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## **The computer as prosthesis**

### **Reflections on the use of a metaphor**

#### **Abstract**

The use of metaphors in a computerized setting is not without its problems. Far from being a simple ‘tool’, in the ordinary sense, the computer has a built-in propensity for ‘capturing’ both its maker and its users. One could say that by its very structure, it defies the boundaries set for normal human activity: speed, memory, (co-) presence, interacting, steering, producing, and so on. If we talk about the computer as a ‘prosthesis’ (one of the most recent metaphors that have been suggested), such talk too, implies a certain attitude towards the prosthetic ‘tool’. The present article examines the various aspects of this particular metaphor and discusses its pros and cons, also with a view towards the newly emerging sub-discipline of Cognitive Technology, CT.

#### **1. Introduction. The use of metaphors in computing**

Like every other human activity, the use of computers, too, has generated its own set of metaphors. We do our word processing using a ‘mouse’, we ‘scroll’ files up and down, we ‘chase’ information on the internet, we get ‘lost’ in cyberspace, or entrapped in the ‘mazes’ of the ‘web’, and even if we have no idea what we are doing there, we can always call it ‘surfing’—sort of hanging out on the computerized corners of our ‘cyber-hood’.<sup>1</sup>

Among the various metaphors that have been current to characterize the computer and its use by humans, that of the ‘tool’ has been one of the most pervasive. Just like tools help us execute certain activities better and faster, so the computer has been considered a tool for performing certain operations (such as bookkeeping, accounting, tallying,

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<sup>1</sup> Actually, I just created what I think is a novel computer metaphor: computational space as a (neighbor)-‘hood’.

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registering, archiving, and so on) in a better and more efficient, and especially faster way. Among the attributes of this tool that have attracted most attention are, naturally, the ease with which it ‘falls into’ the human hand and routine; by extension, the computer is not even thought of as a tool any longer: enter the invisible, or ‘transparent’ tool (as I have called it; Mey 1988), to be preferred over other, more visible and obtrusive kinds of instruments.

Before I go on to discuss the specific metaphor that is the subject of the present contribution, viz., the computer as prosthesis, a few general reflections on the computer’s ‘toolness’ are in order.

## 2. Tool and user

In a non-sophisticated way of speaking and thinking, a tool is a device that humans use in order to make their lives easier, more pleasurable, and more manageable. The early tools of Primitive Man (such as flint knives and fire drills) were tools for survival; in our days, the tools that we surround us with are designed to help us achieve our goals more efficiently and in ways that we would not have dreamt of earlier. As an instance, consider locomotion and its tools. From the *pedes apostolorum* to the Concorde or the solid fuel driven rocket, there is a gap not only of time, but also of order.

The notion of flying humans, as conceived by Icarus, Leonardo, or Jules Verne is *toto caelo* different from the actual thing and its associated mental and real attributes and concepts. Earlier, flying was considered a way of proving to the gods that we, too, can ‘defy space’, ‘with wings not destined for humans’ (*exper[iri] vacuum ... pennis non homini datis*; Horace, *Odes* I,iii:34-35), and that there are no limits for the human species wanting to ‘rush into forbidden territory’ (*gens humana ruit per vetitum nefas*; Horace, *ibid.*:26). In our days, flying has become more of a way of getting to a place in less time, with the places staying in the same location, physically speaking, but their psychological distances from us becoming less and less of a constant, mental reality. On the contrary: in our days, the more miles we cover and the faster we go, the more the distance to the objects of our locomotion becomes fictitious, a mental *un*-reality. And this is the ultimate paradox, the real ‘fear of flying’: What if the sky itself is ‘the limit for our stupidity’? (*caelum ipsum petimus stultitia*; Horace, *ibid.*:39)

This, admittedly somewhat facile, observation conceals a deeper truth than would be immediately visible. Just as the shrinking distance to the object of our travels changes that goal in our minds, so the quality of our aims, when realized with computerized help, changes, so to speak, before our very eyes, on the very screen that we're watching. When our mind 'clicks' on a problem solving program, just like our computer mouse clicks on a computer search scenario, we are under the impression that we've not only solved, but also understood, the problem. While an 'understanding' solution may have been our original and deeper aim, we have been re-programmed to consider, and accept, a purely factual solution, all under the guidance, and in the spirit of, our computerized routines that tell us to ask 'how to', but not 'why'.

