as such they can guide our intuition easier in certain rival thought experiments, aimed at showing that Clark's principle doesn't work, because we can have external items complying with it that don't plausibly realize any of my cognitive processes.[17]

But before seeing what happens when we externalize to such parity compliant devices, we would like to set the grounds by stressing a few points. First of all, constructing functional descriptions means tracking causal chains. Secondly, saying that A causes B doesn't amount to holding that the process leading from state A to B isn't further decomposable into an array of intermediate states and processes. For instance, pushing the throttle pedal causes the car to run faster, but only through the mediation of a host of intervening states and processes in the carburetor, engine, transmission system and so on.

Now, suppose the city I live in is struck by a heat wave. Consequently, I get the sudden urge to have a soft drink, which in turn makes me action a vending machine, by inserting coins into it. The machine passes through a series of states that make it eject into a tray a can of soda and the change it owes me. As a result, I pick up the change, then the can, which I drink. We have here a causal sequence of events that begins with the temperature rise, and ends with me performing of a set of behaviors, like picking up some objects and drinking soda.

In addition, imagine that a certain simple subroutine involved in my decision to have a soft drink finds its isomorphic counterpart in an array of functional states the machine passes through, while controlling the delivery of the soft drink. Think, for instance, of the mental process that computes the amount of money I will get from the machine as change, and that consists in the application of the arithmetical algorithms we were taught in elementary school. We could easily have the same rules written into the program that controls the

[17] One can actually modify the thought experiment below to allow more dissimilarity, albeit this will more likely result in a less efficient "intuition pump".

machine. Imagine that we actually do such operations in the head, as I need to do such calculus in order to know whether I should search for one or two coins in the dedicated tray, or whether the money I insert are enough to buy me a soft drink. Thus, the machine could be provided with a suitable set of internal states, corresponding to each human mental state involved in mental calculus, and onto which the common arithmetic algorithms would be applied, whenever the machine calculates how much money it owes me or whether what I entered is enough for a can. This will allow for a seamless mapping between the mental and the matching machine states and transformations, and so we could have isomorphic processes. This way, the inner workings of the vending machine come to perform operations like additions, subtractions and multiplications that, had they been done in the head, they would be recognized as cognitive, making them comply with the parity principle.

Moreover, in the above scenario, the inner workings of the machine modulate the same way our behavior. The vending machine states lead to the same effects as my internal states. Concretely, the inner workings of the machine, make me do certain things, like empty the contents of the trays. The loud sounds of objects falling into those trays prompt me do that. We have here a process that is triggered by the heat wave and that ends with me manipulating in specific ways certain objects and drinking soda. Within it, both my internal computations and those inside the machine are links in a causal chain that ends with those behaviors. So they must have the same end effects. They even have the same causes, as at the chain of events they are part of is triggered by the same event, namely a rise in temperature, which constitutes stimulus triggering my behavior.

Of course, there is a difference. My internal states, involved in planning and acting, need the intercession of states within the machine, so that I could proceed with picking up the can and money, and finally enjoy the soft drink. Also, what happens inside the machine is not directly generated by the heat wave, requiring the mediation of an array of states in my head, that make me action the device, and so is the causation of my behavior by the machine mechanisms, which needs, for instance, the intercession of some processing by the brain of the sound of the coins falling, in order to trigger my reaction to reach for them. Yet as we have seen, this can't preclude the states thus separated being related as cause and effect, because, generally speaking, there might be many intermediate states between what we identify as cause and effect.

We have therefore an example of a mechanism that shapes behavior in the same way the brain structures do.[18] Were we to find in the head structures

[18] Albeit controlling a narrower range of behaviors. It might be objected that the inner workings of the machine do not contribute to controlling the same set of behaviors as my internal arithmetic routines. Their influence is limited only to eliciting a narrow kind of soda-drinking behavior, while the latter mechanisms make me do a lot more, like determine how I fill in the income tax forms or solve Sudoku puzzles. They do not have the same contribution to what the

that do arithmetics and, as a consequence, make us stretch our hand and pick coins and the beverage, we would have no problem considering it cognitive. As a matter of fact, there actually are such structures performing this sort of computations. When I inserted the coins in the slot, I calculated whether I entered enough money and how much change I should be given. This reasoning made me proceed with entering my hand into the beverage tray and grope for the can, and do the same thing in the coin tray until I retrieve, say, two coins. Nevertheless computations in the microchip of the vending machine cannot be said to extend our cognitive processes. We have therefore an example that complies with the parity principle, and that doesn't yield any extended cognitive system.

