ENVIRONMENTAL
EPISTEMOLOGY

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1. EXTERNALISM AND ENVIRONMENTALISM

There is a view of the mind that began life as a controversial philosophical thesis, and then, much like an aging rock group, evolved into respectability. Indeed, it became common sense. According to this view, minds are to be assimilated to the category of substance. That is, minds are objects that possess properties. Indeed, minds can, to some extent, be conceived of as relatively similar to other bodily organs. Just as the heart circulates blood, the kidneys process waste, the mind thinks. According to the official version of this view, the major difference between the mind and these other organs is that the mind is a nonphysical substance. The brain and mind are, thus, distinct entities; the former a physical organ operating exclusively on mechanical principles, the latter a nonphysical organ operating according to principles of reason. The philosophical thesis from which this view was born was spelled out by Descartes, and its association with him is sufficiently robust for it to be called the Cartesian conception.

The Cartesian conception has famously been ridiculed as the myth of the ghost in the machine. And it has been Descartes' decision to make the mind ghostly (i.e., nonphysical) that has drawn the principal fire from dissenters. The dissenters' case here has been largely successful, and, today,
not many would describe themselves as Cartesian in this sense. Ryle's expression, however, has another facet. Not only is the mind a ghost, but it is one that is in a machine. And while the revolt against ghostly views of the mind has been overwhelmingly successful, criticism of this second aspect of Descartes' view has, until recently, been comparatively muted. This changed with the development of a view that came to be known as externalism.

The term 'externalism' in the philosophy of mind typically denotes a family of views, deriving from the work of Hilary Putnam (1975), Tyler Burge (1989, 1986), and certain work on indexicals associated, principally, with David Kaplan (1980), and all united by the idea that mental states, in some sense, are not in the head. Specifying the content of the clause in some sense, however, is no easy matter. Species and sub-species of externalism abound. Forms of externalism that assert the external location of mental states are contrasted with those that assert merely their external individuation (see, for example, McDowell 1986 and McGinn 1989 versus Macdonald 1990). Forms of externalism that admit a conceptually separable internally constituted component of mental states are contrasted with those that deny such a component. Weak externalism is commonly contrasted with strong, and one would look in vain for any unified constraint of these qualifiers (contrast, for example, Forbes 1987, McGinn 1989, and Macdonald 1990).

Nevertheless, for the purposes of this paper, externalism in all its forms possesses two essential theses, one concerning the nature of the states to which the externalist thesis applies, and the other concerning the properties of those states in virtue of which it applies. The first thesis is that externalism applies only to the so-called propositional attitudes. It applies to beliefs, desires, hopes, fears, expectations, anticipations, and the like, all of which are (i) attributed to a subject by way of a that-clause, and (ii) are individuated, in part, by way of the proposition that follows this clause. The second thesis is that the externalist claim applies to such states because they possess semantic content, because they are individuated by way of the proposition that follows the that-clause.

This means that the scope of externalism is severely restricted: it applies only to that relatively small group of mental states that have their contents essentially (i.e., propositional attitudes and possibly experiences—on some views of experience). What we might regard as the nuts and bolts of cognition, processes, such as perceiving, remembering, thinking, reasoning, whereby we arrive at, or come to have, propositional attitudes, these are left outside the scope of externalism. That is, externalism as it is commonly understood, is compatible with the following claim, one that, until recently, has been almost uncontroversial of cognitive theorizing:

Internalism of Cognitive Architecture: The capacity of an organism to process the information it needs to successfully interact with the environment can be explained purely in terms of internal structures and internal operations defined over those structures.

This, in my view, is the principle problem with externalism: it doesn't go far enough. So, in this paper, I'll try to develop a form of externalism that, as that old heer advert might have put it, reaches parts other externalisms cannot reach. That is, I shall defend a form of externalism about cognitive processes and about the cognitive architecture that underwrites such processes. Susan Hurley (1998), who defends a substantially similar view, refers to it as 'vehicle externalism.' I, however, am going to adhere to my earlier, admittedly somewhat tendentious, label: environmentalism (Rowlands 1999).

2. THE CONCEPT OF EVOLUTIONARY COST

The juvenile sea squirt spends its days migrating its way along the ocean floor, and to facilitate this, it possesses a rudimentary brain and nervous system. However, upon reaching maturity it fastens itself to a rock where it spends the rest of its life. Having done this, it then proceeds to eat its own brain. (The old joke, originating with Rodolfo Llinas, is that the process is much like getting tenure: Why should the squid do this? One might suppose that if any bodily organ can confer selective advantage on a creature that possesses it, then it is the brain. So why dispense with such an advantageous feature?)

