Selective Representing and World-Making

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Abstract. In this paper, we discuss the thesis of selective representing — the idea that the contents of the mental representations had by organisms are highly constrained by the biological niches within which the organisms evolved. While such a thesis has been defended by several authors elsewhere, our primary concern here is to take up the issue of the compatibility of selective representing and realism. In this paper we hope to show three things. First, that the notion of selective representing is fully consistent with the realist idea of a mind-independent world. Second, that not only are these two consistent, but that the latter (the realist conception of a mind-independent world) provides the most powerful perspective from which to motivate and understand the differing perceptual and cognitive profiles themselves. And third, that the (genuine and important) sense in which organism and environment may together constitute an integrated system of scientific interest poses no additional threat to the realist conception.

1. What's In An Umwelt?

The world of the tick, it is sometimes said, is significantly smaller than our own. What matters, for the life and flourishing of the tick, is a scanty framework consisting, in essence, of three receptor cues and three effector cues (Von Uexkull, 1934, p. 12). The first effective stimulus is butyric acid, found on the skin of mammals. Detection of butyric acid causes the tick to drop from the foliage and (with luck) to fall on a live animal. Skin contact triggers running about until heat is detected, which then initiates burrowing. Thus it is, that, as Von Uexkull tells us, the effective environment, or 'umwelt', of the tick is constructed: "out of the vast world which surrounds the tick, three [stimuli] shine forth from the dark like beacons, and serve as guides to lead her unerringly to her goal"(op cit., p. 11).

But what is this vast world that surrounds the tick? Is it our world? Or the world of science? Or something unstructured, elusive, perhaps (dare we say it) noumenal? Once we embrace the basic insight that different animals perceive and cognize a "relevant-to-my-lifestyle world, as opposed to a world-with-all-its-perceptual properties" (Churchland et al., 1994, p. 56), can we properly stop short of the non-realist conclusion that our perceptual world, and the world of science, too, are in some deep sense perceiver-dependent? (Varela et al., 1991, p. 173). Could it be Umwelts 'all the way down'?

Clark (1997) claims that we can, and should, stop short of any non-realist conclusion: that we can, and should, stop short of the problematic idea that objects and their properties are not independent of the mind, asserting merely that the "as-

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pects of real-world structure which biological brains represent will often be tightly geared to specific needs and sensori-motor capacities" (op cit., p. 173). Let us call this latter thesis, shared by Clark (1977), Churchland et al. (1994), Akins (1996) and others, the thesis of selective representing. Chemero (1998) has argued that non-realist conclusions follow directly (like it or not) from the thesis of selective representing and also from recognition (see Section 3 below) of complex interplay between organism and environment and between sensing, thought and action.

In this paper we hope to show three things. First, that the notion of Umwelts and selective representing is fully consistent with the realist idea of a mind-independent world. Second, that not only are these two consistent, but that the latter (the realist conception of a mind-independent world) provides the most powerful perspective from which to motivate and understand the differing perceptual and cognitive profiles themselves. And third, that the (genuine and important) sense in which organism and environment may together constitute an integrated system of scientific interest poses no additional threat (despite the argument of Varela et al., 1991 and others) to the realist conception.

2. Selective Representing Versus World-Making

In some recent work (e.g., Hutchins, 1995; Clark, 1997; Hurley, 1998) there is much emphasis on the blurring of boundaries between mind and world. What may on one occasion be an object of a subject's representations and computations — say a seen and manipulated pencil — may on another occasion function more like a part of the subject, as when the presence of pencil and paper become assimilated into the cognitive system with which a subject confronts a complex problem domain.

Such blurring of the mind/world boundary must, however, be recognized as conceptually distinct from another class of theses that wish to demolish the distinction between mind and world. Such views include the various idealisms, perspectivalisms, constructivisms, relativisms, and subjectivisms that have peppered the philosophical landscape for as long as there has been a philosophical landscape. Common to such views is the doctrine that what we represent cannot exist independently of our representing it. In contrast are realist and objectivist views that allow that what we represent really would be the way we represent it even if unrepresented.

