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Extending the Mind Conservatively

One of the recent major trends in cognitive sciences and its philosophy consists in emphasizing the importance of external props for our cognition. Probably the most striking position here is that of Clark and Chalmers and their "extended mind thesis" (EMT), which deems such outer items not merely as ancillary but as parts of the realization base for the mental. According to EMT, by using various epistemic tools, ranging from supercomputers, which exponentially amplify our capacities to carry out mathematical and logical operations, to humble memory enhancing notebooks, our biological apparatus comes to be linked through an array of reciprocal causal interactions with such external entities, thus creating a "coupled system", which, as a whole, can be seen as cognitive in its own right. Removing the external component would lead to a drop in competence, as it would were we to disable part of the brain (Clark, Chalmers 1998: 7-8).

Central for their approach is the so-called "parity principle", which holds that:

> PP: 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: 8).

PP has not only been intensely discussed but also occasionally misinterpreted. Probably the most inviting way to read PP is to regard it as positing some sort of benchmark, to be identified through examination of the causal structure making up the internal cognitive processes. By matching the network of inner causal relations to a fragment of the external world, one can determine whether the latter can also be considered as implementing a cognitive process.

Yet we should reject this tempting interpretation. At some point, Clark came to call such an interpretation "an all too common misreading of the parity principle" (Kiverstein, Clark 2009: 3, cf. Clark 2007: 166). According to Clark, PP should be seen merely as an invitation to shed our prejudices and offer equal opportunities to internal and external elements when ascertaining whether they realize a mental process or not (Clark 2007: 167). It must not be taken to require any sort of functional identity between the regular psychological processes implemented by the brain and those unfolding outside the body.[1] Extended cognition need not be implemented by the identical or even similar architectures (Clark 2010a: 52). Moreover, he even accepts that the external subsystems can assume roles which are very unlike those implemented by the wetware and influence behaviour in a different way (Kiverstein, Clark 2009: 3). The parity principle was merely intended to engage our rough sense of what we might intuitively judge to belong to the domain of cognition, while asking us not to be distracted by the border represented by skin and skull (Clark 2007: 167).[2]

What actually matters is the "systemic role" the non-neural items play in guiding current responses (Clark 2010a: 52), their contribution to the functional poise of the system (Kiverstein, Clark 2009: 3). It is the way they integrate and complement the rest of the components that makes the external bits cognitive (Clark 2010b: 93). Consequently, we should rather look at the kind of contribution of the candidate element and check whether such contribution, had it been made by processes in the head, would have counted as cognitive.[3]

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[1] The critics of the parity principle have been quick to point out disanalogies between the functioning of the outer and the inner part of the putative coupled systems (Adams, Aizawa 2001, Rupert 2004), and Clark has repeatedly acknowledged this heterogeneity (e.g. Clark 2010b: 93). Therefore, if the parity principle is to work, it cannot assume such strict standards (requiring identity of functioning and contribution), and I will construct my argument accordingly.

[2] This liberalism with regard to the mechanisms constituting the coupled systems was embraced by many others in the extended mind camp. As Sutton emphasizes, such views became increasingly important as the debate went on. Sutton even advances a certain "complementarity principle", which stresses that the external resources are not required to mimic the internal mechanisms in order to become part of a cognitive system. The external and internal components can assume different roles, as long as they collaborate in providing adept thinking and acting (Sutton 2010: 194). This reformulation is nevertheless pretty faithful to the sense of PP intended by Clark. According to Clark, the parity principle is to be understood "as a call for sameness of opportunity, such that bio-external elements might turn out to be parts of the machinery of cognition even if their contributions are unlike (perhaps because they are deeply complementary to) those of the biological brain" (Clark 2007: 166-167).

[3] Ultimately, what makes a process cognitive is that it supports certain kinds of counterfactual and actual behaviour, or more precisely, various types of intelligent behaviour (Clark 2010b: 92-93). One thing that needs to be emphasized is that equating the cognitive with what supports intelligent behaviour merely shifts the problem, rather than solving it. Delimiting intelligent behaviour is as hard as delimiting cognition. This yields a rather unhelpful criterion (cf. Clark 2010b: 92). But perhaps we should just trust our intuitive understanding of what "intelligent behaviour" is and use it? Even so, as I shall demonstrate, we will still be unable to trace the borders of the cognitive in this way. Furthermore, even if we had a clear-cut definition or understanding of what it is to be a mental propriety, that still would not help. There are cases when external processes perfectly on a par with undoubtedly cognitive processes cannot be considered cognitive.

Unfortunately, as I will attempt to show, when upholding an extended view of the cognitive phenomena, parity is not the best approach. The liberalism it forces us into in order to be a plausible proposition turns out to be too permissive, compelling us to overextend the territory of cognition. Nevertheless, this is not to say that the extended view is doomed. In fact, it is supported by the way science works. As it will turn out, in spite of its revolutionary pose, the idea of extended mind could be shown to be an offshoot of an all too common way science expands the application of its concepts to new instances. The way normal science operates can accommodate extended mind in a way that makes parity unnecessary, eliminating the epistemological hurdles PP creates by conflicting with established bodies of scientific knowledge. Moreover, the state of the art in certain domains strongly recommends the extended view as the conceptual framework that could best systematize its current knowledge.

THE PROBLEM OF SYNERGY

The problem faced by the parity-based approach stems from the fact that nature is often served by the joint forces of multiple systems acting synergically. Living beings are regulated by a variety of cognitive and non-cognitive mechanisms, which frequently have to complement each other in order to ensure that the organism reacts as it should to its environment. Sometimes mechanisms of the latter type assume roles that, were they implemented by processes in the head, we would not hesitate to consider cognitive.

Nevertheless, according to the best of our science they are included in various non-cognitive kinds. Thus we can find non-cognitive processes that exhibit the same "systemic" functional role we might assign to paradigmatically cognitive mechanisms, such as certain types of rational consideration involved in decision-making, which weigh the various factors that affect us. If we found such processes in the head, we would not hesitate to regard them as cognitive.