The answer lies in the concept of evolutionary cost. Any evolutionary development of a lineage involves an investment of resources, and these resources are then not available for use elsewhere in the biological economy of organisms of that lineage. Given that any organism of a given lineage has at its disposal only a finite quantity of resources, then any investment of resources in a particular evolved feature will necessarily
now up as a deficit elsewhere. Brains, then, have their costs as well as their benefits. More generally, if the selection pressures that might lead to the development of a given feature F are not sufficiently important, then the cost of developing F might be greater than the benefits that accrue from its possession.

The centrality of the concept of cost to evolutionary processes can be properly appreciated only by understanding its relation to the concept of fitness. Fitness is, of course, what natural selection maximizes, but there are various equivalent ways of specifying what exactly this is. I have chosen a specification that is fairly standard, particularly in the context of game-theoretical modeling of evolutionary processes, but nothing much turns on this choice. If you don't like this particular development of the concept of fitness, you are free to substitute your own. The arguments will, I think, be largely unaffected.

The basic idea is that the fitness of an organism is a function of the trophic energy it consumes. The controlled energy can be broken down into three structural energy, the energy contained in the materials of the organism's body; (ii) maintenance energy, the energy required to maintain the organism in a viable state; (iii) reserve energy, the external energy that is available to predators because it is defended, as by territoriality or lekking; (iv) waste energy, the energy contained in excreta and excreta, and (v) expansive energy, the energy available to the organism for growth and reproduction. The absolute fitness of an organism can be, and often is, defined as the amount of expansive energy controlled by that organism.

What is important for our purposes, however, is not the notion of absolute fitness, but of differential fitness. When an organism adapts positively to its environment, it is always by way of accomplishing some or other task. Ultimately, this is the task of controlling trophic energy, but this is achieved by way of subsidiary tasks. Generally, the task of controlling trophic energy is achieved by way of controlling whatever resource regulates one's population density. And achieving this latter task will involve the adoption of a particular strategy. Given this, it makes sense to speak not only of the absolute fitness of an organism but, also, of the effect that adopting a particular adaptive strategy has on that absolute fitness. The change in the absolute fitness of an organism brought about by the adoption of a strategy of adaptation I call differential fitness. Differential fitness, therefore, is always a function of, and thus indexed to, a particular strategy of adaptation.

Suppose an organism adapts to the environment through accomplishing a task T via strategy S. The differential fitness engendered by this strategy can be represented thus:

\[
\text{Differential fitness} = \text{Energy assimilated} - \text{Energy Expended}.
\]

The energy assimilated is the energy that the adoption of S allows the organism to control, and the energy expended is the energy that the organism is obliged to invest in the adoption and performance of S.

The notion of evolutionary cost is, at least roughly, to be equated with the energy expended part of this equation. And, in this regard, we can distinguish two types of cost: implementational and performance. A desert plant that specializes in deep roots, for example, will incur the implementational cost of diverting certain genetic resources into the production of such roots and the performance cost of diverting extra energetic resources into the maintenance of such roots. Generally:

\[
\text{Energy expended} = \text{Implementational costs} - \text{Performance costs}.
\]

In the next section, I shall argue that the above sort of cost-benefit analysis of evolutionary development favors certain kinds of strategies over others. In particular strategies that involve the manipulation by organisms of structures in their environment typically (but not necessarily, and perhaps not even always) have a more favorable cost-benefit analysis than strategies which do not.

3. EVOLUTIONARY COST AND ENVIRONMENTAL MANIPULATION

Beavers build dams. The explanation of this dam-building behavior goes something like this. A dam results in the creation of a miniature lake. The presence of the lake increases the distance the beaver is able to travel by water, and this is both safer than traveling by land and easier for transporting food. If a beaver lived on a stream only, then the supply of food trees lying along its bank would be quickly exhausted. By building a dam,
the beaver creates a large shoreline that affords easy foraging without the beaver having to make long and hazardous overland journeys.

Of course, in some suitably logical sense of "could," things could have happened differently. Instead of investing in dam-building behavior, the evolution of the beaver might have involved investing in ways that facilitated the beaver's ability to travel overland. Suppose that in the distant evolutionary past, the ancestor had evolved in two alternate ways. The first involved the dam-building strategy and culminated in the ordinary beaver. The second, however, eschewed this strategy and concentrated on making the beaver stronger, quicker, and more intelligent, thus increasing its efficiency in evading predators and transporting food on the long overland journeys it was obliged to make. So, evolution results not only in the ordinary beaver, but also the stronger, smarter, speedier superbeaver.

Both strategies are aimed at accomplishing 'T': the conjunctive task of finding/transporting food and evading predators. Let us suppose that the ordinary beaver and the superbeaver are equally competent with respect to this task. That is, statistically speaking, the ability of the ordinary beaver to transport food and evade predators by way of its strategy is equal to the ability of the superbeaver to transport food and evade predators by way of its strategy. Does this imagined equality entail that the differential fitness associated with the adoption of the ordinary strategy is identical with the differential fitness associated with the adoption of the super strategy? In fact, it would entail this only if it could be shown that the cost of adopting each strategy is the same. But this seems unlikely.