Some Diagnoses

Let us summarize briefly. Although not inconsistent as the Otto example, the cyberpunk thought experiment was inconclusive because an independent reason was needed so that that the ensemble formed made out of the human and his computerized tools could be attributed the cognitive processing. Sure, the parity principle might have provided that independent reason (though that would have not made the thought experiments any more useful), but it doesn't as it is simply false.

There is a general reason for which parity principle fails. It lies on the reliance on function for delineating cognitive systems, which creates problems. On the most general level, one should note that any good biological reason for manifesting certain behaviors turns whatever hardware supports such a worthy goal into a part of a cognitive system. This should go for devices designed to help us quench our thirst, but the commonest form of instantiation of this problem is elsewhere. Biological functions can be carried out both by cognitive and noncognitive mechanisms. One can easily figure a situation where the same control is carried out by cognitive mechanisms, that contribute identically to the poise of the organism. As a matter of fact, there are many control systems for behavior that are not cognitive. For instance, the push back of the kangaroo's legs when it hits the ground is not exclusively due to some neural control mechanisms that trigger a motor reaction. Amongst the many factors that control the kangaroo's hopping are elastic tendons that, like a spring, accumulate kinetic energy at landing and pull back the lower leg for a new jump.[19] Were we to find in the

organism does as the intracranial states. Nevertheless, as we have seen, this is not required by the liberal interpretation of the parity principle Clark promotes, and sometimes emphasizes expressly (Kiverstein and Clark, "Mind Embodied, Embedded, Enacted," 3). After all no one expects a pen and paper to have the same impact on our capacity do do sums than our brain; for instance by the means of the outer tools we can work with larger numbers.

[19] R. McN. Alexander and Alexandra Vernon, "The mechanics of hopping by kangaroos (Macropodidae)," *Journal of Zoology* 177 (1975): 265-303.

head a mechanism that controls a similar movement of the lower limbs, by the usual means of some banal neural processes in the brain, which would make the animal energetically distend its legs when it lands, we would consider them cognitive right away. Nevertheless the action of the tendons is merely mechanical, due to the elastic properties of the proteins in the tendon. Yet, this makes for a set of complex interaction between the action of the tendon, the nervous terminations involved in proprioception that pick the effects of the tendon distension, the brain that orders the muscles to compensate, so that the animal would head in the right direction, at the right pace, and would maintain its balance, which in turn redounds upon the way the tendon is tensioned and releases back energy, generating more processing in the brain and so on. This amounts a coupled system with components in permanent interaction and which has parts that, although comply in the way they function with the parity principle, do not get to exemplify a cognitive process.

The same problem could be illustrated by the hormonal modulation of behavior. The way parts of the endocrine system interact with the neural system satisfies the formal conditions for being coupled system realizing cognition. They are permanently interlocked with the nervous system, regulating what the animal does. Neuroendocrinological mechanisms influence the nervous system. But most of all, were we to find a cortical mechanism that is tailored to fulfill that regulating function with respect to behavior by the means, we would not hesitate to consider it cognitive. For instance melatonin levels, increases after dark, making us sleep (of course ceteris paribus)[20]. Nevertheless, the same is true of our conscious reflections to go to bed when the night falls, which also makes us go to bed under normal circumstances. And the array of examples could go on and on.

True, the kangaroo's tendons or the endocrine system lie entirely within the borders of the organism. Nevertheless, the parity principle can't be taken to discriminate in that respect. As we have seen, the parity principle was presented precisely as an urge not to discriminate between the inner and the outer, or, to put it in Clark's words as a veil of "metabolical ignorance".[21] So the border of the skin and skull should not count here. On the other hand, this makes the parity cut both ways, blurring the borders between biological kinds that everything keeps apart, from mechanisms and investigating methods to evolutionary history.