Probably the most instructive in this respect are the various endocrine mechanisms, which are amongst the processes that regulate the adaptive responses of living beings. Take for instance the role of leptin, which is a hormone produced by the adipose tissue. *Ceteris paribus*, the level of leptin in the serum is proportional to the amount of fat, which makes it carry information about the state of adipose reserves to the brain. The level of leptin is also affected by a few other factors linked to the energy balance of the body. Prolonged fasting substantially decreases the levels of leptin, while overfeeding increases them markedly (Mantzoros 1999). Intense exercise lowers the concentration of leptin (Essig et al. 2000). The level of hormone has behavioural effects, as it acts on the nervous system. It informs the brain about the balance between energy intake and expenditure, thus influencing feeding behaviour by making the individual adjust its food consumption in order to compensate the deficit or excess (Friedman, Halaas 1998, Davis et al. 2011).

Were we to find, confined within the limits of the brain, a mechanism that responds to the amount of food intake and the amount of fat deposits by issuing an output that modulates the eating drives so that the individual will not become overweight or too skinny, we would consider them cognitive. And there is such a mechanism: this is what our rational deliberations actually do whenever we are prompted to consider how much we weigh, whether we exercised, and so on.[4]

The hormonal and neural components seem to form the type of tightly integrated, causally "coupled system" required by the "active externalism" of Clark and Chalmers. The adipose tissue and whatever else is involved in setting the levels of leptin on the one hand, and the brain, on the other, form a coupled system, where each part is active in driving behaviour and impacts the other component. Leptin influences the nervous system. It acts on special receptors in the hypothalamus, thus playing a major role in determining the alimentary drives (see Sahu 2004). Reciprocally, the decisions taken by our brains — to eat, fast, or exercise — affect the level of fats in our organism and, implicitly, leptin secretion.

Moreover, when the hormonal mechanism is rendered ineffective, the competence of the person to regulate its food intake drops dramatically. For instance, in cases of leptin resistance induced by environmental factors, people tend to gain too much weight (Shapiro et al. 2008). So does an organism having a defective gene that impairs leptin secretion (Zhang et al. 1994). If we remove the hormonal component, the system competence will decrease, just as it would if parts of the brain involved in integrating various types of information in view of a decision were impaired. Thus it has been found out that binge eating in patients with frontotemporal dementia is underlain by the disruption of the cortical integrative systems harnessing eating behaviour — function of various kinds of information fed into them via cerebral pathways (Woolley et al. 2007).

The above studies emphasize one more thing. Leptin secretion is deeply complementary to the decision mechanisms in the head. Equilibrium can be achieved only through the joint effort of both components, which must effectively contribute to the whole regulatory process, so that the mechanism could stay in equilibrium and display the requisite behaviour. As the above scientific data show, the cortical processes are not sufficient to keep body weight in check. Both hormonal stimulation and conscious consideration are required.

The fat–brain system meets even the additional criteria advanced at one point by Clark and Chalmers (1998: 13, cf. Clark 2010a: 46) in order to block possible counterexamples. They require that:

[4] We might even say that this is a type of mechanism that supports intelligent behaviour. Though defining intelligent behaviour is probably as hard as defining cognition, as it was previously emphasized (see the previous footnote), if one holds that processes become cognitive by supporting intelligent behaviour, the endocrine mechanism would fit the bill, because it modulates the same behaviours — such as eating or refraining from eating in certain circumstances — as the ones supported by the deliberative processes.

1. The resource should be reliably available and typically invoked.
2. In principle, the information thus retrieved should not be subject to critical scrutiny and must be automatically endorsed.
3. The information should be easily accessible when required.

The secreted hormones are constantly present in the system and are continuously modulating our behaviour. Under normal conditions, a certain level of hormone in the bloodstream informs the brain about the energy balance, and the latter goes on to employ the information thus conveyed. This has the following consequences: (1) it makes the brain get the information simply by being irrigated, so that hardly any physical event can deprive the brain of this resource. Normally, the brain will use the information, as it is designed to do, and its decisions will be issued as a result of the interaction with the endocrine system. (2) The information is automatically endorsed by the hypothalamus, which promptly makes us feel inclined to eat more or less than we would otherwise. It is not normally subject to scrutiny. We just feel more or less willing to eat and, unless we are prompted by special circumstances to be suspicious about the appropriateness of our alimentary drives, by default, we do not question our inclinations. The hypothalamus automatically endorses what the level of hormone tells it and subsequently influences our motivation. (3) It is also hard to imagine a type of information which is more easily accessible. Normally, as long as the brain is alive and irrigated, the information will be there for it.[5]

Such a multiplicity of regulatory forces poses serious problems to Clark's approach, since it represents a pool of non-cognitive processes some of which pass the parity test. Of course, leptin secretion is an internal process, but if we are going to deny any significance to the limits of our skin when granting cognitive status, as the parity principle asks us to, that should not have any importance whatsoever. Therefore, we should be prepared to deem the ensemble formed by our adipose tissue and the nervous system as forming a cognitive system.

Thus parity clashes with our scientifically informed intuition, and ultimately with the way our best science carves nature at its joints, since neuroendocrinology has drawn a line between endocrine and proper cognitive processes. Yet the supporter of an overtly revisionist stance, such as EMT, could disregard the subsequent disruption in the established ways of doing science in a given discipline and ask for it to be reformed according to the new approach she advocates. Nevertheless, the trouble runs much deeper, ultimately amounting to the impossibility of distinguishing between the cognitive and non-cognitive. Hence the problem not only contradicts the tried and tested methods of doing science but also becomes a self-defeating approach of ascertaining the borders of the mind. The reason lies in the fact that PP makes cogni-

[5] Of course, the information conveyed by various levels of hormones might not be consciously invoked or endorsed. Yet we should not interpret (3) as requiring conscious access or availability to the consciousness, since the output of many cognitive processes does not hit the consciousness, nor does Clark seem to demand it; see Clark, Chalmers 1998: 17.

tive any regulatory processes which somehow impact the brain and can be carried out by the mind.