Consider, first how the implementational costs of the strategies compare. The implementational costs of the ordinary strategy comprise largely the genetic resources necessary for the development and maintenance of the structures that allow the beaver to pursue it. The primary structures here will be large, strong teeth, and a flat, powerful tail. Compare these implementational costs to those of the superbeaver. Firstly, the superbeaver will require more powerful muscles for dragging its food on its long overland journeys. Thus, its limbs and torso must become more powerful (i.e., larger). Secondly, it must also possess the capacity to escape from the predators it will inevitably encounter. Thus, it will have to become quicker, requiring perhaps longer limbs and increased muscle density. Sensory modalities might have to be improved, allowing quicker and more reliable detection of predators. And such improvement might require encephalization, which would entail more weight at the front of the body, weight which must be balanced by gains elsewhere, which will in turn require larger muscles, and so on. Given that this is so, it seems very likely that the implementational costs of the superbeaver strategy are greater than those of the ordinary beaver strategy. At the very least, and this is all my argument requires, the implementational costs of the superbeaver strategy will be no less than those of the ordinary beaver strategy.

It is when we turn to performance costs that the disparity becomes glaring. The performance costs of dragging, food trees overland, perhaps long distances, running away from the predators one is likely to encounter, and making sure one's attention is constantly tuned to the possibility of predators, seems to be far greater than the cost of depositing the food trees in the lake and letting it do most of the work for you, particularly when this procedure also removes the risk of predation. Of course, in terms of performance costs, the ordinary beaver strategy requires a significant initial outlay in the form of building a dam. However, when you compare this outlay with the alternative of regular overland journeys dragging heavy food trees, then it seems clear that this outlay would soon be compensated for.

Consider one more example. The environment that an organism can manipulate or exploit includes not just immediate structures but also other creatures. Sometimes this is true in the quite dramatic sense that one organism, a parasite for example, is spatially located inside another host organism. Its environment, thus, is another organism. Parasites that have a life cycle involving an intermediate host, from which they have to move to a definitive host, often manipulate the behavior of the intermediate host to make it more likely to be eaten by the definitive host. For example, there are two species of acanthocephalan worm, *Polymorphus paradoxus* and *P. marilis* which both use a freshwater shrimp, *Gammarus lacustris*, as an intermediate host, and which both use ducks as their definitive host. The definitive host of *paradoxus*, however, is generally a mallard which is a surface dabbling duck, *marilis*, on the other hand, specializes in diving ducks, *paradoxus*, therefore, should benefit from making its shrimps swim to the surface, while *marilis* would benefit from its shrimps avoiding the surface. Uninfected shrimps tend to avoid the light and therefore stay close to the lake bottom. However, when *lacustris* becomes infected with *paradoxus* it behaves very differently. It then stays
close to the surface, often clinging stubbornly to surface plants. This behavior presumably makes it vulnerable to predation by mallards.

In the same sort of way as the beaver, paradoxis is manipulating its environment to reduce its performance costs. Instead of having to break out of its host, fight its way to the surface, evade predators that would be nonsuitable hosts, and so on, it gets lacustris to do most of the work for it. There is admittedly a certain implementation cost in developing the means for producing the behavior altering chemical, but there is little reason to think that this cost would outweigh the cost of developing the alternative structures necessary for the alternative strategy where lacustris is not manipulated.

Time does not permit further examples. But there is nothing isolated or unusual about the cases of the beaver and paradoxis. I could have talked about what the fluke Dicrocoelium dendriticum does to the snails and ants unfortunate enough to become its intermediate hosts. I could have talked about the method male canaries have for bringing females into reproductive cycle. I could have talked about the hunting technique of the angler fish, or the extraneous parasitism of cuckoos. Several books worth of similar examples could be taken from the behavior of ants alone. Manipulative strategies are employed by a vast array of organisms and for a vast array of different tasks: predation and the evasion of predators, reproduction, rearing of young, feeding and gaining access to food, locating suitable habitats, and so on. What is going on here?

4. BARKING DOGS AND THE NOT SO OBVIOUS

I suggest that what is going on is the expression of a truism. Suppose you have to accomplish a certain task, a task that requires a certain expenditure of resources such as energy, time, and so on. That is, accomplishing the task requires that you put in a certain amount of work. Then, if you can get someone or something else to do some of this work for you, you will have less work to do yourself, providing, of course, that you work you have to put in to get them to do work for you is less than the work they then do for you. This is ultimately a principle of mechanics, not biology, but has biological expression in the heterogeneous ways in which organisms have evolved to manipulate and exploit their environments.