Evolution

Now if the functional isn't enough, we must turn elsewhere for a working method that could help us decide what is to be deemed cognitive and what

[20] And vice-versa, the decisions of the brain influence melatonin secretion. For instance the decision not to go to sleep, but to turn on the lights and read a book instead, lowers the level of melatonin, as a result of light exposure.

[21] Clark, *Supersizing the mind*, 114.

shouldn't. Luckily, there is one more way to argue for the idea of an extended mind, that can put us on the right track, albeit it needs some tinkering to make it helpful. It pops out occasionally as part of the arguments aimed at tracing the borders of the mind. We are talking about evolutionary argumentation.

Thus, Sterelny points at two evolutionary models that have striking affinities with the hypothesis of the extended mind, and can be considered as sources for an evolutionary account of it[22]. One of them is Dawkins' idea of an extended phenotype[23], namely that the phenotypical effects of a gene should not be confined within the limits of the body; on the contrary, we should consider as part of the phenotype the outer structures effected by the genes, like the beaver's dams and bird's nests. From such a standpoint, the beaver's dam is as part of the phenotype as its beaver's fur.

Unfortunately Sterelny rejects the extended phenotype view as an evolutionary account of what goes on with cognitive outsourcing. The problem Sterelny sees is that it requires a "gene for" building nests, dams and so on, which increases the chance for the production of such items in their typical environment. They are developmentally stable, heritable and predictable in their ecological effects. On the other hand, there is no similar "gene for" using pen and paper. My use of pen and paper in order to enhance my cognition is due rather to the fact that former generation humans perfected such artifacts, with which they populated the environment of the present generation.[24]

Sterelny prefers a second evolutionist approach, stemming from the idea of "niche construction". In a nutshell, the latter holds that species are not passively adapting to a fixed set of selective pressures, but are also actively modifying their environment.[25] Thus, according to Sterelny, when it comes to cognition, humans populate their environment with thinking tools and elaborate techniques to use them, which are passed to the new generation, adding to the set of resources humankind can tap into when solving cognitive problems. It is this rich complex of objects and techniques – or "collective resources", as he calls them – that scaffolds the intelligence of humans.

As a matter of fact I can agree entirely with the above depiction of the way cognition is scaffolded within its niche. But there are three problems with Sterelny's account. On one hand although there is no "gene for" specific epistemic artifacts, it doesn't mean that the use of those epistemic tools isn't genetically informed. Secondly, Sterelny's theory about the way human niche is

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[22] Kim Sterelny, "Minds – Extended or Scaffolded", *Phenomenology and The Cognitive Sciences*, 9, vol. 4 (2010): 465-481.

[23] Richard Dawkins, *The Extended Phenotype* (Oxford: W.H. Freeman and Company, 1982).

[24] Stelelny, "Minds – Extended or Scaffolded", 468-469.

[25] For an overview of the consequences of the niche construction idea, see John Odling-Smee, Kevin F. Laland, and Marcus W. Feldman, *Niche Construction: The Neglected Process in Evolution* (Princeton, NJ: Princeton University Press, 2003).

populated with collective resources is no rival to the extended phenotype, as both can be smoothly integrated. And thirdly, niche construction per se cannot ground the extended mind hypothesis anyway, although it complements it nicely.