Think in this respect of the kangaroo's legs, which feature an elastic tendon that accumulates energy at landing and releases it when the animal rebounds. This spring action is a simple process that partly controls hopping. Certainly, kangaroo locomotion is also neurally controlled. The brain modulates the muscle contraction, thus modifying the pace, direction, or height of the hops. Here too we have a two-way interaction, which makes tendons and nervous system drive locomotion. The brain is typically informed about the tendon strain, through the various mechanisms of proprioception. This creates a collaborative apparatus that controls kangaroo locomotion. When the kangaroo hits the ground, the tendon dampens the fall, then makes the animal rebound while the nervous system controls muscle contraction. Were we to find mechanisms in the brain that control the gait analogously, we would consider them cognitive.[6]

For instance, we could imagine an animal whose landing and rebound are controlled by dedicated nerve centres, processing the proprioceptive information, dampening and initiating the jump by sending electric pulses to muscles, the same way humans, who lack appropriate elastic tendons, do when they practise clapping push-ups. Nevertheless, the tendon does not implement a cognitive function, both according to what biology says today and in line with our intuition. More importantly, we could go on with similar examples, real and — since the issue is conceptual — imagined. For any punctual brain function, nothing a priori prevents us from performing thought experiments and imagining a species where that function is carried out by other types of mechanisms, providing the same services for the organism, like in the kangaroo example. And vice versa, for any regulatory process belonging to other biological genera, we could imagine a species where the same task is carried out by cognitive means. This forces us to embrace an extreme form of embodiment that sees any physiological process as cognitive and amounts to depriving "cognitive" of any possibility to circumscribe a peculiar class of processes amongst our bodily mechanisms, making it effectively useless as a scientific category.

Thus the attempt to spell out a tenable analysis of the parity principle (or even to update it) by adopting a liberal view about cognition, based on functional complementarity of internal and external mechanisms, leads to failure. More generally, it seems that any role-based approach is bound to fail. When building structures that need to address a certain environmental demand, nature simply does not care whether the mechanism in charge is cognitive, endocrine, or belongs to any other kind. As long as the job gets done, the kind of structure put to work — and this should hold for situations where behaviour is to be shaped in a certain way — is ir-

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[6] And, no doubt, the brain is reliably informed about the state of the locomotory apparatus, having unimpeded access to information that is not usually questioned and typically used when it controls locomotion, thus making the new ensemble satisfy Clark's further criteria too.

relevant. Eating behaviour might be cognitively or hormonally modulated, just as locomotion can be shaped cognitively or by simple mechanical devices. This is the reason why tracking cognitive mechanisms by means of their role in the economy of the larger system seems the wrong strategy, since what cognition can perform could be carried out by non-cognitive mechanisms.

Secondly, but not less importantly, the parity-based approach ultimately fails as a reliable guide to ascertaining the scope of the cognitive domain because it invites us to be too indiscriminate. So it proves to be a bad heuristic approach, since it does not allow us to reliably determine the domain of the extended systems, making us instead trespass on the turf of different kinds of biological control mechanisms.

Still, there is something even more significant for the analysis of the extended cognition (if there should be any). Although some of the mechanisms that comply with the specifications formulated by Clark might be cognitive, some are not, which implies that we do not as yet know what leads to extended cognition. As it stands, the parity approach must be lacking as an analysis of what makes mind leak into the environment. Moreover, since we cannot really accept it, it should not be invoked as a good ground for EMT.

If EMT is to be the viable and well-founded metatheoretical position it aspires to be, it would greatly benefit from a new explanation of why certain extended systems are cognitive. In the remaining part of the paper I will attempt to provide an alternative analysis of why some hybrid assemblages could be considered cognitive. Nevertheless, my analysis will not rely on the role of their parts but on the realizing mechanics. I will hold that some benchmark is still needed for circumscribing the cognitive, showing that we can take the common neural mechanisms as a reference point but avoid considering as cognitive only what is structurally identical to what actually happens in the head.

SCIENCE, CONCEPTS, AND NONSTANDARD BIOLOGICAL MECHANISMS

The point of view I am promoting is also a departure from another very common approach to circumscribing the mental. It seems improbable that we will ever be able to say what cognition is by indicating a single shared property — e.g. "operating on underived representations" — which would characterize how cognitive processes function, and that would thus be capable to act as "a mark of the cognitive" (see Adams, Aizawa 2001, 2008). My skepticism is motivated, as is Clark's, by the sheer variety of possible cognitive mechanisms, which might prevent us from finding such shared traits, even for internal processes (cf. Clark 2010a). Nature has the habit of tirelessly reworking and patching its designs in order to cope with new environmental conditions, thus relentlessly modifying the traits of cognition in ways that never cease to surprise the scientists.

Nevertheless, this does not preclude knowing what cognition is.[7] The same process of constant re-engineering is actually giving us the key to our problem. Thus, being cognitive, "the mark of the cognitive", to use Adams and Aizawa's phrase, might mean belonging to a continuum, to an array of structures modified by brute biological forces, like those of natural selection or human intervention, rather than possessing some characteristic design feature.[8] What I intend to show is that, in order to decide whether a problematic mechanism is cognitive or not, we will rather have to know its history while also being able to indicate a stock of paradigmatic cognitive processes (we could take them to be those taking place inside the nervous system)[9] of which it is a modification. The rules that tell scientists what to include in the extension of the concepts for various types of cognitive processes, which after all have to track such incessant tinkering, might yield mere family resemblances and no universal trait. But the important consequence of such rules, from the standpoint of EMT, is that they make various biotechnological aggregates instantiate cognitive processes.