The view expressed in Clark (1997), for example, is explicitly presented as compatible with realism. The kind of mind/world blurring there discussed has to do mainly with the way that things external to the outer membranes of an organism can be co-opted into the organisms' cognitive system. In some, perhaps surprisingly many, cases, it is claimed, the vehicles of representation and computation include more than just the organism's nervous system, indeed more than what we would typically regard the organism's body. What the organism thus represents, however, need not depend on being represented for its existence. That is, the organism may

still represent things that are metaphysically objective. (For more on metaphysical objectivity and related notions, see Mandik, 1998.)

In a recent article, Anthony Chemero (1998) argues against the compatibility of realism and such embedded, embodied approaches to the mind. Chemero argues that emphases on "the embodied, active mind leads to non-realist conclusions" (paragraph 14). The crux of Chemero's argument moves from ideas about what we have termed 'selective representing' to the anti-realist conclusion that different ways of representing bring about the existence of different worlds that are represented.

Chemero's argumentative strategy may be unpacked further as follows. According to the thesis of selective representing, organisms' representational apparatuses operate on a pretty strict need-to-know basis. The way an organism represents the world is the result of a quick and dirty solution to a problem created by the special circumstances of the organisms' biological needs. Different niches give rise to different species-specific representational schemes. If it is safe to assume that both gibbons and goldfish represent the world, then it is also safe to assume that they represent the world in radically different ways. A gibbon may represent the world as having good branches to swing from whereas whatever goldfish represent surely doesn't include swinging from tree branches.

Chemero makes the move from there being multiple species-specific representational schemes to there being multiple mind-dependent worlds brought about by these different representational schemes. As Chemero sees it, our human ways of representing the world — including science — are themselves quick and dirty need-to-know solutions to biological problems constrained by the biological peculiarities of our species. Our ways of representing are as different from gibbons' ways as the gibbons' ways are from the goldfishes' ways. Why, Chemero asks, privilege our way as the one way that gets it right? Why privilege our scientific ways of representing the world as the representations that represent the way the world really is?

There are, we think, two initial ways in which Chemero's argument goes wrong.

The first way involves the supposition that the different ways of representing the world are in conflict — that they somehow constitute disagreement. Let us suppose that organism X represents only varying temperatures and that organism Y represents only varying concentrations of sulfur. The organisms are not disagreeing. It is not like X represents the presence of temperature and Y represents the absence of temperature. And since X and Y are not in disagreement, it is entirely consistent to maintain that both X and Y represent the way the world really is.

Now there is a way to import disagreement into the situation of X and Y, but such a way is entirely illicit. One may attempt to redescribe the situation by saying that X represents the world as containing ONLY temperature and saying that Y represents the world as containing ONLY sulfur. Thus X and Y are representing the same thing in contradicting ways (on the assumption that temperature is not sulfur). The key point here is that such simple organisms simply are not equipped

to represent the world as a whole and predicate of it the presence of ONLY varying degrees of sulfur. They simply do not have the conceptual resources to pull this off. Instead the situation is akin to one person saying that dogs are furry and another person saying that dogs have four legs. While each person is saying different things, the situation need not be one of disagreement, thus it is entirely consistent to maintain that both people represent the way dogs really are.

We think that the illicit importation of disagreement arises by treating as interchangeable "X only represents Y as Z" and "X represents Y as only Z". One must guard against such a maneuver. One must not treat as interchangeable the phrases like "The only things that George thinks about are cheese burgers" and "George thinks that only cheese burgers exist". In the first situation, George need employ only the concept of cheeseburgers. But in the second situation, George needs in addition to the concept of cheeseburgers, the concepts of existence and negation.