First and foremost, we have to remember that is of the essence of the phenotype to be brought about by the interaction of the genotype with the environment. Thus, jungle crows (Corvus macrorhynchos) and carrion crows (Corvus corrone), living in urban environments build their nests out of wire coat-hangers that they steal from balconies, where they are used for drying laundry, instead than using only sticks.[26] The use of these artifacts isn't the result of crow's specific gene, that was selected for picking up coat hangers as such, any more than our genes were selected for use pen and paper. In ancestral environments natural selection could not have favored the use count hangers, nor of pen and papers, as such items are recent inventions. The genotype of the crow was shaped for picking sticks, that it uses in its original environment, but for which, at some point the crow found substitutes. Nevertheless there is a genetic mechanism at play here. Not all species of birds have a similar material selection. A species with a different set of genes wouldn't pick coat hangers, nor would species other than man be capable to use pen and paper to do arithmetic. Finding (cultural) forces that furnish the environment with useful artifacts doesn't automatically exclude genetic factors, which must shape the cognitive makeup so that one could employ them. The genes shaping our organisms gave us the propensity to use pen and paper, unlike the genes of dogs or cats, that don't do that, although, no doubt, there is no gene "gene for" using pen and paper. Therefore, we cannot discount the gene factor in an account of extended cognition. The capacity to employ such and such environmental item is due to the specific genes, that shaped our brain such that it could take advantage when encountering certain items. The likelyhood of using epistemic tools is increased by the possession of certain genes, which thus get the chance to form an extended phenotype. An ape, which is incapable of doing arithmetic, will have a null chance at employing writing for that, while our makeup, as a species, leads to the use of writing aids for the purpose of calculating in a multitude of cultures. This predisposition is inheritable as any other due to genes, and quite predictable. We have very good reasons to expect that the next generation to use pen and paper, in an environment that provides them with the right education and utensils. In these respects, emphasized by Sterelny, recruiting for cognitive purposes novel items present in the environment is as genetically determined as the non-augmented functioning of cognition and the functioning of many other structures we deem as products of the genotype.

[26] J. Matsuo, "The relation between nests in which jungle and carrion crows used wire hangers and the vegetation coverage in Osaka City and Sakai City", *Strix* 23 (2005): 75-81.

What niche construction, at least in the Sterelny's variant, brings over and above is a description of a second mechanism of inheritance, cultural in its nature, that shapes environment. Nevertheless the two mechanisms – genetic and cultural – dovetail nicely in a very robust theory of extended cognition. As we have emphasized the phenotype is the joint result of genes and environment, which can be of several types. For instance, the gene might get to shape the phenotype in a "pristine" environment, where there are no novel or artificial artifacts that it can recruit, be they epistemic or mere non-cognitive tools. A crow in its original environment would use only twigs. Mutatis mutandis, an environment with no suitable cognitive artifacts would leave the individual only with its intraorganismic cognitive resources. Nevertheless environments change, and consequently, so do factors with which the genotype interacts in order to produce the phenotype change. At one point, the environment of crows became highly urbanized. The cognitive mechanisms of some of the species that enabled them to build nests, as they were genetically shaped, were also triggered by several artificial items, such as the wire hangers, which happen to be reasonable good building materials.[27]

Humans[28], as the idea of niche construction holds, can shape shape their niche, which creates a specific environment that interacts with genes influencing their cognition. They can do it as individuals, by spontaneously inventing epistemic artifacts (or modify those already in use so that they could better suit their purposes), and these can be even passed into the common material culture. Whatever mechanism underpins invention, we might realize that our cognitive mechanisms for carrying out a certain cognitive task are better served by employing outer items, from pen and paper to supercomputers. For instance, at some point in time, someone must have realized that one can do arithmetics better by employing physical tokens, which kick-started the development of abaci or other similar implements. Thus, our capacity to apply algorithms gets to work with external items rather than internal representations. Instead of, for instance, imagining tokens [29], and mentally performing transformations on such representations in order to, say, find the solution to an addition problem, we can algorithmically manipulate physical items available in

[27] For an attempt to integrate the behavior of these crows into the niche construction theory, see John M. Marzluff and Tony Angell, "Cultural Coevolution: How the Human Bond with Crows and Ravens Extends Theory and Raises New Questions," *Journal of Ecological Anthropology* 9 (2005): 69-75, who see this case as an example of human-crow cross-niche construction.

[28] But not only humans. There are also other species that shape their environment, rearranging it for cognitive purposes. For instance certain spiders create special threads, whose vibrations inform them that prey has landed in their web (cf. D. Klarner and F. Barth, "Vibratory signals and prey capture in orb-weaving spiders (Zygiella x-notata, Nephila clavipes; Araneidae)", *Journal of comparative physiology*, Vol. 148, Issue 4 (1982): 445-455.