There is an old adage that seems to capture the gist of this idea quite nicely: why keep a dog if you are going to bark yourself? Or, closer to the present point, if you do have a dog, then you don’t have to bark yourself. And getting your dog to do your barking for you will save you considerable investment of resources (i.e., energy). More precisely:

Barking dog principle: If it is necessary for an organism to be able to perform a given adaptive task T, then it is differentially selectively disadvantageous for that organism to develop internal mechanisms sufficient for the performance of T when it is possible to perform T by way of a combination of internal mechanisms and manipulation of the external environment.

That is, given the ‘option’ of two evolutionary strategies (1) developing internal mechanisms that are themselves sufficient for the ability to accomplish T, and (2) developing internal mechanisms which, when combined with a certain type of environmental manipulation, are sufficient for the ability to accomplish T, then the latter strategy is typically selectively advantageous relative to the former. This is because, typically, the latter strategy can be adopted at less evolutionary cost than the former. More precisely, the implementation costs of the latter strategy will typically be no greater than those of the former, and may often turn out to be less, and the performance costs of the latter strategy are markedly less than those of the former. This is because, with the latter manipulative strategy, at least part of the performance costs are met by the environment. The manipulative strategy for the accomplishing of T, therefore, typically involves less investment of resources.

Another important point emerges. In manipulating the environment, some internal structures or mechanisms must be developed. The ordinary beaver, for example, in order to implement its particular adaptive strategy, must have evolved structures such as large flat teeth, powerful jaws, flat tail, and the like. However, the structures and mechanisms developed in conjunction with the manipulation of the environment may be not at all obvious ones given the nature of the task or problem at hand. One does not need a precise criterion of obviousness to appreciate this. If we were told that the adaptive task in question was one of enabling a smallish furry creature to transport food and/or avoid predators, then the inference to the development of big flat teeth and the like is by no means obvious. Once we allow that the performance of a given task can involve, in part, manipulation of the environment, then the internal mechanisms
which are necessary for the execution of this strategy may be very different from what we might initially expect. That is:

The principle of the unobvious character of evolved internal mechanisms: For the performance of a given task T, and for any internal mechanism M which has evolved in organism O and which, when combined with suitable environmental manipulation on the part of O, allows O to perform T, the nature of M is not always obvious on the basis of T.

The unobvious character of evolved internal mechanisms derives from the fact that it is not the mechanisms alone that perform the relevant task but the mechanisms in conjunction with suitable environmental manipulation on the part of the organism.

5. EVOLUTION AND COGNITIVE PROCESSES

If the argument developed here is correct, then we have prima facie reason to suppose that manipulative strategies for the accomplishment of a given task T can typically be accomplished at less cost than non-manipulative alternatives. And, therefore, we have prima facie reason for supposing that manipulative strategies typically result in greater differential fitness than non-manipulative alternatives.

Very briefly, what should we expect of cognitive processes should these principles be applicable to their development? I suggest that we should expect the mechanisms that subserve cognition to have developed to work in conjunction, on the part of the possessor of those mechanisms, with manipulation of relevant structures in the environment. This would be true not necessarily, nor always, but in a non-negligible number of cases. Cognitive processes would be realized not just by the manipulation of internal information-bearing structures, but also by the manipulation of external information-bearing structures. With respect to cognition, there would be no theoretically salient distinction between the transformation of internal information-bearing structures (i.e., mental representations) and the transformation of external information-bearing structures. Cognitive processes, understood as the manipulation of information-bearing structures in the solution of cognitive tasks, would not be located exclusively inside the skin of cognizing organisms. Nor would it be possible to understand such processes by focusing exclusively on what is occurring inside the skin of cognizing organisms. Indeed, the nature of the internal structures might be by no means obvious given the nature of the task at hand.

What is required to apply this principle to cognitive processes? Simply this claim: the internal structures and mechanisms that allow us to accomplish various cognitive tasks are ones that have evolved through natural selection. And once this assumption is properly understood, and properly qualified, I think it is scarcely debatable.

Perhaps the most familiar source for discounting this application of evolutionary principles to cognitive processes can be traced to Stephen Jay Gould and collaborators. Gould and E. S. Vrba, for example, distinguish between adaptations and what they call exaptations. An adaptation, at least for Gould and Vrba, is 'any feature that promotes fitness and was built by selection for its current role.' Exaptations, on the other hand, are 'character . . . evolved for other uses (or for no function at all) and later "co-opted" for their current role.' It might be argued, then, that the mechanisms responsible for human cognition are exaptations rather than adaptations. And this might be thought to cast doubt on the applicability of evolutionary principles in this case.

Happily, however, the arguments developed here do not require that the mechanisms responsible for cognition evolved for that purpose. One must never forget that evolution acts not just to produce structures and mechanisms, but also to maintain them once in existence. A mechanism that is maintained because of the role it plays in its own kind of cognitive processes is an evolutionary product no less than is a character that was originally evolved for the role. Both adaptations and exaptations are evolutionary products, and considerations of cost apply to both of them. Thus, whether a feature has been adapted for a role in its own kind of cognition, or co-opted for a role in another, it is better, in terms of cost, for it to fulfill this role in conjunction with manipulation, on the part of the organism, of relevant structures in its environment.