We suspect that Chemero does not adequately guard against such an illicit move. Chemero writes:

> Because the needs of one type of animal can be are so different from those of another, the perceptual systems that result will constitute the world in very different ways, as full of barbecues and highways and myriad other things for humans, but, for example, as containing only three things — what we see as butyric acid, pressure and temperature changes — for ticks (see von Uexkull, 1934, p. 10). (paragraph 15)

In the above passage, the assertion that ticks represent the world as containing only butyric acid, pressure and temperature changes is unwarranted and may not be inferred from the mere fact that the only aspects of the world ticks are capable of representing are butyric acid, pressure and temperature changes.

It is one thing to say that ticks represent only X, Y and Z. It is an entirely different thing to say that ticks represent the world as having only X, Y, and Z. The latter case is what is needed for the tick's representations to be in conflict with ours. But the former case is all that the thesis of selective representing is committed to, and the former case is consistent with realism.

The second way that Chemero goes wrong is by a fallacious supposition of the exclusivity of functions. The fallacy is to infer from the premise that the function of organisms' representational schemes is to get by, to the conclusion that the function of organisms' representational schemes is not to represent the way the world really objectively is. Chemero writes:

> [G]iven the way evolution works, we should not think of the perceptual systems (or any parts of animals) as ideal solutions to problems posed by the environment. Instead, animals that survive and reproduce are those that do well enough to find food and so on. So, there is no reason to assume that any particular animal's perceptual system gets the world, as it is independently of thought, *just exactly right*; they all do only well enough. (paragraph 15)

Continuing on this theme, Chemero writes:

> Consider that Clark argues that "higher thought," the kind exhibited in mathematical and scientific theorizing, depends on the scaffolding provided by public language. He also suggests (pp. 211–213) that language is adapted to the way our brains worked pre-linguistically; human language, that is, is adapted to and built upon action-oriented representations. But, as we have seen, these representations are biased by pressures to fulfill human needs throughout evolutionary history. And if the foundation on which language is built is biased, it is overwhelmingly likely that language itself is similarly biased. So if physics and other sciences depend upon our language-using abilities (and Clark argues that they do), they have no claim on being reflections of the world-in-itself." (paragraph 19)

Chemero's passages echo suspicions that have been around for a while. For example Patricia Churchland (1987) urges "Looked at from an evolutionary point of view, the principle function of nervous systems is to get the body parts where they should be in order that the organism may survive. . . . Truth, whatever that is, definitely takes the hindmost" (pp. 548–549).

We offer in response that two different functions can be compatible: an organism can be tightly fit into a particular and peculiar niche and represent the way things really are. To suppose otherwise, that is, to suppose the exclusivity of the two functions is like arguing that the function of a stop sign is not to get cars to stop because the function of a stop sign is to help prevent car accidents (See also Grush and Mandik, in press). A tick may represent just what it needs to get by: concentrations of butyric acid etc.. But this is entirely compatible with representing the way things really are: as being concentrations of butyric acid, etc.

The rhetorical device Chemero employs and that is worth pointing out is the way that he moves between the phrases "The way X represents the world" and "X's world". This rhetorical device paves a smooth passage for anti-realism for it makes it seem that there is a world for each way of representing-that different representational schemes are different ways of world-making. Admittedly, such language is encouraged by the introduction of appealing to Umwelts in the first place. Nonetheless, one must avoid the view that makes idealism rest on the following tautology: the only world that we represent is a world that is represented by us. Now, of course, the world represented by us is representation dependent in at least this sense: it depends on being represented by us for its being represented by us. But this can't be what the realist and anti-realist are disagreeing about. We mention this point not to attribute it to Chemero, only to point out the dangerous proximity between the tautologous version of anti-realism and the rhetoric employed in these discussions.