[29] Or similarly using any other type of representation.

the environment. This means, inter alia, as Clark emphasizes[30], substituting offline representations with another set, which is perceptual and online, and thus easier to work with, which accounts for their adoption. This way, we press into use such items, that modify the way things have been done up to that point. This amounts to a situation in which a gene gets to produce phenotype by the means of a mechanism that includes external items, rather than using only factors within the limits of skin and skull. And of course, the genes structuring our calculation capacities can be offered a ready made tool for thinking, in the manner Sterelny's model says the society takes care to. But that won't make any difference with regard to the genetically determined mechanism into which such items get to be integrated. From this standpoint, it is irrelevant whether the tools are created by ourselves as ad hoc implements or by others – either way, they enable the gene project the effects of the genotype into the environment in order to create the extended phenotype. Nevertheless, the case of cultural transmission represents one way our genes get to interact with a certain type of environment, and must be documented in order to have a complete picture, that goes beyond the fundamental mechanisms.

What's more, it is paramount to be able to tackle the extended mind question by the means of the idea of an extended phenotype, as the niche construction theory isn't capable to account properly for the extended cognition. Proper instances of mind extension can't be explained away as limiting cases within the wider framework of niche construction.[31] The latter isn't capable to account for the constitutive nature of epistemic artifacts. Thus it is entirely possible that in spite of their essential role with respect to cognition, epistemic artifacts might stay invariably ancillary and never get to be constitutive, as for instance claims Rupert's "hypothesis of embedded cognition".[32] The fact that culture makes us use pen and paper for cognitive purposes doesn't tell us whether pen and paper is constitutive or merely instrumental. For instance the air conditioning machine, which provides me the comfort necessary to solve efficiently complex mathematical problems is merely an aid for my cognition. It is so in spite being in my environment precisely for the same reasons (as cultural niche modification that favors cognitive activity) why pen and paper are there, which are, in some accounts at least, plausible candidates (according to the extended mind hypothesis) for the realization of mind. One needs to assume more than the fact that culture produces tools and technologies which can be employed for cognitive purposes.

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[30] Andy Clark, "Reasons, Robots and the Extended Mind", *Mind and Language* 16 (2001): 132-133.

[31] Cf. Sterelny, "Mind, Extended or Scaffolded", 480.

[32] Robert Rupert, "Challenges to the Hypothesis of Extended Cognition", *The Journal of Philosophy*, Vol. 101, No. 8 (2004):389-428; Robert Rupert, *Cognitive systems and the extended mind*, (New York: Oxford University Press, 2008).

And this is precisely where the idea of an extended phenotype comes handy, as it dissolves traditional phenotypic boundaries. It can provide the sort of neutrality with regard to the outer items that can realize cognitive processes advocated by the parity principle, without having to deal with its unwanted fallouts. A phenotypical trait, like exhibiting symbolic thinking or having semantic memory, can be equally instantiated by elements inside or outside the body, indiscriminately.[33]

The external realizers may include a mix of natural items and artifacts. Also the set of realizers can change over time, as the environment with which the genotype interacts changes. Both the natural and the artificial, the internal and the external can help a set of genes aggregate mechanisms, function of what it gets to interact with. Let us think again here at the crows whose nest is made out of clothes hangers, which illustrate very well these two points. The latter artifacts replace the usual items the natural history of crows made them use as materials. Similarly whatever genes endowed us with the sort of symbolic thinking that enabled us develop mathematics, at some point in time the mechanism was offered the possibility to manipulate symbols on paper rather than work only with internal representation. From an ontological standpoint, this means that the bodily building blocks normally put together as a result of certain genes, in order to set up the various types of cognitive mechanisms, can be occasionally replaced or supplemented with items in the environment and still express that kind of mechanism. The important thing to note is that even thus modified, such mechanisms can still express the same biological kind. A nest is still a nest, even if it is made out of wires and clothes hangers. Similarly, we could stay within the limits of the same type of cognitive process even the mechanics of the information crunching get to include external artifacts like computers or pen and paper. The genes at the origin at various biological mechanisms allow typing them, and do that irrespective of the location of what enters into their composition and even of the natural or artificial origin of those elements. It is this that might make cyberpunks, as a whole, plausible cognitive systems, rather than parity.