To see this more clearly, consider the following parallel from the area of manual labor. Elsewhere (Mey 1996), I have discussed, using a very simple example, how the technology we use serves to change the objects targeted by those techniques—not just before our eyes, but within our very minds. Here is the example: A modern invention, the leaf-blower, now a household item in most gardening environments, has entirely changed our mental perceptions of the proper goals of gardening and of the proper means to attain those goals. What earlier was done *centripetally*, so to speak, using a rake to gather the leaves on the ground, then transferring them with the help of a shovel or a dust-pan into a refuse bag or barrel, is now done by moving the leaves and other garden detritus *centrifugally*, away from us, 'with no particular place to go'.

Moreover, our aim: cleaning the lawn or the garden path or the patio, has hereby itself become redefined, and the standards for 'successful lawn cleaning' have changed from a normal level of 'leaflessness' to a level of perfection only to be matched by the vacuumed domestic carpet. In addition, any secondary aim (for example, of gathering the leaves in our yard for the purpose of composting) has been mostly abolished, being now subordinated to the new, re(de)defined primary aim of getting the leaves, all of the leaves, and nothing but the leaves, out of one's way. (Actually, adding: 'nothing but the leaves' here is a bit of a misnomer, since the leaf-blower removes also most of the other components of the vegetal and animal, not to mention mineral, material that makes up our garden environment).

The thrust of his analogy is that the leaf-blower, being a tool, does more than help us realize our aims. In the process of helping us, it changes those aims, and makes us more dependent on the tool in order to realize the changed, ‘tool-adapted’ aims. Thus, it is simply not the case that the use of a tool (such as the computer) only changes the task, not the performer, as advocated by Norman, who talks about merely ‘bridging’ what he calls the ‘gulfs’ of evaluation and of execution, with the aid of computerized tools (1986). In actual fact, computers *do* make the user smarter (cf. the title of a later book by Norman: *Things that make us smart*; 1993); the risk is that this ‘smartness’, some way down the road, may not be all that smart, or maybe not even smart at all. To see this, consider now the computer metaphor of the prosthesis.

### 3. The computer as prosthesis

The notion of considering computers as prosthetic devices is not new. In a thoughtful recent article, Richard Janney remarks the following:

“The idea of computers as mental prostheses was implicit fifteen years ago in an article published in the *Journal of Pragmatics*, in which Trevor Pateman (1982:237) argued that ‘computer programs are things to think *with*, not things which think ... this is their virtue’.

In the same issue of the *Journal*, Jacob Mey (1982:212) emphasized the need for developing artificial intelligence technology that works for us, in our service, helping us to perform our tasks, and not simply technology designed to meet its own needs or intended to replicate, compete with, or replace human thought. These were the beginnings of the view, which is now an underlying assumption of Cognitive Technology, that computers can be regarded as prosthetically extending the capacities of the human mind”. (Janney 1999:71)

A prosthesis is usually understood as a mechanical device that functions as a (pseudo-) replacement or an extension of a human body part. For instance, prostheses like an artificial leg or a crutch do not really ‘replace’ a missing leg; they merely help the body in maintaining some of the functions that the vanished leg used to have (keeping balance, practice locomotion, etc.). In other cases, existing body parts are given an extension or redefinition so that they can function as aids to, or replace missing functions of, other body parts. Ontogenetically, this happens all the time: our present inner ear is a redefined body part from the time we used to swim around as fish (stirrup, hammer, and anvil are parts of a primitive maxilla still found in *gadus*, the common cod). With

the help of modern technology, the mouth or the feet can be trained to handle paint brushes in the case of para- or quadriplegics, persons who have been (almost) totally paralyzed, and thus allow them to exercise their human and artistic functions, keeping themselves not only busy, but simply alive.