3. Beyond Selective Representing?

One can, it seems, have one's Umwelts and a robust scientific realism too. Or at any rate, Chemero's specific attempt to derive the non-realist conclusions directly from the notion of selective representing seems to fail. All that the thesis of selective representing really works against, we want to say, is a kind of hyper-realism that gives some special place to our native take on the structure of the world. Objectivism, understood simply as the view that there is a mind-independent world that has some mind-independent properties and features to which life has adapted (changing things in the process, to be sure), seems, moreover, to be the natural stance from which to assert the very idea that different kinds of organism, with different needs and different modes of perceptual and motor engagement with the world, will become sensitized to different aspects of this common underlying reality. Different needs and niches yield different native takes on the world. Different needs and niches may then lead different animals, if they are sufficiently advanced, to carve up the world into objects and properties in varying ways. This too is compatible with objectivism, just as the metaphor of a single and perfectly real cake accommodating many different carvings suggests. There are, however, at least two further and deeper problems that might then motivate a non-realist conclusion hereabouts, and we want to end with a word or two on each.

The first is what might be called the problem of characterization . It is one thing to simply assert the existence of a common, underlying reality to which various animals are variously adapted. It is another thing, alas, to say something concrete about the character of that reality, about what that reality is like: to describe, if you will, the properties of the cake, prior to our native carving. In personal communications, Chemero suggests that this broadly Kantian worry is, for him, the real driving force behind his anti-objectivism. We agree that this is a hairy topic, but want to insist on a simple realist response. The very idea of multiple Umwelts, at least in the way we want to motivate and deploy it, is a scientific one. It is an idea rooted in the observation that ticks, for example, are sensitive to the butyric acid found on mammalian skin and that, as Von Uexkull (1934, p. 11) himself put it "out of the whole environment, no stimulus affects [the tick] until a mammal approaches, whose blood she needs before she can bear her young". This whole Umwelt-laden story depends on taking seriously the set of environmental features and properties picked out by our scientific understanding.

Part of that understanding includes the notion that the sorts of things that the tick is responsive to — temperature and butyric acid — are the sorts of things that exist independently of tick's responsivity. The scientific story licenses saying that the tick is responsive to stuff that would be there even if the tick were not. Chemero wonders what reason the scientific realist has for supposing that human Umwelten capture the way the world really is. The reason the realist provides is the same reason for supposing that tick Umwelten capture the way the world really is: the

world really does contain concentrations of butyric acid and ticks are responsive to those concentrations.

Taking science seriously as a picture of mind-independent reality is, we think, a pre-condition of using the kinds of evidence and argument both Clark, Churchland et al. and Von Uexkull deploy. True, Von Uexkull talks also of the Umwelt of the astronomer, a scientist. But this strikes us as more a piece of phenomenology (a comment on the objects most immediately salient in the astronomers reflective domain) rather than a claim that science cannot claim, in some fair measure, to depict the larger environment of which the tick and indeed the astronomer (immersed in her subject) are sensitive to only tiny parts. (And if that isn't what Von Uexkull thought, we think he should have! Incidentally, the same goes, as one of us argued long, long ago, for the Evolutionary Epistemologist who must likewise negotiate a tricky compromise between accepting her own somewhat species-specific perspective and undermining the science-based generality of her own claims (see Clark 1986).)

The second deep problem is, in some ways, rather more interesting. We don't know if Chemero has this one in mind or not. We can call it the problem of co-constitution and it goes something like this. Our defense of realism, it may be objected, buys into a scientifically suspect idea of selective representing. We sometimes spoke as if there was a world, described by human science, full of objects and properties such that different animals simply pick on different pre-existing things. The tick picks on butyric acid, the astronomer on stars and planets, the cat (literally) on the mouse. But sensing and perceiving, so this powerful objection goes, are not always (perhaps not ever?) like that. Sometimes, it is best to think not in terms of simple information pick-up so much as of the coupled, and even creative, dynamics of an organism–environment system. In exactly this vein Timo Jarvilehto (1998) has argued that "knowledge is formed by perception through a reorganization. . . of the organism–environment system rather than through the transmission of information from the environment. With the help of efferent effects on receptors, each organism creates its own particular world" (op cit, p. 1). This sounds, to us, like a claim that Chemero would applaud. Indeed, it is even a claim we applaud: but (once again) we think it needs to be handled with care if it is to make the correct scientific case rather than feed a bloated and dangerous metaphysic. Here, then, is a simple example of what we think may be one of the (important) insights that Jarvilehto is expressing.