The first thing that needs to be emphasized here is that many concepts employed to describe living beings can accommodate deviations from the biological norm. Such tolerance is indispensable, since various processes in our organism can go wrong or at least be non-standard. Digestion affected by a disease will still be digestion, although its mechanisms are certainly altered. Scientists will rather speak of healthy or pathological digestion but will not restrict the use of the term to the normal processes. There is also individual variability within a population, which is the basis of natural selection. A mutation can introduce non-standard ways of processing information or food. Terms describing how the mind or the body of the living beings work have to be elastic enough as to encompass this variability, without having to come up with a new category each time we encounter a deviant case.

Such elasticity forms the basis for manipulating the processes in our organisms, while keeping them within the same conceptual boundaries. Moreover, scientists regularly intervene in the functioning of regular biological mechanisms, for a variety of reasons, both theoretical and practical. Thus they may want to know how various physiological processes unfold once a drug is administered. For instance, they could inquire into how circulation is affected by an enzyme inhibitor drug, like those prescribed for high blood pressure, which suppresses production of a certain vasoconstrictor substance synthesized by the body. Nevertheless, that does not make application of the usual biological categories to the new cases inappropriate. No one would say that people taking this class of drugs lack blood circulation or pressure regulation, but just that the mechanisms involved are different, deficient, drug modulated or whatever

[7] I do not intend to rule out the possibility that future scientists might identify a common trait for all cognitive mechanisms. The point is that one can circumscribe cognition without it.

[8] Regardless of the fact that there might be as yet undiscovered invariants which are preserved.

[9] A stock to which other processes are added, since new processes become widely acknowledged by the scientific community to be cognitive. It is a set that is evolving as science moves forward.

we might want to hold about them. In such circumstances, according to the standard way scientific experiments are organized, whenever researchers attempt to find the effects of an intervening factor — like the presence of a compound in the systems — the unmodified functioning of that process becomes a mere baseline in respect to which the role of the new factors, which in our case modify the way circulatory system works, are to be evaluated.[10] This has a few interesting consequences.

First and foremost, sometimes — although by no means always — the foreign entities involved, from molecules to macroscopic artefacts, become part of the realization base of the processes they modify. Arguably, this is the case with the substances introduced into the organism to control vasoconstriction. In patients who are administered the drug, it is partly supplied by the biochemical reactions mentioned above. Together with whatever other parallel mechanisms might exist, the interaction between substances performs such a regulatory function. Thus the foreign compound becomes part of what realizes vasoconstriction regulation, as it is a realizer of the new biochemical reaction. Moreover, since keeping vasoconstriction in check is part of blood pressure regulation and, more generally, is one of the processes that compose circulation, the foreign substance will become part of the realization base for blood pressure regulation and circulation.

Turning to the macro level, the inclusion relations should be equally clear. Take for instance the replacement of the hip articulation with titanium and ceramic prosthesis. On the one hand, no one will deny that a person having a prosthetic hip truly walks. The same concepts apply. Nevertheless the realization base of locomotion has been altered by the insertion of pieces made out of titanium and ceramics.[11] The artificial device is part of what realizes locomotion.

Such processes can even involve a partly external realization base. For instance, in order to maintain the circulation of a patient with a heart failure or during surgery, the patient can be connected to an external "artificial heart". In spite of the fact that one of the key realizers of the blood circulation (which is composed of sub-processes such as pumping, blood transport, of the regulatory mechanisms, and so on) is now realized by an artificial device, it cannot be denied that such a patient has blood circulation. After all this is the point of connecting her to such a machine, one that, as it happens, comes to realize some of her physiological processes externally.

We might even allow a considerable degree of liberalism. Such artificial devices might have no natural counterpart, in terms of function or architecture. The way an-

[10] Depending on the scientific evaluation, the baseline process might be that of healthy patients or that of hypertensive patients. This should not matter for the purposes of our discussion since both instantiate cases of vasoconstriction of blood pressure regulation, although one is pathological. What interests us is whether such artificial modifications lead to a change of categories applied in cases where the scientists have intervened.

[11] Such persons can even become objects of a study aimed at evaluating various aspects of their motility with respect to a group of baseline cases provided by healthy or diseased subjects that have retained their biological apparatus.

giotensin inhibitor drugs contribute to regulating blood pressure, by blocking the course of usual biochemical reactions, has no counterpart in the action of a substance produced by the human body. An artificial heart or hip might have as many mechanical dissimilarities with the biological organs as the engineers wish to allow, and can be tailored to impact the circulation or walking differently, compared to their natural equivalents.

From this more general vantage point, treating biotechnological hybrids as realizing the same mental processes amounts to nothing more than sticking to the same procedures. After all, cognition is a biological function like any other. There is no reason why a patient having a hip prosthesis can be said to walk, while an individual whose cognition is aided by artificial devices could not be said to think or perform some other cognitive activity.

All this can be summarized in an "extension principle" for biological kinds, of which cognitive kinds form a subset. It states that *a process belonging to a biological kind will still instantiate that kind even when it is modified by the insertion of causal chains realized by novel or even artificial entities, unless it is precluded by some other rules governing theory construction, given the available observation data*.

In other words, as long as we know that a process belongs to a cognitive kind, its modification, by default, will belong to it too, although, as the second part of the principle emphasizes, we must allow for exceptions, which enable us to accommodate other theoretical desiderata. The above procedure, which makes it possible to subsume new instances under our usual concepts, is not the only rule a scientist needs to observe in constructing her theory. Consequently, we have to make sure that we do not clash with what is commonly accepted as general principles of theory construction when trying to systematize the observation data we have. Thus we need to make sure that it does not introduce inconsistency into the wider set of statements we accept, or at least that it is an inconsistency which can be conveniently eliminated; that — if simplicity is to be considered such a desideratum — it does not lead to a baroque theoretical construction (for instance, because, for some peculiar reason, applying the old predicate to composite systems rules out important generalizations, while restricting its application to internal cases allows us to formulate simple and elegant general statements), and so on.

Yet unless it is irrevocably at odds with these other rules, we have no reason not to apply the concept to chains of events where realizers are partly artificial. In fact, we are required to include them. Since any failure to do so is *ex hypothesi* unmotivated, it will be an ad hoc limitation. It would be like the case of a scientist refusing, for no reason, to classify horses belonging to a certain population — e.g. the Shetland ponies — as horses.

