

What Mindedness Is

Michael L. Anderson
Institute for Advanced Computer Studies
University of Maryland
College Park, MD 20742
mikeoda@cs.umd.edu

Because I don't know what a cultural imaginary is, nor how to put (or find) something in one, I propose instead to provide a brief, general account of what, when we think and write about, and thereby determine, the characteristics of mindedness, the members of my tribe imagine themselves to be doing.

Recent work in theoretical cognitive science can be fruitfully characterized as part of the ongoing attempt to come to grips with the very idea of *homo sapiens*—an intelligent, biological entity—and its signature contribution is the emergence of a philosophical anthropology which, *contra* Descartes and his thinking thing, instead puts doing at the center of human being.¹ This shift in our understanding of human nature is owed proximally to the work of Heidegger and Merleau-Ponty, but has clear precursors in, for instance, Hegel, and more specifically Marx and Marxist interpreters of Hegel such as Kojève. Naturally, Darwin must be considered as central as any philosopher, and Aristotle, too, sits smiling behind the velvet curtains (playing Wizard of Oz and Polonius both at once).

I suggest this is a more fruitful axis on which to arrange contemporary cognitive science than is the more common and familiar theme of the emergence of scientific reductionism,

¹ I describe this shift in more detail in Michael L. Anderson (2003) “Embodied Cognition: A Field Guide” *Artificial Intelligence*.

not just because it more adequately ties this work to its intellectual forbears, but because it does not prejudice the question of the ultimate relation between mind and its physical substrate—for a reduction of mind to (the properties of) matter is only one narrow version of the explanatory and relational possibilities.² Cognitive science in fact offers a wider characterization of what we are up to: an attempt to understand how the structures and characteristics of human subjectivity are related to, shaped by, emerge from, and influence the structures and characteristics of human biology and society.

What have thus recently been put into play are competing visions of human beings and their place in nature: the traditional scientific view according to which psychology is (or ought to be) a kind of physics, and which, insofar as it treats body and brain as mere mechanism and ignores self-conscious inter-subjectivity, is fully compatible with the Cartesian worldview, with only an apparent reversal of valuation to distinguish them; and a view of human being(s) rooted in the centrality of human agency and practical activity. Although these two positions in fact suggest fairly complete visions of the nature of human life (not just biological, but ethical, social, emotional and political—something to which the inclusion of Marx in the list of intellectual forebears already alludes) I would like to focus just on the competing views of mindedness itself, of what it is, where it is, and how it might be possible.

As has been indicated already, the central opposition concerns the relation of agency and practical activity to mindedness, and it therefore concerns precisely the role of the body

² Michael Silberstein (2002) “Reduction, Emergence and Explanation” *Blackwell Guide to the Philosophy of Science*, Blackwell Publishers, pp. 80-107.

in (and for) mind. Whereas on the Cartesian view the body is understood as the source of afferent stimulus and the target of efferent output—is, therefore, neither more nor less than a set of sensory receptors and physical effectors, peripheral devices playing subordinate roles to the brain-as-CPU (where representation and calculation occur, on this view the central hallmarks of intelligence)—on the enactive³ view, the body and its activity play not a peripheral, but a central role in the processes of mind, and, in fact, the activity of an organism in relation to its environment can be considered not just the most salient *expression* of mindedness (its location, if you will), but also in some sense its *constitution*.

Pretending for a moment that mindedness is composed of perception and cognition (it is not; not only does this leave out such important elements of mindedness as emotion—the recently emerged conception of emotion as an embodied cognitive system⁴ is an extremely important development in the overall program of cognitive science—but this distinction between perception and cognition is itself Cartesian in origin) will provide an opportunity for drawing these distinctions somewhat more finely. In considering the issue of perception, the Cartesian asks first how it is that the features and elements of the outside world can be captured and re-presented inside the organism. (This simple question, thus framed by the notions of inner and outer, and centrally featuring the idea of representation, points us in the direction of the familiar and intractable anxieties of modern philosophy: how to relate the accessible, inner given to an outer reality—i.e. how

³ The term comes from Francisco Varela, Evan Thomson and Eleanor Rosch (1990) *The Embodied Mind: Cognitive Science and Human Experience*, MIT Press.

⁴ For a good introduction to the issue, see Antonio Damasio (1994) *Descartes' Error: Emotion, Reason, and the Human Brain*, Avon Books.

to determine truth and representational accuracy⁵—and likewise how to adjudicate the relation between the well-known, easily accessible self and the social world—i.e. how to determine meaning.⁶) The assumption is that the end product of perception is an inner world that fully re-produces—that in its elements and their relations is appropriately homologous to—the outer. This approach to perception accords perfectly well with a notion of mind that is contemplative (or, perhaps better, *reflective*⁷) in character; such a mind needs, above all, objects to behold, to alter. Thus is cognition, on this view, the manipulation of, and the calculation over, such inner representations (a notion which points us in the direction of such harmful abstractions in ethical and social thought as the “rational calculation” of individual and collective utilities).