Consider running to catch a ball (a fly ball in baseball for example). Giving perception it's standard role, we might assume that the job of the visual system is to take in enough information to project a trajectory so that we can run to where the ball will land. It seems, however, that nature has a better solution: you simply run so that the ball's trajectory looks straight against the visual background (McBeath et al., 1995). This solution exploits a powerful invariant in the optic flow, discussed in Lee and Reddish (1981). It yields a nice, cheap, robust solution. But it also displays, as the roboticist Tim Smithers (1994) points out, a somewhat different role for

perceptual input. Instead of using sensing to get enough information into the system to allow it to 'throw away the world' while it solves the problem internally, it uses the sensor as a conduit allowing environmental magnitudes to exert a constant influence on behavior. As Jarvilehto might put it, the sensor enables the creation of a coupled organism–environment system whose intrinsic dynamics solves the problem.

This is, admittedly, a very simple case. There is growing evidence, however, that even in more complex cases it may be unwise to depict perception as simple information pick-up. Susan Hurley (1998) argues convincingly that instead of identifying the intuitive category of perception with something like systemic input, we would do better to identify it with whole cycles of input–output behavior in which sensing and acting combine to yield ongoing adaptive fit between organism and world. The perception/action distinction, if it is to be maintained at all, then emerges, for Hurley, as a personal level distinction concerned with the role of different input-output cycles in intentional behavior. (See also Grush, 1998 and Mandik, 1999 for similarly motor-oriented analyses of perception.)

This perspective fits well with recent work in so-called interactive vision (see Ballard, 1991). It also resonates with the insistence by both Merleau-Ponty (1942) and Varela et al. (1991) that in perception the organism actively elicits the very stimuli to which it then responds. An example from Merleau-Ponty captures the idea:

> When my hand follows each effort of a struggling animal while holding an instrument for capturing it, it is clear that each of my movements responds to an external stimulation; but it is also clear that these stimulations could not be received without the movements by which I expose my receptors to their influence. (1942, p. 13)

What this now adds to the simple ball/gaze example is the idea of a kind of active creation of the very stimuli to which we respond.

The theme of active creation is similarly visible in a variety of recent treatments that stress the 'idiosyncratic', 'deictic', 'action-oriented' or 'narcissistic' nature of different organismsm ways of perceiving and conceiving their worlds (see Ballard, 1991; Agee and Chapman, 1990; Clark, 1997, pp. 47–51, 149–53; Akins, 1996. See also Dennett, 1996, p. 146; Churchland et al., 1994, p. 56; Michaels and Carello, 1981, p. 45). The idea here — and it is a compelling one, as far as it goes — is that the kinds of environmental property and features that will matter to different animals will not merely be simple subsets of some fixed set of possibilities (licensed by physics). Instead, they will look somewhat odd and gerrymandered, reflecting as they do the motor profiles and lifestyle proclivities of each different kind of being. Such claims bring us full circle to the notion of Umwelts (Umwelten) with which we began. Except we now add, as a point of clarification, that Umwelts are indeed deeply 'action-oriented'(Clark, 1997) and that, as a result, the ontology of an Umwelt is not just a simple, non-gerrymandered selective subset of the ontology of

physics. Instead of featuring simple subsets of the properties of a 'pre-given world' (Varela at al., 1991), biological Umwelts consist in complex dynamical couplings that reflect the sensorimotor structure of the perceiver (Varela et al., op cit, p. 173).