We are all aware of the pitfalls in the following inference: it is most efficient for organism O to have evolved in way W. Therefore, organism O evolved in way W. Such an inference relies on a sort of Panglossian conception of evolution that is, at the least, controversial. What this shows is that arguments from evolution can, at most, create a presumption in favor of a certain view of cognitive processes, and not demonstrate that such processes must be a certain way. Evolutionary arguments, then, need to be-
supported by detailed and independent examination of specific cognitive processes, examination which would show, one way or the other, whether the expectations elicited by evolutionary considerations are in, fact, the case. The next section provides at least the outline of such an examination.

6. AN ENVIRONMENTALIST MODEL OF COGNITION

Most definitions of the notion of a cognitive process begin by defining the notion of a cognitive task, usually by enumeration. Thus, the concept of a cognitive task includes such things as perceiving the world, remembering perceived information, making predictions about unperceived states of the world on the basis of such information, and so on. A cognitive process is then defined as (i) one that aids in the accomplishing of a cognitive task, and (ii) that does so by the manipulation or transformation of information bearing structures, that is, by information processing. Condition (ii) is required to exclude processes that are necessary for accomplishing cognitive tasks but which do not themselves count as cognitive. For example, one cannot accomplish any cognitive tasks if one is dead, but respiration does not thereby count as a cognitive process since it does not involve manipulation of information bearing structures. The most basic kind of cognitive process is perception, and it is here we shall begin the development of the environmentalist model. Specifically, I shall focus on visual perception.

The starting point for any environmentalist model of visual perception is what J. J. Gibson calls the optic array (Gibson 1966, 1979). Light from the sun fills the air, and the environment is, as a result, filled with rays of light traveling between the surfaces of objects. At any point, light will converge from all directions. Therefore, at each point in the environment there is what can be regarded as a densely nested set of solid visual angles composed of inhomogeneities in the intensity of light. Thus, we can imagine the observer, at least for the present, as a point surrounded by a sphere which is divided into tiny solid angles. The intensity of light and the mixture of wavelengths will vary from one solid angle to another. This spatial pattern of light is the optic array.

For our purposes, what is crucial is that the optic array is an external information bearing structure. It is external in the quite obvious sense that it exists outside the skin of perceiving organisms, and is in no way dependent on such organisms for its existence. It also carries information about the environment in virtue of the fact that its structure is determined by the nature and position of the surfaces from which it has been reflected. Thus, the optic array is divided into many segments or angles. Each of these contains light reflected from different surfaces, and the light contained in each segment will differ from that of other segments in terms of its average intensity and distribution of wavelengths. The boundaries between each segment of the optic array, therefore, provide information about the 3D structure of the environment. At a finer level of detail, each segment will, in turn, be subdivided in a way determined by the texture of the surface from which the light is reflected. Therefore, at this level also the optic array can carry information about further properties of objects and terrain. Not only is the optic array external to the perceiving organism, so too is the information it carries. Information, in this context, is simply homological dependence. The structure of the optic array nomically covaries with the structure of the environment. The optic array is thus specific to, in the sense of nomically dependent upon, its environmental sources. And, in virtue of this, the former carries information about the latter.

The optic array is, thus, a source of information for any organism equipped to take advantage of it. But the optic array does not simply impinge on passive observers. Rather, the living organism will actively sample the optic array (Gibson 1966). The perceiving organism obtains information from the optic array by exploring it, and thereby actively appropriating the contained information. One way of doing this is by moving, and thus transforming the ambient optic array. By effecting such transformations, perceiving organisms identify and appropriate what is known as the invariant information contained in the optic array. This invariant information takes the form of higher-order variables. Consider, for example, what is known as the horizon ratio relation (Seligman 1973). The horizon intersects an object at a particular height. All objects of the same height, whatever their distance, are cut by the horizon in the same ratio. The horizon ratio relation provides an example of the invariant information contained in the optic array. Invariant information, by definition, is information that can be made available only through the transformation of one optic array into another. Thus, an organism can detect such invariant information only by moving, and, hence, effecting transformations in the ambient array.
What is crucial here is that (i) the optic array, a structure external to the perceiving organism, is a locus of information, and (ii) an organism can appropriate or make this information available to itself through acting upon this structure and effecting transformations in it. In this way, the perceiving organism uses or employs an external structure to make available to itself information that it can then use to deal with its environment. On standard definitions of the notion of a cognitive process, this acting upon an external structure should count as one. It is a process which aids in the accomplishing of a cognitive task, and which does so by manipulating or transforming an information bearing structure. It just that, in this case, the information bearing structure happens to be external. Indeed, manipulating the array to make available its contained information is, in effect, a form of information processing. If we want to think of perception in terms of information processing—and this is a standard view—then there is no good reason for insisting that the relevant information processing occurs only inside the skin of perceiving organisms. The external optic array is an information bearing structure, and the organism, by acting upon it, effects transformations in this information bearing structure. Again, according to standard definitions of information processing, this counts as information processing.