Sure not always such a replacing and supplementing exercise yields cognition. A less fortunate species, whose genes make it pick materials that are totally unsuited for building a nest might lead to a structure that can hardly qualify as such, for whatever reason would prevent us thus doing so. Similarly, not all use of external items would lead to an extended cognitive process. There might be various strong reasons not to consider these odd cases as realizing the

[33] Our internal and external variants of a certain kind of cognitive process would represent an example of polyphenism. But who says polyphenism, says variants of the same type of trait. External and internal items would be realizers of two different morphs of the same cognitive process. This means that mind extends into the environment, as one type of cognitive process can be instantiated by both internal and partly external realizers.

old type of process. For instance, as it is the case with Otto and his notebook, it might introduce inconsistencies amongst the psychological attributions we make. If that inconsistency cannot be conveniently eliminated, for instance by operating changes elsewhere in folk psychology, we will have to step back. Other such extensions might lead to theories that are more complicated and so on. The general constraints of scientific theory construction can provide us with examples of such interdictions to apply cognitive concepts to certain biotechnological hybrids or to other "coupled systems". Nevertheless sometimes there aren't such reasons, as there aren't reasons to consider the coat hanger construction of the crow as a nest. Then, at least for the sake sort of simplicity thus obtained in theorizing Clark and Chalmers talk about,[34] we should keep such extended mechanisms within the same conceptual pigeonhole.

Concluding Remarks

This attention to the mechanisms genes build offer us a new type of criterion deciding what is a cognitive system. The extended mind theory, in its parity based, classical form, is a type of functionalism, which is explicitly assumed as such by Clark[35]: by using parity, it employs the gross functional role to establish what to be considered cognitive.[36] Our approach goes one step lower, and puts to work a criterion that relies on the mechanisms implementing the algorithms. Unlike the functionalism of Clark, which is neutral with regard to what implements mental processes, our story points at the mechanism at whose origin is a certain gene, which can have extended and non-extended variants.[37] It is this implementing mechanism that singles out what is to be

[34] Clark and Chalmers, "The extended mind", 14.

[35] See Andy Clark, "Intrinsic Content, Active Memory, and the Extended Mind", *Analysis* 65 (2005), 2; Andy Clark, "Pressing the flesh: A tension in the study of the embodied, embedded mind?", *Philosophy and Phenomenological Research* 76 (2008), 37; Andy Clark, *Supersizing the mind*, 96 etc.

[36] Moreover, Mark Sprevak ("Extended cognition and functionalism", *The Journal of Philosophy*, 106 (2009), 503-527) demonstrates, quite cogently that Clark's hypothesis of extended cognition is a consequence of functionalism. Last but not least, as Wheeler emphasizes, because functionalism entails multiple realizability, it allows cognitive processes to come in two different formats, extended and non-extended (John Wheeler, "In Defense of Extended Functionalism," in *The Extended Mind*, ed. Richard Menary (Cambridge, Mass: MIT Press, A Bradford Book, 2010), 248).

[37] As a matter of fact in a new environment it can generate a mechanism with quite a different architecture, because it interacts with novel environmental items. This provides for a natural explanation for why the functional description of the mechanisms implementing the wider coupled systems can be so utterly different of those inside our head. This has created a great deal of controversy, some of the adversaries of the extended mind hypothesis objecting that we won't be able by allowing extended and nonextended variants of the same cognitive processes to come up with unitary laws governing such proceses, but rather with a motley crew of anarchically

considered as exemplifying a certain type of cognitive process, rather than its higher level functional description in a mereological hierarchy.

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behaving mechanisms (see Rupert, "Challenges to the Hypothesis of Extended Cognition", 410; Adams and Aizawa , *The Bounds of Cognition*, 52; Andy Clark, "Curing cognitive hiccups: a defense of the extended mind", *The Journal of Philosophy* 104, no. 4 (2007), 174). As long as we have origin criterion, we will have a common mechanism - that by which the gene constructs the phenotype – which is at least as good as anything we can find in genetics, where to the degree such issues arise, they don't seem to create real problems.