Glossed a certain way (as, e.g., the 'bringing forth of worlds' (Wheeler, 1996, and so on) this can begin to sound very much like the kind of anti-realism we mean to reject. Yet, as we think the examples show, there is really nothing in even this more complex picture that upsets the idea of a fully mind-independent reality. For once again, the best way to motivate the cyclic and creative picture itself is to appeal to the scientific image of an organism and an embedding environment, complete with various features and properties. Given these ingredients, we can go on to appreciate how the organism uses sensory channels to couple it's behavior with salient environmental features (such as the ball in the angle of gaze example). And we can appreciate how the organism continually acts so as to elicit more and better stimuli so as to support adaptive response — a complex interplay beautifully captured by Merleau-Ponty in the image of the struggling animal. Finally, if we sometimes add structure to our world, in ways that then further guide our behavior (think of ants laying chemical trails, or of academics using yellow stickies), that just shows that intelligent action can increase the amount of real structure in the environment, not that there is no independent structure there at all.

We thus echo Peirce (1955) who writes: "One will meet, for example, the virtual assumption that what is relative to thought cannot be real. But why not, exactly? Red is relative to sight, but the fact that this or that is in that relation to vision that we call being red is not itself relative to sight; it is a real fact". (p. 264). Putting it another way, some features may be subjective, but whether they are subjective is itself an objective matter (Mandik, 1998). The features that comprise a creature's Umwelt may reflect the subjective proclivities of the creature. Tick Umwelten contain temperatures but not telephones because, in part, of tick-relative facts — facts that cannot obtain independently of ticks. But the fact that certain facts are tick-relative may itself be an objective fact. A similar point can be made in cases in which it is not merely the inclusion of the feature in the subject's Umwelt that is subject relative, but the very existence of the feature — cases in which the feature is literally created by the representing subject. Telephones figure in human Umwelten and humans literally brought telephones into existence. But that these relations between humans and telephone obtain may itself be objective. Features not created in factories like telephones, but instead by the active and reciprocal engagement of perceptual/motor systems may likewise be objective.

Our ability to actively elicit, and sometimes create, useful environmental stimuli, added to the fact that we sometimes use sensing to set up a channel of influence rather than to build an inner model, does indeed work against a simplistic vision of organism–environment interaction and selective representing. But it in no way detracts from the idea that these productive cycles of organism–environment exchange are themselves best explained by taking seriously the idea of an environment, with many intrinsic properties and features, embedding an evolved organism,

with well-matched sensory channels, needs and projects. Indeed, that is the picture we need if we are to justify and understand the non-simplistic vision in the first place.

4. The Last Word...Physics?

What, finally, of physics (and more generally, science (including ethology) itself? Is human science just another sensorimotor profile and lifestyle specific probe, incapable of revealing the true (noumenal?) structure of the action-neutral environment? It is our suspicion that, at root, it is precisely this belief that motivates the non-realist position of Chemero (1998), Cantwell-Smith (1996), Varela et al. (1991) and others. It does not seem to us, however, that any of the points we have just conceded undermine the claims of human science to describe the common reality to which various animals (including ourselves) are variously adjusted. For one thing, the categorizations and classifications of science are (notoriously) often not those suggested by our native sensorimotor engagements with the world. That glass and water should both be counted as liquids can hardly be explained by common patterns of sensorimotor engagement or by the basic groupings provided by unaugmented human perception.

Moreover, there is a sense in which our scientific probings are open-ended. Where the tick is permanently limited to its small, narcissistic (Akins, 1996) window on the world, human science constantly builds new and different probes, and constructs vastly differing theories by means of which to organize and cognize their deliverances. In the human case, more than that of any other animal, it is more than biological systems alone that must construct and cognize the world: it is the biological system augmented and extended by an apparently limitless array of props, aids and cognitive scaffolding: think of pens, paper, calculators, computers, alidades, sextants, software agents (for discussion, see Dennett, 1995; Hutchins, 1995; Clark, 1997). Given the ability of the human/technological environment to create more and more such structures, aids, and probes in a golden loop of reciprocal facilitation, it is not at all clear that there are any limits (imposed, as someone might imagine, by our native sensory and cognitive endowment) on our technologically mediated capacity to sense and comprehend the mind-independent universe: the very universe whose objective contours, in dense and reciprocal interaction with the equally objective contours of its variegated sentient inhabitants, determines the "bringing forth" of sensory, cognitive, and experiential worlds.