Of course, one could always stipulate that the concept of information processing is to be restricted to processes occurring inside the skins of organisms. One could make a similar stipulation for the concept of a cognitive process. One can stipulate anything one likes. However, given that information is embodied in structures external to organisms, and given that an organism can manipulate and transform these structures in order to appropriate this information, and then employ the appropriated information in the accomplishing of cognitive tasks, it is difficult to see the theoretical salience of the restriction to internal processes. When the goal is to make available to oneself information relevant to the accomplishing of a given cognitive task, and when the method is to effect transformations in relevant information bearing structures, the theoretical relevance of the distinction between inside and outside collapses.

If, relative to the concept of information processing, there is no theoretical salience to the distinction between inside and outside, considerations of simplicity apparently oblige us to say that when an organism acts upon an optic array and, by effecting transformations in this array, appropriates, or makes available to itself, the information contained therein, the organism is, in effect, engaging in a form of information processing. That is, an organism can process information relevant to visual perception task T by acting upon, and thus effecting transformations in, the optic array. And this gives us a proof, by instantiation, of the more general claim:

E. In certain circumstances, acting upon external structures is a form of information processing.

E is the central claim of what I have called the environmentalist model of cognition. E, of course, does not claim that no information processing occurs inside the skin of cognizing organisms. It claims that not all of the information processing relevant to cognitive tasks occurs inside the skin of such organisms. Information processing and, hence, cognition, occur not just in the head; they occur also in the world.

Entails the seemingly radical conclusion that cognitive processes are not purely internal to organisms. Yet E can be established from uncontroversial premises. First, that information can be carried by structures that are external to cognizing organisms. Second, that such organisms can appropriate at least some of this information by acting upon such structures. Once we accept these premises, the externality or environmental character of at least some cognitive processes emerges quite quickly and easily.

7. EXTENDING THE MODEL: REMEMBERING AND REASONING

Michael Cole, Losi Hood, and Ray McDermott (1982) describe a case where a child is seeking an ingredient for baking a cake. The child does not need to remember exactly where the ingredient is located. Instead, the child simply goes to the shelf and works her way along it until the ingredient is found. In this case, part of the environment (the shelf) goes proxy for a detailed internal memory store.

The idea of using environmental cues that aid memory is, of course, well-known. Tying a knot in one’s handkerchief, writing down a shopping list, making calendars, asking someone to remind you to do something, leaving something at a special place where it will be encountered at the time it needs to be remembered, and so on, all constitute a small subset
of the number of external memory aids people employ. These are typically viewed precisely as external aids to memory, as extrinsic devices that might help trigger the real process of remembering, itself regarded as a purely internal operation. It is this dichotomy between the internal process of remembering and external aids to remembering that an environmentalist model of memory breaks down.

Examples of the Cole, Hood, and McDermott variety can be extended indefinitely (Rowlands 1995, 1999). Suppose I want to find a book at the library. I’ve seen the book before and think it might be useful to what I am now doing. But I cannot remember what it is called or who the author is. Moreover, I do not remember exactly where it is in the library, but I do remember the floor, and I also remember that it is on a shelf with a peculiar distinguishing feature, say a distincively colored tray at the end. Therefore, go to the correct floor, look for the shelf with the distinguishing feature, and then work my way along the shelf until I find the book. In this case, the library floor and the shelf together seem to go proxy for a complex internal memory store. Similar remarks would apply to the process of navigating one’s way around the environment by way of remembered landmarks (I can’t remember exactly where X lives, but I know that if I turn right by the lake, go on as far as the pub and then take a left…). In this case, the environment also seems to stand in for a detailed memory store.

Again, in the above sorts of cases, the environment contains structures that carry information. This information is relevant to the accomplishing of a cognitive task, and it can be appropriated by organisms that are capable of acting upon the structures in the right sort of way. The information-processing operations required to accomplish certain sorts of memory task, therefore, consists not just in the manipulation and transformation of internal information-bearing structures (i.e., mental representations) but also in the manipulation and transformation of external information-bearing structures. Once again, the distinction between the information that gets processed in the head and information that gets processed outside the head is of little relevance for understanding a cognitive process such as memory.

This claim can be reinforced by focusing on not the present employment of memory capacities (the focus of the above examples), but on certain developmental features of such capacities. Consider, that is, how the existence of environmental information-bearing structures will influence the development of our capacity to remember. To see this, consider, a fairly early and simple case of visuographic representation (i.e., writing). One of the more ancient forms of such representation takes the form of knots. The Chinde tribe of Peru, for example, had a special officer assigned to the task of tying and interpreting *kūnis* (knots’ in Peruvian). Originally such officers were rarely able to read other people's *kūnis*, unless they were accompanied by oral comment. However, with time the system was rendered uniform and could be used to record all the major matters of state: census, taxes, laws, events, and so forth.