In contrast, the enactive view treats perception first and foremost as an organism’s means for negotiating its environment. This suggests at least two things: first, that perception is a tool of exploration, and second that it is intimately bound up with, is primarily fitted to the service of, action. Perception is not the passive reception of abstract qualities from the environment, but is itself active, often highly selective and goal-directed, designed to extract from the world all and only information of importance to the current (or ongoing background) purposes of the agent. The primary task of perception, then, is not the construction of models, but the detection of opportunities for action, a notion that recalls

⁵ On these issues see, e.g., Ian Hacking (1983) *Representing and Intervening*, Cambridge University Press; and Michael O’Donovan-Anderson (1997) *Content and Comportment: On Embodiment and the Epistemic Availability of the World*, Rowman and Littlefield Publishers.

⁶ On these issues see, e.g., Michael O’Donovan-Anderson (1996) “Wittgenstein and Rousseau on the Context of Justification” *Philosophy and Social Criticism* 22: 75-92; Michael Sandel (1997) *Liberalism and the Limits of Justice*, 2ed. Cambridge University Press; Richard Schmitt (1995) *Beyond Separateness: The Social Nature of Human Beings—Their Autonomy Knowledge and Power*, Wesview Press; and Charles Taylor (1989) *Sources of the Self: The Making of Modern Identity*, Harvard University Press.

⁷ cf. Richard Rorty (1981) *Philosophy and the Mirror of Nature*, Princeton University Press.

the familiar phenomenological claim that the perceptual field is always an action-field, that the perceived world is always known in terms directly related to an agent's current behavioral options. To put it in terms of affordances, the perceived availability of things to certain interventions: the world is *seen as* a continuous series of invitations to action.⁸

As with perception so, too, with cognition. On the enactive view, cognition first emerged from, and is still rooted in, mechanisms to control the behavior, and augment the survival, of particular agents in particular environments. Given the real-time demands of rapidly changing circumstances, one would expect systems to develop which, rather than rely strictly on "inner" manipulations of abstract constructions, instead utilize and exploit the various properties of the environment to simplify decision-making. Thus, in the simplest sort of case, the frog's vision system is highly attuned to contrast and motion, and prey-capture is a hard-wired response to the detection of small, dark, moving dots.⁹ The frog does not represent individual insects; it cannot distinguish between them or recognize one in particular. Nor does it model its whole environment and *decide* which objects are tasty. Indeed, the detection of a fly and the eating of that fly are not really separate events; eating is the sign of detection. This illustrates two important principles of the enactive approach to cognition. First, the classification of an object or situation, and the response to it, are deeply related. To *see as* is often to act *as if*, and, more generally, what one sees is a function of what one does. Indeed, as we will see in more detail below, it is often untenable to speak of a separation of visual and motor systems; seeing is not a

⁸ J. J. Gibson (1979) *The Ecological Approach to Visual Perception*, Houghton Mifflin Press.

⁹ J. Lettvin, H. Maturana, W. McCulloch, and W. Pitts. (1959) "What the frog's eye tells the frog's brain." *Proceedings of the Institute of Radio Engineers*, 47:1940-1951. See also Horace Barlow (1999) "Feature Detectors" *The MIT Encyclopedia of the Cognitive Sciences*: R. A. Wilson and F. C. Keil, eds., pp. 311-13.

single process, the information from which is neutrally specified and centrally available, but is often highly task-specialized, such that separate, encapsulated systems have evolved to support the distinct visual needs of different classes of action. Thus, for instance, the frog has distinct visuomotor systems for orienting itself to its prey, and for capturing it.¹⁰ Second (this returns us to the two principles of the enactive approach) the organism exploits facts about its environment, and its relation to the organism's needs, to turn a simple mechanism to somewhat more sophisticated uses: black dot detection *is*, in the frog's environment, fly detection. Were the world different, the environment different, or the frog's tastes more discriminating, such simplification would not work. And, indeed, many human feature detectors are like this, based on abstractions that are good enough for the usual circumstances, but easily foiled when the circumstances change. (Famously, face recognition in general is utterly compromised when faces are turned upside-down¹¹; infamously, cross-racial facial recognition can be difficult, apparently because people privilege race-specifying cues over individuating information when recognizing faces cross-racially.¹² These are facts that wouldn't be predicted by a thoroughgoing world-model version of face recognition.)