Consider now a case such as the following. In William Gibson's cult novel *Neuromancer* (1995; originally 1984, hence an 'oldie' as far as sci-fi goes, and by now a classic of its genre), the female protagonist is a woman by the name of Molly. Among other things, she excels in computerized implants: her fingers have sprouted motorized ten-inch long razor blades attached under the nails, and her eyes have been 'augmented' by inset lenses which not only enhance her vision, but in addition, are wired up as small computer systems, connected to a distant mainframe. Among the more mundane features of this system is a time read-out in digital; on a more sophisticated level, the lenses also give a 'wired' partner the possibility to share the visual and other sensations that Molly experiences, via a computer technology known as 'simstim' (for 'simulated stimulation'). Here is how Gibson describes some of the system's less technical details, as seen by the male protagonist, Case, on their first encounter:

"She wore mirrored glasses. ... He realized that the glasses were surgically inset, sealing her sockets. The silver lenses seemed to grow from smooth pale skin above her cheekbones, ... " (1995:36)

Later in the book, Molly is scanned for possible other implants by a shady technician-technodealer called Finn, who comments on his findings as follows:

"Something new in your head, yeah. silicon, coat of pyrolitic carbons. A clock, right? Your glasses gimme the read they always have, low-temp isotropic carbons. Better biocompatibility with pyrolitics, but that's your business, right? Same with your claws." (Gibson 1995:64; the last remark refers to Molly's 'amplified' fingers).

And here is Case's own description of what he experiences when he enters Molly's 'sensorium' in simstim:

"The abrupt jolt into other flesh. ... he willed himself into passivity, became the passenger behind her eyes.

The glasses didn't seem to cut down the sunlight at all. He wondered if the built-in amps compensated automatically. Blue alphanumeric winked the time low in her left peripheral field. Showing off, he thought." (Gibson 1995:72)

When we read a story such as *Neuromancer*, deep down we know, of course, that this is just fiction, and that it really doesn't have to bother us. But fiction is always more than fiction. Being a figment of the author's imagination, it is a fictive, 'shaped' nature; but at the same time, it is a 'shaping nature', a fiction that creates us, the readers, as part of the fiction. *Neuromancer* has taught us to 'see' things with eyes like Molly's, to move around the city like Case, or like another 'Bladerunner', witness those Japanese who introduced Gibson (in real life) to the vast commercial and shopping district of Shibuya in Tokyo, in what is described as the overwhelming sensation of a

"first nighttime view, ... mazed by highrises cascading with vast television images ...  
[O]ne of my two black-raincoated Japanese guides gestured up at all of this and said, in explanation, 'Bladerunner town, like Neuromancer.'" (Gibson 1995:320).

In the next section, I will examine the circumstances of this 'fictionalizing', and ask the question in what sense, and to what extent, it will change, or maybe has already changed, not only our understanding of ourselves as cognitive beings, but our cognitive faculties as well.

#### **4. Task and artifact**

It has been well known, ever since the pioneering work of people like Carroll (1991) that the tool we use to perform a particular task not only assists us in doing what we have to do, but also changes our understanding of the task itself and of a host of other things related to the task; in the end, it may change the very nature of the task altogether.

Consider again the case of the leaf-blower, discussed above, in Section 2. Our experience of cleaning the lawn, and our understanding of our duties in keeping the lawn leaf-less, have changed as a result of our using this particular tool. Similarly, it has been said that the vacuum cleaner, originally introduced to alleviate and lessen our housekeepers' boring chores, in the end has made them work even more, and made their work even more boring, because now it had to be performed more often, and to a greater degree of perfection. The artifact changes the task, and vice versa, in a never ending cycle (or maybe better, a 'spiral', as Salomon has suggested to call it; 1993).