It is perhaps ironic, then, that it may be precisely the blurring of the mind/world boundary, by means of various technological innovations that extend and transform our cognitive horizons, that ultimately allows human thought and reason to transcend its lifestyle-specific origins and to appreciate the variety of organism–environment couplings as the complex co-evolutionary products of physical forces and natural selection acting in a fully mind-independent material arena. Not only, it seems, is the kind of boundary blurring advanced in Clark (1997) distinct from the

various non-realist theses that pepper the nearby philosophical landscape: it is actually inimical to such theses, and hints not of permanent lifestyle-oriented blinkering and cognitive closure, but of open-ended and continuous cognitive change and exploration. In so doing, it constitutes an explicit challenge to, for example, recent attempts to fix human cognitive horizons directly in terms of human evolutionary history (see, e.g., Pinker's (1997) story about our congenital incapacity to understand phenomenal consciousness, and compare e.g., the implications of the "neural constructivist" manifesto of Quartz and Sejnowski (1997)).

At the very least, and whatever the reader may make of these last few speculations, we see no good reason to suppose that human science is limited and lifestyle-reflecting in just the same way as the ticks' perceptual (and, if we are generous, cognitive) systems. Chemero, to his credit, attempts to build an explicit bridge between the two, arguing (as we saw in Section 2) that science depends on language which in turn reflects the pre-linguistic, action-oriented substrate of what might be called 'native human cognition'. There may be something in this: perhaps, for example, science depends heavily on the use of metaphors derived from our embodied experience (see Lakoff and Johnson, 1998). But whatever the grain of truth, it would seem rash indeed to conclude that science cannot, for example, advance and justify ideas and frameworks directly at odds with our immediate embodied experience: a theory of surfaces, for example, which recognizes multiple boundaries, not all of which would present themselves as such to a human agent; or a theory of space and time in which the two are not distinct, or in which space itself can be curved. In short, then, even if science depends on language, and language reflects embodied and species-specific experience, it does not seem to follow that science cannot hope to discover and express lifestyle-independent truths. The fact that (let us suppose) metaphors based on our bodily experiences play a major role in leading us to grasp the theory of super-strings (or whatever) does not imply that those bodily metaphors are part of the truths thus grasped.

5. Conclusions: Von Uexkull's World

Von Uexkull, as Timo Jarvilehto (personal communication) nicely reminds us, had another notion, that of the Funktionskreis — a kind of interactive circle in which sensory and motor processes home in on lifestyle-relevant aspects of the larger world (the Umgebung). The tick's Unwelt, thus construed, is just a tick-relevant subset of the Umgebung. The creation and maintenance of an Umwelt, on the face of it, thus involves nothing more ontologically threatening than a bit of selective sensing and representing. No threats (as we saw in Section 2) to realism here. But Von Uexkull, influenced by Kant, also stressed a kind of active perception, and clearly glimpsed the large contribution of the organism itself to the sensory and cognitive realms it constructs. It is this aspect of active construction that leads to the deeper problem discussed in Section 3: the problems of active co-constitution and the attendant problem of how to characterize the putative common environ-

ment. The notion of active construction is a crucial one for cognitive science and philosophy. But it leads to non-realist conclusions only when combined with (what we believe to be) a groundless skepticism about the deliverances of human science. Our view, by contrast, is that the open-ended symbiosis of human biological cognition and technological support gives the lie to such radical skepticism, and enables us to make increasing scientific sense of complex organism–environment systems. To use these emerging ideas as a stick with which to beat the notion of a mind-independent reality strikes us as perverse indeed. In the end, then, we stand by the original claim. Strong non-realist rhetoric compromises, rather than explains, the scientific interest of an embodied, embedded approach to mind and cognition.

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