So far I was talking about artificial realizers rather than extended ones. Nevertheless, our principle can play the same role as the parity principle, without having the unpalatable consequences of the latter. It allows for realizers of biological and, subsequently, cognitive kinds that are not normally part of our usual biological endowment. Note that nothing is said of the location of such processes. In other words, our principle is neutral with regard to where the realizers are. Thus it has the same desired consequence as the parity principle — namely it does not discriminate based on location. Of course, it does not imply that there will be actual cases where the artificial realizers of a given biological kind are external, although external hearts and similar devices demonstrate that such artificial realizers are sometimes external. Nor does the parity principle imply this, as it is only an invitation to be unbiased towards possible external realizers. The extension principle is not prejudiced either.

Not only is our formula capable of doing the job of the parity principle; it is also capable of curbing its liberal excesses. True, all these altered structures might substantially differ from the core examples, theoretically even to the point of sharing no commonality with the set of services the latter provide and the way they provide them, until we find good reasons to control what we include into the extension of the concept. But this does not mean that there is no "benchmark" for the type of processes animating living beings. The "normal" structure and its functioning still acts as a reference point for whatever deviant case we might create or discover in nature. Sometimes the new cases might be modifications of already deviant cases, subsumed under that mental kind because of their relation with a process already belonging to it, thus creating a chain of successive alterations. In any case, the derivation chain will have to be traced to a reference point, although the relation between it and its derivations will be merely historical, not structural. Belonging to a certain biological kind need not consist in sharing certain functional architecture but rather in belonging to a continuous thread of modifications to which some paradigmatic architectures also belong.

On the positive side, the extension principle is also capable of telling us what cognition is. It regards as cognitive the processes implemented by the regular neural mechanisms to which it adds the variants it talks about. Thus, more specifically, auditory processes will be regular neural processes that pick up certain air vibrations, crunch the data, and integrate it with other information,[12] and at the end make it available to other kinds of cognitive processes downstream, plus their modifications admitted by the extension principle.

No doubt, the extension principle per se does not prove EMT, if we take the latter to make claims about the cognition on earth, not only to state theoretical possibilities. Nevertheless, as I intend to show next, it obliges us to see certain hybrid internal-external processes as exemplifying a certain kind of cognition, namely, sight. They represent modifications of standard processes that can follow the pattern we described above and there is no reason to consider them otherwise. It is such processes that make EMT true.

[12] Such as the information coming from other senses, as the supporters of multimodalism argue — see below, footnote 15.

SENSORY SUBSTITUTION, DISPLACEMENT, AND THE EXTENSION PRINCIPLE

On the example side, fortunately, there are a few technologies that managed to plug artificial devices into the normal cognitive apparatus.[13] Although confined to peripheral cognitive processes like vision, they are sufficient to prove our point. If such internal-external combinations, as a whole, manage to implement certain cognitive processes, such as sight, they will make EMT true.

Namely, there are pieces of equipment that displace, invert, or reverse the image projected on the retina. When people wear such “goggles”, at first they have coordination problems, but after a while they manage to operate normally. This makes them interesting subjects for the study of psychological mechanisms such as those of proprioceptive adaptation, hand-eye coordination, attention, and so on (Stratton 1896, 1897, Held, Freeman 1963, Harris 1963, 1965a, 1965b, 1980, Kohler 1964, Redding, Clark, Wallace 1985). One thing to notice when reading the literature is that the authors are by no means reluctant to employ terms like “vision” or “see” transcranially to describe the experiences of their subjects. But maybe they should have been more cautious. Although philosophical doubts were invisible in the discussion regarding the use and effects of vision modification, they arose in the discussion occasioned by another technology involving external devices that supplement human biological capacities, namely, sensory substitution. I will examine these experiments and try to bring out whatever conceptual and principal clarifications philosophy might come up with.

The field we will focus on was pioneered by the neurologist Paul Bach-y-Rita, who, ever since the late 1960s, has created an array of tactile vision sensory substitution (TVSS) devices and studied their impact on cognition. Technologically, his approach was to convert visual information captured by a camera into information transmitted to the person by means of a matrix of solenoid stimulators placed on the back (Bach-y-Rita et al. 1969), or, in a later refinement, made out of electrodes stimulating the tongue surface (Bach-y-Rita et al. 1998). This enabled TVSS subjects to perform a variety of new cognitive tasks such as making perceptual judgements by means of visual analysis (regarding perspective, paralax, depth, and so on), identifying complex objects such as faces, body positions, or performing real time hand-eye coordination (González, Bach-y-Rita, Haase 2005: 482). In the present context, the work of Bach-y-Rita is doubly helpful. On the one hand, it is a rich source of interesting data about the interaction of biological systems with artificial pieces of equipment, and, on the other, it has triggered a debate that somehow managed to encompass the most important worries one could have about applying good old psychological concepts — those pertaining to vision — to wider ensembles.

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[13] We are dealing here with actual systems, which blocks the objections of some of the critics of EMT, who consider such extended hybrids as mere non-actual possibilities (Adams, Aizawa 2001, 2008: 83, see also Rupert 2004: 392).

TVSS devices conform to the pattern of manipulations described above, whereby a certain process is modified by means of foreign additions.[14] A part of the normal visual circuit is replaced by an artificial device, gathering and transmitting data, which, by means of tactile neural paths, is plugged into the mechanisms underpinning the cognitive processes in the brain, involved in visual information processing. This is not only a mere inference, based on the normal performance, in many respects, of the visual tasks that is revealed by purely psychological tests. PET scanning of the brain of TVSS subjects showed activation in several "visual" areas, that is, in areas normally underpinning sight (Kupers et al. 2003, Bach-y-Rita, Kercel 2003).