### **4.1. The prosthesis and its consequences**

In the context of our discussion, the computer as a prosthesis, this has some profound effects. A simple and simple-minded way of viewing a prosthesis is to say that it represents an augmentation of a human capability (either in the sense of a replacing a lost faculty or of extending an already existing one). But if we scratch this seemingly innocent surface, a host of hidden assumptions and unexpected problems turn up. First, there is the question of the augmentation itself: how far should we go, or be allowed to go, in the enhancing of the human sensory faculties? In the example of ‘simstim’, mentioned in the previous section, the question of ethics should be brought up: Can one legally enter a person’s ‘sensorium’, partake in his or her sensations and feelings of all kinds? We are all familiar with the problem from tabloid journalism: when it comes to media coverage of events, very few people would question the legality of photojournalism, but when people are confronted with an event such as Princess Diana’s death, everybody instantly wants to distance themselves from the paparazzi and their activities. ‘They are going too far’, we hear people say. But what exactly is ‘too far’, and how do we know?

### **4.2. The prosthesis: Good or bad?**

Another problem that lurks in the remote caves of our subconscious is the question of good and evil. Knowledge gives us power, but the tree of knowledge was not particularly helpful in signposting our first parents towards a brighter future. Given that their instantly acquired, post-apple mortality is usually construed as a punishment for their original sin, we could even say that not only is knowledge not always useful, but it may be outright dangerous. Too much knowledge kills, as the case of Adam and Eve amply illustrates, even ‘unto this last’; similarly, an overload of information is not conducive to proper linguistic cooperation, as we all have come to realize ever since Paul Grice set down his conversational maxims.

### **4.3. On naturalness**

Be that as it may, we are not exactly prepared to shut down our machines in the name of a return to basics, a kind of information-age Ludism. We will have to live with the computer, even if its perceived role

as a prosthesis carries with it some serious problems. A parallel comes to mind: suppose we consider the car under the angle of a prosthetic device, then we can easily see how the device both has helped us to ‘conquer distances’, and at the same time reduced our ability to cope with distance in a *natural* way. When people do not wish to leave their cars, even to satisfy such elementary human needs as food and drink, we simply have become too dependent on our prostheses. In America, at the drive-through liquor store or the McDonald’s, you don’t even have to get out of your car to buy beer or a hamburger. In other parts of our globe (to stay with the subject of human needs), a new problem has arisen for those servicing and upkeeping the highways. Bags of faecalia, discarded from passing automobiles, pose serious personal, medical, and even mechanical hazards to the unfortunate workers who are mowing the grass along the highway and inadvertently hit a bag of human excrements.

#### **4.4. Primary and secondary effects**

As is well known, and has been remarked on by a number of researchers, the secondary effects of technological innovations are usually much more far-reaching than was intended by the original inventors. Henry Ford wanted to put an automobile in everybody’s driveway, and look what we’ve got: highways extending into everybody’s backyard! As for the automobile itself, it is much more than a transportation device; it figures in our minds as the premier status symbol, our ‘escape on wheels’, for some even serving as an extra bedroom. As we see, the innovation changes that which it was supposed to innovate: the prosthetic tail wags the human dog.

#### **4.5. Augmenting what?**

Another problem with the prosthetic augmentation metaphor, when applied to the computer, is that the notion of augmenting a human faculty presupposes the existence of something which is not augmented, or ‘natural’. In this sense, applying a prosthesis to a human is akin to the techniques of putting air brakes in your car, or adding a spoiler. What these prostheses do is to enhance the brake function that was originally there, or to improve the stability of the car at high speed.



The trouble with humans, however, is that they cannot behave ‘naturally’: while we do have certain ‘innate’ functions, these cannot properly be put to work unless we initiate them, break them in, socially and culturally. And when it comes to enhancing a particular human, culturally-bound and socially-developed function, it remains an open question if we can do that without taking the other parts of the human profile into account.