It is open for someone to object that the frog example is misleading—the frog is not thinking, but only reacting; this is not an example of cognition, but merely of instinct.

Whatever the force of such an argument from within a Cartesian world-view, it makes

¹⁰ D. J. Ingle (1973). "Two visual systems in the frog." *Science* 181: 1053-55; D. J. Ingle (1980) "Some effects of pretectum lesions on the frog's detection of stationary objects" *Behavioural Brain Research* 1, 139-63; D. J. Ingle (1982) "Organization of visuomotor behaviors in vertebrates" In D.J. Ingle, M.A. Goodale, and R.J.W. Mansfield, eds., *Analysis of visual behavior*, MIT Press.

¹¹ Bartlett and Searcy (1993) "Inversion and Configuration of Faces" *Cognitive Psychology* 25: 281-316.

¹² Daniel T. Levin (2000) "Race as a Visual Feature: Using Visual Search and Perceptual Discrimination Tasks to Understand Face Categories and the Cross-Race Recognition Deficit" *Journal of Experimental Psychology: General* 129: 559-74.

little sense as a specific objection to the enactive view. For the frog doesn't eat indiscriminately; it exhibits very specific, and appropriate, responses to differential aspects of the environment. It eats bugs, and avoids predators. It shrewdly negotiates its environment in accord with its very limited set of needs and goals. For the enactive view this *is* intelligence, albeit of an extremely limited sort (but note the conflation, in the example, of perceptual, cognitive, and performative elements of the phenomenon in question; this is typical of the enactive approach, but looks sloppy to the Cartesian). One suspects that were the frog also endowed with a limited vocabulary—along the lines of Wittgenstein's builders¹³, so it said “fly!” when it saw a fly, and “hawk!”¹⁴ just before diving under cover of water to avoid the bird overhead, and perhaps whistled just-so when it saw an attractive potential mate—that its intelligence would be more widely recognized and praised. Herein lies a simple prejudice, which the enactive view does not share.

Besides which, there is evidence that a significant part of the humans visual system is not entirely unlike the frog's (which is the sort of fact one comes to expect when looking at these matters from an evolutionary perspective; solutions to common adaptive problems are often common across species, and conserved along lines of descent¹⁵). For the human visual system is likewise split into two separate pathways: a “dorsal stream” (also known

¹³ Ludwig Wittgenstein (1999) *Philosophical Investigations*, 3ed. Prentice Hall Publishers, p.3.

¹⁴ Technically, I am conflating my animals here: rabbits, not frogs, have hawk detectors.

¹⁵ “In summary, the modular organization of visuomotor behaviour in representative species of at least one mammalian order, the rodents, appears to resemble that of much simpler vertebrates such as the frog and toad. In both groups of animals, visually elicited orienting movements, visually elicited escape, and visually guided locomotion around barriers are mediated by quite separate pathways from the retina right through to motor nuclei in the brainstem and spinal cord. This striking homology in neural architecture suggests that modularity in visuomotor control is an ancient (and presumably efficient) characteristic of vertebrate brains.” Milner and Goodale (1995) *The Visual Brain in Action*, Oxford University Press, pp. 18-19.

as the “where” pathway) that provides information about the location and size and shape of an object, and a “ventral stream” (the “what” pathway) that provides detailed conceptual or cognitive information used in classifying or identifying objects. The two streams are so named because of their anatomical relations: the dorsal stream connects the primary visual cortex (V1) to the Posterior Parietal Cortex, up the dorsal side of the brain (towards the brain’s motor control areas), while the ventral pathway runs along the side into the Infero-temporal cortex, (towards the brain’s language-related areas).¹⁶ The dorsal stream is a specialized perceptual processing system that represents information in a form optimized for calculating and directing motor responses aimed at an object in virtue of its location, orientation, and spatial extent. This information is used to guide such things as the orientation of sense organs for optimal perception, perceptual tracking, reaching, and grasping. Thus, the natural way to characterize what one knows in virtue of dorsal stream representations (what the information means) is in terms of ego-centric spatial coordinates: where it is in relation to one’s self, and what might be done to get the self-object relation into a preferred state. One might say that the dorsal stream places objects in an ego-centric visuomotor space, or an ego-centric action field, and the object is thereby presented in these terms. Like the dorsal stream, the ventral stream is a specialized perceptual processing system, but in this case optimized for representing information about the *look* rather than the *location* of an object, information specialized for making classifications, generating descriptions, and the like.