According to our principle, if there are no valid reasons to the contrary, we should, by default, attribute sight to such persons, because they instantiate a modification of the regular biological processes that drive our vision — by way of adding novel causal chains. The combination of the usual cortical areas and electronic circuitry are the sort of non-standard cases to which the rules we emphasized apply. That is to say, the regular neural basis underpinning vision, which is considered paradigmatically cognitive, is altered by inserting a new causal chain, represented, inter alia, by the processes inside the camera and the matrix. If there are no good reasons to the contrary (which is an issue I shall deal with in subsequent sections), the new aggregate should be regarded as realizing the same process as the core cases instantiated by normal biological circuits, namely — sight. Thus parts of the external world should be considered to realize vision.

Moreover, insofar as we can apply visual concepts like "see" to a TVSS user, they should be taken to refer collectively to the whole process of making the visual information available to the person, not merely to the internal leg of the journey. What would it mean to hold that "seeing" denotes a strictly internal process? The only relevant intraorganismic process is the one that takes tactile input from the nervous terminations in the skin and carries it to the brain, where the information is further crunched.

Nevertheless, seeing cannot be equated with a perceptive process whose distal stimulus is the matrix of pins or electrodes stimulating skin or tongue. Taking the process to be strictly internal might conflict with the way we use visual-perception words such as "see". For one thing, TVSS subjects do not see anything located on the back or on their tongue, as the object of perception is located further away. In other words, it refers to a process whose distal stimulus is situated in front of the camera. If "to see" is to be employed here — and it should unless something prevents the application of the term — the perceptive process must be different from

[14] According to Bach-y-Rita, his tactile-vision sensory substitution programme was conceived to a large extent as a model for studying brain plasticity (Bach-y-Rita 1983: 31). But the range of problems this sort of extended systems might help solving include how experience of a continuous visual world is developed, visual illusions, or the cortical representations of functions (Bach-y-Rita 1984: 158).

those realized by strictly intraorganismic components, since the object perceived is distinct. Its realization base must therefore extend outside the borders of the skin.

THE DEBATE

But do the TVSS subjects really see? There are several possible answers here. For instance, Morgan contends that they genuinely do, because they respond as a normal sighted person does when presented with the stimuli they can react to, although the subjective side of perceiving might be utterly different. But as far as science can tell, we should say that they truly see, and not merely "see" (Morgan 1977: 204). Heil also thinks that they see, although not in an entirely unqualified sense. Insofar as one takes the sensed objects to be those in front of the camera, we should rather describe the TVSS device user as seeing, but they should say they have tactile sensations if the object of their perception is considered to be the matrix of solenoid stimulators (Heil 1983: 13-18). Bach-y-Rita occupies some sort of middle ground, which favours certain reshuffling of the traditional categorization of modalities (Bach-y-Rita, Tyler, Kaczmarek 2003: 285-286, González, Bach-y-Rita, Haase 2005: 491-494). Nevertheless, he holds that when functional compensation of lost or modified senses can be accomplished through training and the provision of the appropriate devices, one could see with the skin or hear with eyes (González, Bach-y-Rita, Haase 2005: 491).[15] Myin and Auvray (2009) argue that such biotechnological hybrids generate new modalities, irreducible to the old ones. The reason is that they complement the substituting modality, which is thus modified and extended to ac-

[15] Although it needs explaining, it is not a contradiction, especially if one holds that there might be principled distinctions between modalities (González, Bach-y-Rita, Haase 2005: 492). We might not want to tie a certain type of cognitive process to a specific modality. As it has been shown, some of our perceptive processes are multimodal. Take for instance the McGurk effect (McGurk, MacDonald 1976): a film in which the voice of a person uttering repeatedly the syllable /ba/ is dubbed on to lip movements for /ga/, makes normal adults hear her pronouncing /da/. This shows that hearing speech depends both on visual and auditory input, and the visual source of information might modify the auditory source. The taxonomy of perceptive processes does not follow the taxonomy of modalities, especially the traditional one (or vice versa). One cannot take for granted that we will be able to draw sharp lines between modalities taking as a guide certain types of cognitive processes, since some straddle two or more modalities. By the same token, we cannot assume that the traditional division between modalities smoothly corresponds to the categorization of perceptive processes for which they provide information. The fact that sight provides input when hearing speech does not mean that we see the syllables. Thus one can hold that the TVSS subjects see, even if she is a revisionist about the traditional modalities, as the modality acting as a source of information implies nothing about the nature of the process it feeds information in. She is even more unconstrained if she doubts that such demarcation lines between modalities are possible. Conceptual niceties aside, our problem does not, strictly speaking, depend on how we taxonomize modalities or how we match them to peculiar processes but on the more modest issue of how we taxonomize cognitive processes themselves.

quire a novel functionality that partly compensates for the lost sense while acquiring novel sensorimotor routines driving the perceptual activity (2009: 1053).

We have argued at length that the mere modification of processes which animate living beings by means of integration of artificial elements does not require novel categories to describe them. On the contrary, as we have seen, the general scientific practice recommends sticking to the old concepts. Although unveiling the rules of scientific practice should suffice, it would probably be illuminating to examine how we routinely describe cases that meet Myin's and Auvray's description. Thus we can invoke the parallel case of thermal vision goggles. They extend and modify our vision, which thereby acquires a novel functionality, normally reserved to different sense organs — the thermoreceptors. Nevertheless, we will not grant a new kind of perceptive processes to the users of such contraptions. The fact that their use leads to the acquisition of new sensorimotor routines (e.g. those necessary to efficiently scan the environment by moving the device at the right pace, given its angle of view and the salience of the colours representing different temperatures), which is, after all, expected from someone gradually becoming a skilled user of the device, does not seem to change anything. We would remain perfectly comfortable with the way we employ our words if we explained that a soldier adept at using such goggles suddenly fired his weapon because he saw the enemy approaching.