Computerized functions, such as the use of a word processor, may facilitate the ways in which we produce texts; on the other hand, the texts we produce may be radically different from those that originated in a non-computerized environment. Here, I’m not talking about the outer appearances of a document (by which a draft may look like a final version of an article, and be judged on that count), but rather, about the ways we practice formulating our ideas.

For instance, if we know that what we write may be disseminated across an international network, or abstracted in a database that is used by people from different walks of life and contrasting ethnic and cultural backgrounds, we will try to express ourselves in some kind of ‘basic conceptualese’, shunning the use of metaphors and idiomatic expressions, thus sacrificing style to retrievability of information. As Kelly Wical has observed, automated indexing of documents

“will encourage people to write plainly, without metaphors ... that might confuse search engines. After all, everyone wants people to find what they have written”. (Wical 1996; quoted in Marsh et al. 1999:105)

#### **4.6. The fragmented body**

The tool-originated metaphor of the computer as a prosthesis carries with it yet another drawback. Since prostheses typically target one particular human capacity for augmentation, we come to think of our capacities as individually ‘enhanceable’. There are two aspects to this enhancing: one, we consider only the individual agent, without taking his or her larger societal context into account, and two, we enhance single faculties in the individual, without taking into account the fact that these capacities form a unit, a human whole.

As to the first aspect, the societal character of our capacities, consider the paradox that Kaptelinin and Kuutti draw attention to: the very fact that, say, a decision making computer tool may have proven suc-

cessful in the United States, may warn us against trying to introduce it into a Japanese surrounding, where decisions among humans are made in rather different ways than is done in the US (Kaptelinen & Kuutti 1999:152).

The other aspect relates to a currently popular notion of human capacities as being ‘modularly replaceable’. Just as we are seeing the beginning of ‘surgical engineering’, in which techniques of replacement have substituted for old-fashioned operation and healing procedures, so we are witness to a trend toward substituting and augmenting not only parts of the body itself (such as is done in heart or kidney transplantation), but entire mental functions. A reasoning chip implanted in our brain relieves us from the headaches of going through the motions of filling in the trivial parts of a mathematical proof, or a chain of syllogisms. A memory chip may replace a person’s worn-out or Alzheimer-affected remembering capacities. In general, wetware can be replaced by more sturdy and robust electronic hardware, pre-wired to augment specific mental functions, and even tooled precisely to fit the needs of a particular individual. The potential for prosthetic innovations of this kind is virtually unlimited, up to the point where the whole person may end up being ‘re-tooled’ electronically.

#### **4.7. Mind and body**

Conceiving of the computer as a prosthesis thus seems to lead us to the final resolution of that ancient dichotomy: the mind-body split. If anything in the mind can be reproduced on a computer, then we don’t need the body at all. Or, vice versa, if the computerized body can take over all our mental functions, why then do we have to deal with a mind?

There are indeed tendencies afoot that seem to advocate this kind of thinking. A recent book by Andy Clark proudly announces, in its subtitle, the ability to ‘put brain, body, and world together again’ (1997, frontispiece). However, this synthesis is performed strictly on the basis of a computer-as-prosthesis informed philosophy: one describes the mental functions as modules (if need be, computerized) to be united under a common ordering principle, or joined loosely in some kind of mental republic, a ‘society of mind’ à la Minsky (1986). All the time the emphasis is on the brain, not the mind, the latter being characterized as a “grab-bag of inner agencies”, while the “central executive in the brain

— the real boss who organizes and integrates the activities” is said to be “gone”. Also “[g]one is the neat boundary between the thinker (the bodiless intellectual engine), and the thinker’s world”. No wonder, then, that replacing this “comfortable image” puts us in front of a number of “puzzling (dare I say metaphysical?) questions” (Clark 1997:220-221).

In a final section, I will examine these questions, and the claims they imply, in the light of the ‘prosthesis’ metaphor; I will also try to draw some conclusions.