As A. R. Luria and I. S. Vygotsky (1992) point out, invention of *kūnis* will have had a profound effect on the development of strategies of remembering. Compare the memory of, for example, the envoy transmitting word for word the lengthy message of his tribal chief with the memory of the Peruvian *kūnis* officer. The envoy has to remember not simply the content of the message. Much more difficult, he has to remember the precise sequence of words uttered by his chief. The *kūnis* officer, on the other hand, does not have to remember the particular information contained in the knot he has tied; he simply has to remember the code that will allow him to extract this information. The envoy must rely on what is known as *episodic memory*: memory for concrete, specific, detailed events. The *kūnis* officer’s reliance on this sort of memory is much less; he must employ it only in the learning of the code. Then he is able to tap into the information contained in the knot, and a potentially unlimited quantity of information becomes available to him without further employment of his episodic memory.

Once an environmental information store becomes available, it is easy to see how memory is going to develop. Episodic memory becomes a lot less important, restricted to the learning of the code necessary for the appropriation of the information that is environmentally embodied. Luria and Vygotsky conjecture that this is why, during the process of cultural development, the outstanding episodic memory of members of less developed cultures tends to wither away. The cultural evolution of memory is, in this sense, also *involution*: constituted not only by an improvement in certain areas, but also by retrograde processes whereby old forms shrink and wither away. With the development of external forms of representation, internal development now becomes exter nal.
As Merlin Donald (1991) points out, the development of external forms of memory storage constitutes a hardware change in the cognitive architecture of human memory, albeit a nonbiological hardware change. In this context, Donald introduces a useful analogy, that of networking. The capacity of a given computer can be described in terms of its hardware features (memory size, central processing unit, etc.) and its software features (operating system, programming support, etc.). However, both the software and the hardware features of an individual computer will change if it is embedded in a network of computers. This is because networking involves a structural change; the processor and the memory of the computer are now part of a larger network. As part of a network, the computer can now delegate computations beyond its own internal capacity. It can also assign priorities within the larger system, and can store its outputs anywhere in the network. In a true network, the resources of the system are shared, and the system functions as a unit larger than that of its individual components.

The invention of external representational systems such as writing should be regarded as, in the first instance, a hardware, rather than a software, change. Such systems constitute a collective memory as real, in terms of hardware, as any external memory device for computers. Individuals in possession of reading, writing, and other visuographic skills thus become somewhat like computers with networking capabilities; they are equipped to interface, to plug into whatever network becomes available. And once plugged in, their skills are determined both by the network and by their own biological endowments. Those who possess the code, the means of access to the environmental structures, share a common memory system. And as the database in that system expands far beyond the mastery of any single individual, the system becomes by far the greatest determining influence in the memory of individuals.

In a network, memory can reside anywhere in the system. For example, a program running a computer may not be located there; or it may reside there wholly or in part. In terms of the execution of its algorithms, these things do not matter. The crucial thing is that the information required for the performance of a given task (e.g., memory) is located out there, in the external representational system. It is stored not biologically, but environmentally. Biological retrieval strategies are largely limited to the storage and retrieval of the relevant code that yields access to this environmental store of information, and not with the storage and retrieval of a great deal of specific information.

Therefore, in the case of memory, just as perception, it seems plausible to suppose that the information processing relevant to a given memory task can occur when an organism uses, or acts upon, a physical structure in its environment and, in so doing, appropriates or makes available to itself, information relevant to that task. That is, an organism can process information relevant to memory task T through acting upon, and thus effecting transformations in, physical structures in its environment.

Once again, this is not to say that all remembering involves acting upon environmental structures, only that some of it does. In the case of memory, as in perception, the distinction between the transformation of internal information bearing structures and transformation of external information bearing structures is not a theoretically salient distinction. Acting upon environmental information bearing structures is a form of information processing, hence a form of cognition. And this is precisely what is claimed by E., the central thesis of the environmentalist model of cognition.