Furthermore, not only are we perfectly comfortable about working with the usual concepts, but we actually need them. The old mental categories enable us to explain the patterns of behaviour they influence, while an ad hoc mental property cannot. For instance, it would be unclear why that exotic state or process made him fire his weapon in that direction.[16] Unlike in the case of the old psychological process, we do not grasp the relations between the newly coined kind and numerous registers of our behaviour.[17]

On the other extreme of the spectrum, Prinz denies that we can attribute sight to the users of such prosthetic devices for methodological reasons. According to him (Prinz 2006: 5), the TVSS subjects reporting visual qualities are not credible, be-

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[16] No doubt, we might explain the event by saying that the soldier "sensed" the enemy running towards him, but in such a case it is unclear what explanatory power the new category brings over and above the genus concept, i.e. "sensing" or "perceiving". Anyway, not all sense modalities provide the sort of instant information about the spatial location of the distal stimulus (think of olfaction), which determined that the soldier acted as he did.

[17] There is yet another related possibility we should deal with for the sake of completeness, namely that the TVSS devices extend touch. But there are good reasons to hold that the extended perceptive process, taken as a whole, is not tactile in any sense. Perceiving the object in front of the camera cannot be considered tactile, because it conflicts with the reports of the subjects. From a certain point on, when perceiving the object in front of the camera, they no longer feel the pins on the skin (Bach-y-Rita 2004: 86, Guarniero 1974: 101). Nevertheless, touch essentially involves localizing the sensation on some part of the body. The statement "I have tactile sensations that are not located anywhere on the surface of my body" seems absurd.

cause there is no way they can recognize such experiences. They merely make automatic inferences about where the objects are located in space as a result of tactile information. But recent research is capable of dispelling such doubts. Take for instance the subjects who became blind at an adult age described by Ward and Meijer (2010). For several years they were using a sensory substitution device — "the vOICe" — which takes images of the environment and converts them into sounds. The interviewed vOICe users report a rich range of visual experiences, including phenomenology usually associated with normal visual processes, such as perceiving edges, gradients, movement, depth, and so on. One of them vividly describes his technologically aided experiences as "looking at the world with dirty glasses on" (Ward, Meijer 2010: 495). What the interviews with the vOICe users clearly show is that they are strongly inclined to regard their experiences as seeing. "Just sound? […] No, it is by far more, it is sight!", one of them emphatically exclaimed (Ward, Meijer 2010: 495).

As long as no special reasons are put forward, their competence in applying visual terms, that is, adequately describe the visual experiences, should be equal to any sighted person, since the interviewed subjects were blinded in adulthood.[18] So we should credit them with seeing — at least if we allow introspection as a source of empirical data (which, like it or not, is routinely exploited in the postbehaviourist era). If we are to believe them, and we should, their experience includes more than exercising the modality substituting sight. And once such salient experiences are generated, there is hardly any problem in accepting that the congenitally blind person could learn how to apply appropriate terminology to them — the same as any other person learning the use of words expressing inner states (e.g. when confronted with a novel sensation such as seasickness and learning how this feeling is called) — and how to recognize them when they occur again.

CHOOSING BETWEEN THEORIES

So far we have examined a few reasons that could prevent this peculiar type of devices from becoming genuine realizers of the mental. Next, I will analyze an important line of argument showing that no extensions, regardless of the type, are truly cognitive. Namely, on a more general note, there is the idea that, in spite of their oc-

[18] Of course, there are many possible phenomena that can interfere with their recognitional abilities. Thus Ward and Meijer (2010: 497) examine and reject a few responses one can give, based on known psychological phenomena that might be relevant in context. We must also keep in mind that science is in a state of flux. There is always the possibility of discovering additional phenomena that might affect the possibility to describe the inner world and to which these patients are peculiarly prone to. But as long as there is no good reason to challenge their avowals, we must accept them as true. Dialectically speaking, the burden of proof lies on those who want to argue against the idea that they have visual experiences. As far as we know, we should say they see.

casionally crucial role in cognition, external causal chains can only be instrumental, not constitutive. For instance, in spite of the essential role the light bulb in my room plays in many cognitive activities, such as reading or searching for an object, it does not realize any of my mental states. This is the route taken by Rupert (2004) and his rival “hypothesis of embedded cognition” (HEMC). Currently, EMT and HEMC are typically framed as inferences to the best explanation (IBE), with each camp holding that their way of constructing psychological theories is capable of satisfying conditions the other is less capable of meeting. But IBE has been contested as a framework that could enable us to effectively choose between EMT and HEMC (Sprevak 2010). Still, there is a way one can avoid this rather complex discussion, involving more general, higher-order questions (e.g. what are the criteria that make a theory better), if it could be shown that the choice is not amongst competing explanatory approaches but rather between having a workable psychological explanations and having none at all.

Are there good epistemological grounds to think that the whole does not realize a cognitive state and thus to believe that the individual is merely embedded into a network of auxiliary processes which boost his cognitive power in HEMC style without becoming themselves part of the mental? According to Rupert, treating the wider ensemble as cognitive will be uninformative about the fine-grained details of the internal cognitive processes, whose investigation is, after all, one of the goals of cognitive science. If the predicates characterizing the larger ensemble add any explanatory power, it is too little to justify new ontological commitments, as long as a traditional, non-extended explanation is available (Rupert 2004: 421).

I can admit that sometimes it is better to separate the internal and external factors driving cognition. Nevertheless, it is not always possible. Note that EMT does not rule out that what a person does can be described or explained by splitting things into an internal part, an external part, plus the mechanics of their interaction. As Sprevak (2010: 361) emphasizes, and Rupert (2009: 41) acknowledges, EMT does not urge us to abandon treating humans as integrated systems or trying to describe, in a traditional manner, what happens inside them. According to EMT, explanation in terms of how the internal and external components, taken individually, work and interact, as recommended by HEMC, amounts to constructing lower-level explanations of behaviour.