## 5. Conclusion: Mind or brain? The ecological prosthesis

In the preceding discussion (which is typically found not only in Clark’s book, but also in the literature elsewhere), the emphasis is on the *brain*, as opposed to the *mind*. If the latter is introduced at all, it is only in a parenthetical (not to say prosthetic) function, as in the quote at the end of the previous section. Note also that the word ‘mind’ does not even occur in the subtitle of Clark’s book: “Putting brain, body, and world together again”). What (if anything) does this (willful?) omission imply?

We started out talking about the computer as a metaphorical substitute for, or aid to, the human’s cognitive abilities: a mental prosthesis. Prostheses are thought of as material instruments, designed to implement a certain function, associated with a particular part of the body. As to the brain, it can be thought of as a highly specialized body part, endowed with capabilities to execute functions that, while still embodied, are only remotely similar to the simple functions that can be supported or emulated by prosthetic devices such as artificial arms or legs.

As a next step, while considering the complexities of modern computers and computer programs, and despite being impressed by their ability to perform the most intricate functions, earlier thought to be the unique domain of the human (as in artificial intelligence or expert systems), we have started speculating about these functions’ similarities with the functions that a human performs. This applies not only to the execution of simple mental operations, such as adding, subtracting, and so on, but also to the more complex functions of perceiving, thinking, comparing, deciding, and even feeling. Pursuing this line of thought, we may end up considering the computer program as the most suitable

model of brain activity, and the computer as some kind of metaphorical, prosthetic brain.

There are two kinds of dangers inherent in this modeling. First, we may be tempted to reverse the direction of the metaphor: rather than thinking of the computer as a metaphorical prosthesis for the mind, we may conceive of our minds as prostheses for some outside agency, a central computer that keeps us all in place via an intricate system of wiring. After all, when a popular journal of computer gossip-cum-technology calls itself *Wired*, the implication is that one considers oneself as 'connected', just like the protagonist in *Neuromancer* had himself wired into the sensorium of another agent by means of 'simstim' (see Section 3, above).

I will readily admit that the vision depicted in Section 3 is a mildly futuristic one. For a contemporary approximation, one can consider the way most people are 'wired' into the mass media of communication: their lives and thoughts are dictated by the media, and if one doesn't plug into this immense network of information and entertainment, one is 'out', in the strictest sense of the word: outside of the talk of the day at the workplace, outside of the discussions in the press, outside of the newscasts and the television reports on current scandals and shootings; in other words, the non-wired' person is the typical outsider.

The insider, on the other hand, does not (and cannot) realize to what extent the simple presence of thought and feelings, otherwise considered as 'naturally' arising within the mind, is due to this connection, this 'wiredness'. It takes a 'black screen' (or another temporal media deprivation) to fathom the depths of one's dependency, the extent of one's being 'hooked' (itself a near-synonym of, or even a metaphor for, 'wired') up to or into the 'infotainment' universe of our days. For all practical purposes, one could replace the media outlets by some central instance, have this wired directly into people's heads, and bingo, we're in business: the wired society becomes a frightening reality, with Big Brother embodied in a central monster computer, controlling and directing our entire lives.

The other danger is more subtle, and not as sci-fi inspired as the first one, and for that reason all the more real. It has to do with the nature of the mental prosthesis that the computer represents. The computer's special features (programs and functions that are distributed throughout the hardware rather than being encapsulated in neat, identifiable blocks of

instructions, routines being divided into subroutines to be used independently and/or recursively, and so on) have led us to think of the brain as a similarly organized, distributed architecture. The connectionist view of mental processing is based on this analogy, and the prosthesis metaphor, if applied within this frame of thinking, transforms the individual mental features and functions into a set of independent, yet connected components (a ‘grab bag of inner agencies’, as Clark irreverently calls it; 1997:221). The question is, and the problem remains, how to orchestrate all those brainy agencies into some kind of mental unit.