The environmentalist model of cognition is not limited to perception and memory. Most types of cognitive process can, in certain circumstances, involve manipulation or transformation of information bearing environmental structures. New interest in this environmental aspect of cognition has been sparked by recent developments in artificial intelligence. In particular, certain problems that plagued connectionist or parallel distributed processing approaches to the modeling of higher forms of cognition may well be overcome if we allow neural nets to be embodied in appropriately structured environments (Rumelhart, McClelland et al. 1986, Rowlands 1999). The idea, very roughly, is that a process—for example, reasoning in accordance with formal rules—that seems to be beyond the modeling ability of a connectionist system can, in fact, be broken down into an internal process of pattern recognition and completion, which very much is within the modeling ability of a connectionist system, plus an external process of manipulating and transforming mathematical structures in the environment. If the formal structure is built into the environment, it does not need to be built into the connectionist system. Or so the idea goes. Proper analysis of the idea is, unfortunately, outside the scope of the present paper.
The central features of the environmentalist model of cognition are, therefore, as follows. First, there exist structures that are external to—outside the skin of—cognizing organisms. Second, these structures carry information that is relevant to the completion of cognitive tasks. Third, the organism can process this information by acting upon, and effecting transformations on, these external structures. Therefore, not all the information processing effected by an organism in the performance of a cognitive task occurs inside the skin of that organism. Just as information processing can be achieved by way of manipulation of internal information bearing structures ( mental representations), so too can it be achieved by way of manipulation of external information bearing structures. Cognitive processes are ones that involve the manipulation of information bearing structures in the performance of cognitive tasks. Therefore, the skin has no relevance to understanding cognition. Cognition is not just something we do in our head. Cognition is fundamentally something we do in the world. And that portion of cognition achieved in the head is just a subset of this wider category.

8. ENVIRONMENTALIST EPISTEMOLOGY

The Cartesian conception of the mind, with which this paper began, has well-known epistemological corollaries. A close relative of Descartes' ontological internalism is epistemic internalism. The central idea of epistemic internalism is that the difference between true belief and knowledge consists in some form of justification and, crucially, that justification consists in factors that are internal to the subject of the belief. The relevant notion of internality, however, is fundamentally epistemic. The activities of the heart and lungs are clearly internal to me, but these are not candidates for transformers of true belief into knowledge. Whatever does transform true belief into knowledge must, according to the epistemic internalist, be something to which the subject has epistemic access. However, I can have epistemic access to many things—including, say, the fact that it is presently raining (here). But this is not access of the relevant sort. Rather, the access must be of some special sort. According to Descartes, for example, the special access consists in the fact that the thinking subject can determine with certainty whether a belief has justification or not. And according to Chisholm, an internalist descendent, whether a belief has justification is something that can be determined by reflection alone.

One of the most direct casualties of a consistent environmentalism is this notion of special access. Processes of belief formation, and, indeed, processes of reflecting on the beliefs thus formed, will often have environmental constituents; they will be literally composed of environmental information bearing structures, and of the processes whereby we manipulate these structures in relevant ways. Our access to the factors that transform true belief into knowledge, therefore, can often be no more special than our access to environmental structures in general.

Environmentalism, however, has application wider than simply epistemic internalism. It also casts doubt on the frameworks of debate within which the dispute between epistemic internalists and externalists takes place. At a high level of generality, and with some corresponding degree of oversimplification, we can represent the fundamental assumptions of this framework as follows. The world exists 'out there'; and the cognitive operations in terms of which we acquire information about and represent that world exists 'in here.' The fundamental concern of traditional epistemology is finding a method of determining (i) the adequacy of those cognitive operations by way of which we find out about the world, and, consequently (ii) the degree of cohesion between the world and the operations by way of which we represent it (i.e., 'consequently' because representations of the world are typically conceived of as the culmination of the operations by way of which we acquire information about that world). According to epistemic internalism, determining the extent of this adequacy and cohesion is a matter of identifying relevant epistemically accessible states or processes that are internal to the cognizing subject; states or processes that provide a justification for believing in the cohesion between external world and internal cognitive operations. According to epistemic externalism, the degree of adequacy and cohesion is a matter of warrant, rather than justification, and this is constituted by some sort of external relation—typically causal epistemological—between world and the means by which we find out about and represent it.

The environmentalist model of cognition, if correct, will subvert this agreed framework. The cognitive operations, by way of which we are supposed to acquire information about, hence represent the world, are themselves, at least in part, processes of the world. They possess, quite literally, worldly constituents. And even those vehicles that can legitimately be regarded as located inside the skin of cognizing organisms can, in
many instances, not be identified independently of the world. Such vehicles will, in many instances and perhaps most, have been designed to operate only in conjunction with the manipulation of environmental structures. We can understand them, hence theoretically specify them, only in conjunction with what their bearers do in (and to) the world. The question of the cohesion of the world with the means we use to represent it would appear to make little sense, if those means are already of and in the world. The idea that the fundamental question of epistemology pertains to the adequacy of the operations by which we find out about the world, and the degree of cohesion between the results of those operations (i.e., representations) and the world will, I think, have to be re-assessed if environmentalism about cognition comes to be accepted. Ultimately the same point can be at an ever higher-level of generality. A consistently applied environmentalism may cast doubt on both the content and the usefulness of the concept of representation. To the extent that it does so, it will also cast doubt on the framework within which the epistemic internalist/externalist debate has been conducted.

REFERENCES