The truth of EMT does not hinge on the fact that keeping the role of the world and of the nervous system separated yields a better explanation — for a variety of reasons which one might adduce, e.g. that it explains more (Rupert 2004: 391) or that it is more conservative (Rupert 2004: 395). On the one hand, one may doubt whether such reasons, by themselves, are capable of countering EMT. Compared to the explanations that are legitimate from the standpoint of HEMC, which deal with the functioning of the components, the laws specific to EMT pertain to a supraordinate level, describing the functioning of the system as a whole, not of its mereological parts. The regularities on the inferior levels of organization, in a mereological hierarchy, are commonly regarded as capable of explaining more, arguably underlying the logic of conservative reduction and of the unity of science (Putnam, Oppenheim 1958). Also, as Sprevak points out, conservativeness is not a good reason for preferring HEMC, as HEMC is conservative with respect to a certain folk-psychological view, which ultimately needs justification (Sprevak 2010: 360). On the other hand, more importantly, the virtues of the rivals of EMT, whatever they might be, are relevant only when there are two or more competing theories available.

What I now intend to show is that sometimes the EMT-style explanation is our only option. The reason is that, when the biological apparatus is supplemented with electronic devices, as it is the case with the TVSS devices users, it is not always clear how some of the components are affected. According to Bach-y-Rita, sensory substitution systems are made possible by what he calls "instrumental sensory plasticity", by which he means brain's ability to reorganize itself when there is a functional demand which induces a "perceptual recalibration" (González, Haase, Bach-y-Rita 2005). Perceptual systems are naturally calibrated during development to implement certain sensorimotor invariants, that is, learned procedures at the core of the cognitive activities driving perception. These can be used as a sort of "standard", where "the calibrating process can be perhaps best conceived as a behavioral and cognitive background against which recalibration is to be evaluated" (González, Haase, Bach-y-Rita 2005).[19] When faced with novel possibilities of accessing information the internal cognitive procedures are reconfigured to accommodate the new way data is delivered.

What is crucial here is that we normally do not have a proper explanation of how exactly the brain readjusts itself as a result of using sensory substitution devices and what the internal routines involving perceptions are in such cases, where there is a departure from the natural standards. Nevertheless, this knowledge of the internal activity is needed for constructing the sort of explanations HEMC, and generally speaking, the orthodox adversaries of extended cognition favour — that is, explanations that keep internal and external resources separate and emphasize their distinctive contributions. The internal variables are simply unknown, because the default parameters have been modified as a result of recalibration. They are yet to be determined. After all, the initial purpose of the TVSS experiments was to facilitate insights into the brain plasticity (cf. footnote 14 above). But the goal of finding an internal explanans is still a long way off. As Bach-y-Rita and Kercel (2003: 544) note, "although brain imaging and physiological activity correlates of sensory substitution have been described, precise neural mechanisms have not been identified". Thus, leaving aside the state of the art, the very logic of scientific investigation into matters where there are no ready answers deprives us of an adequate internalist account of what subjects do. HEMC requires knowledge of what is unknown, and makes the

[19] We can see again that the TVSS use follows the pattern of application of concepts in life sciences — application of a procedure presupposing a standard which is modified through the scientist's intervention.

inquiry worthwhile. Obviously, in certain epistemic situations this is impossible while EMT is able to supply the missing explanation.

Moreover, by contrast, the extended approach allows constructing certain experiments, for which it is essential to frame subjects' activities in visual terms — namely, experiments aimed at determining how subjects perform in visual tasks, such as seeing objects under a microscope or reidentifying shapes seen from different viewpoints (e.g. that of a coin, which looks oblong when seen from a certain angle) or employing visual means of analysis (cf. Bach-y-Rita 1984: 151, González, Bach-y-Rita, Haase 2005: 287). This is an important source of observation data for inquiries into issues such as sensory plasticity, and, on the applied science side, it is a source of data for how rehabilitative these devices can be. Whatever the further use of the results, the experimental tasks which Bach-y-Rita asked his subjects to perform imply that what these subjects do is seeing, and, as we have seen, this implies that we are dealing with a transcranial perceptual process.

This makes our choice pretty straightforward. First, by saying that using TVSS devices amounts to instantiating visual processes, we have the possibility to construct various experiments which will make valuable theoretical contributions. We can also make use of a variety of explicative approaches where "seeing" appears, even the usual folk-psychological ones, such as "The TVSS device user went to the far end of the room because she saw the coin was there" or "She moved the hand because she saw the ball coming". And once we say that the TVSS user sees something, we are referring to an extended process. What we will definitely not have, at least during the initial stages of the research, is an orthodox explanation in terms of the individual components, since the internal part is yet to be investigated.[20]

Therefore, sometimes we have no choice but to embrace the extended mind, as it is the only option we have in order to push forward the research by constructing certain types of experiments, and, at least for the time being, our only available explicative tool. The extended approach works, and we have no internalist replacement for it.

This completes our argument for EMT. We have shown that the kind of process implemented by means of a sensory substitution device, as a whole, realizes sight, thus exemplifying a cognitive activity that is partly externalized. To summarize the positive argument, it started with an analysis of the rules governing the employment of biological concepts which identified what I called "the extension principle". The principle provides us with more flexible concepts when it comes to theorizing about the mind, allowing for certain modifications of biological systems that incorporate

[20] One day, we can hope to identify the computations driving the internal neural resources allocated to the task. Nevertheless, these explanations, in terms of the functioning of the mereological parts, will not cancel the legitimacy of the higher level explanation. They will share the same sort of complementarity all elementary psychological mechanisms and higher order internal mental states enjoy.

bits of the external world to be subsumed under the same old concept. Next, I argued that sensory substitution devices extend a cognitive process, namely sight, whose conceptual borders come to encompass modifications of regular neural mechanisms. Such hybrid systems, composed of the artificial and neural resources, should be considered instances of a visual system. In this regard, the paper demonstrated, on the one hand, that such modifications are of the sort envisaged by the extension principle and as such should be considered, by default, as realizing vision. On the other hand, there are no reasons to consider them otherwise. Thus, since we have instances in which one type of cognitive process — sight — extends into the environment, EMT should be regarded as true. This offers an alternative to the parity-based approaches, which have dominated the extended mind debate — an alternative which is better able to accommodate the tenets of present-day science.

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