Let’s for a moment return to the original idea of a prosthesis. What does the artificial leg essentially represent? Not so much a leg, as it does a function: that of human locomotion. Similarly, Molly’s mirrored eyes in *Neuromancer* embody, in addition to vision proper (the domain of the eyes) a couple of ‘extra-visual’ functions, belonging to other domains (mostly those of information processing and -storing), that somehow could be incorporated into the prosthesis without causing too much trouble or discomfort to the user.

The key word here is *embodied*. In a sense, all prostheses are embodied, since they are part of, or attached to, some body. In the particular case of the computer prosthesis, the metaphor acquires a new dimension, based on the distributed architecture that is considered to be characteristic both of the brain and of the computer itself. Such a distribution can only be successful if it is embodied, not only in the person using the prosthesis, but also in the world surrounding him or her. An artificial hand must respect the needs of the prosthesis wearer not only to be able to exercise certain functions, but in addition, must do so in an environmentally acceptable way. The artificial limb has to be made part of the environment in order to work properly; this includes, just as in the case of the transparent or invisible tool that I discussed in Section 1, the capability of blending in with the environment: the ‘natural’ artificial hand or leg, as opposed to the pirate captain’s hook or Long John Silver’s wooden stump.

However, this ecological embodiment of the mental prosthesis has a deeper level of significance. And so has its distribution. The psychologist James J. Gibson (1979) has created the concept of ‘affordance’, by which he meant to capture the fact that our sensory knowledge to a certain degree is incorporated in, ‘afforded by’, the objects of perception surrounding us. Not in the sense of the post-Kantian idealistic

philosophers, who thought that the external object was a pure creation of the internal spirit, but rather akin to the original sense that Kant envisaged, when he proclaimed that the ‘categories without object are empty’. What we see, depends on *what* we see; seeing is not just something in the eyes of the beholder, but exists, pre-formed as it were, in the objects of his or her seeing. The way objects are adapted to our vision, and the way we can perceive them as such, together make up the concept of *affordance*: we see what we can afford to see, in the strict sense of the term.

The danger that I identified earlier in this section, namely of locating the individual features of the mind as prosthesis-like attachments to some central brainy hardware, can be obviated by placing those ‘computer-like’ functions in their proper environment, by *embodying* them in the sense of Gibson’s affordances. Our eyes see that which they can afford to see, based on their visual capabilities and on the way these capabilities are placed in their proper environment. In the same way, we think what the brain allows us to think, but on condition that the brain’s functions are embodied in some informed mental hardware, the ‘brainy prosthesis’. The mind is where the brain meets the environment, and receives its affordances. The mind is the embodied brain.

When using a metaphor such as that of the ‘computer-as-prosthesis’, we should therefore be careful to keep in mind that to focus on the hardware aspects of the prosthesis alone would be just as wrong as to uniquely define and describe the functions of the prosthesis in terms of ‘what it can do’. That question should be expanded to comprise also such elements as the users and the environment. Hence, we should ask not just what the computer can do as a prosthesis, as a help *in* our lives, but what it does *to* our lives and to ourselves, as well as to our environment.

Conversely, in evaluating the success of a particular prosthetic program or device, we should inquire how well it fits in with both the user’s needs and the environment’s affordances. Just as in the old debates about ‘innate’ vs. ‘acquired’ capabilities, we must stress again that the development and fit of a prosthesis is defined not only by what it functions as, but by *how* it does that, and can do that, in a particular environment. Innateness is worthless without an affordance; human faculties are meaningless without the acquired culture that will support them, witness the celebrated cases of the *enfants sauvages*.

Here in particular, the case of language offers an egregious example. Despite the efforts on the part of the Chomskyites and their fellow-travelers to restrict the workings of human language acquisition to an abstract mechanism called LAD ('language acquisition device'—a failed prosthesis metaphor, if ever there was any—), language acquisition can only proceed successfully in the ecological, affordable environment of a community of users. The 'acquisition device', if there is any such thing, should be thought of as being 'distributed' ecologically, just like an affordance, among users and environments; the same thinking should be brought to bear on the metaphor of the computer as a prosthesis.

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