As is often the case in cognitive science, some of the most striking illustrations of this separation and its importance come from studies of individuals with specific neural

¹⁶ See Appendix 1 for a picture.

deficits. Thus, for instance, patient DF, who has widespread lesions in the ventral stream caused by carbon monoxide poisoning, although unable to identify objects by sight (she can neither draw nor describe them), can nevertheless reach for these objects with fluent and appropriately sized and oriented grips. Similarly, while she is unable to perceive and describe the orientation of a letter-slot, she is easily able to post a letter through it.¹⁷ In contrast, optic ataxics, who have dorsal stream lesions, are able to see and describe visual scenes without trouble (for instance the objects on a table or the letter-slot in a wall), but are unable to fluently grasp those objects, or post a letter through the slot, despite the apparent clarity of their visual experience.¹⁸

The same kind of disconnect between conscious perception and perceptually guided action can be seen for *everyone* in the case of a clever variation of the “Tichener Circles” illusion.¹⁹ In this experiment, subjects were presented with poker chips arranged like the discs in the Tichener Circles diagram, and were told to pick up the center chip on the left if the center chips appeared to be of the same size, and on the right if they appeared to be different. Although the *choice* of chip showed that the participants were subject to the relevant illusion, in reaching for the chip they used a grip perfectly suited its *actual* and not its *perceived* size.²⁰ Subjective experience to the contrary, it appears that much of our behavior is (still) governed by specialized, even unconscious, visuomotor systems. When

¹⁷ Described in Michael Gazzaniga (1998) *The Mind's Past*, University of California Press.

¹⁸ For a thorough discussion of these findings see Milner and Goodale (1995) *The Visual Brain in Action*, Oxford University Press.

¹⁹ See Appendix 2 for a diagram.

²⁰ S. Aglioti, M. Goodale, and J. F. X. DeSouza (1995) “Size contrast illusions deceive the eye but not the hand” *Current Biology* 5: 679-85.

it comes to actually acting in the world, we are, perhaps, more frog-like than we care to admit.

Still, one is certainly entitled to doubt whether this sort of orientation to the environment can account for the complex tasks routinely faced by the typical soccer mom, as she shuttles her various children to their various activities at the right time, in the right order, meanwhile figuring out ways to work in laundry, dry cleaning, and grocery shopping. Surely she cannot simply let the world unconsciously guide her and expect to accomplish her daily tasks; rather, she must think about, and plan in reference to, the way the world *will be*. Doesn't this require world modeling, concepts, and representations? No doubt. But the point of the enactive view is not that there is no representation, but rather that representation is *also* likely to be action-oriented, built upon faculties that govern our ability to move and act in a dynamic environment. From this perspective what emerges as crucial (and fabulously interesting) is understanding the relations between the lower level, older, specialized sensory-motor systems and the structure, elements, and rules of operation of the more general, highly flexible, symbolic computational system we also seem to possess. My bet, for what it's worth, is that these are significantly intertwined, with bi-directional feedback and cooperation—that, for instance, some conceptual contents can be traced to specific sensory-motor systems, and some sensory-motor systems have been adapted to utilize some of the resources of (or at least be responsive to) more general conceptual systems.²¹ But the moral remains the same: the first work of

²¹ On the dependence of conceptual contents on action and embodiment see M. O'Donovan-Anderson (1997) *Content and Comportment: On Embodiment and the Epistemic Availability of the World*, Rowman and Littlefield Publishers; M. L. Anderson (2003) "Representations, Symbols and Embodiment" *Artificial Intelligence*; and G. Rosenberg and M. L. Anderson (in preparation) "Content and Action."

perception is to provide information for action; as the organism's possibilities for action become more sophisticated, so, too, must the structures of representation that support that activity.

This returns us to a point we left behind earlier: it isn't just that perception and cognition are action-oriented, but that they are *interactive*, exploiting properties of their environment to guide and simplify cognitive tasks. Thus, to understand the character of (advanced) cognition one needs to understand not just the basic faculties that support and constrain it, but also the nature of the environment within which an organism exercises those faculties. Put somewhat differently, seeing is an activity of embodied agents in particular circumstances, and is not easily localized "inside" or "outside" the agent. Since this is true of both human *and* frog, the massively greater sophistication of human intelligence needs to be explained in terms *both* of the enhanced (representational, linguistic) faculties of human brains, *and* of the richer resources of the human environment. For human-level cognition is marked by the use of and interaction with the environment in myriad ways: using a pencil and paper to store intermediate results in long division or large-number multiplication; arranging a hand of cards or scrabble tiles to better see relevant patterns, matches, or potential words; rotating puzzle pieces to better discern their fit; making grocery lists, or otherwise storing information to be consulted later; and even more complicated things like using management structures, and the constraints of individual roles, to accomplish complex tasks like ship navigation or building construction.

The overall picture that this suggests is of an intelligence that lies less in the individual brain, and more in the dynamic interaction of agents with the wider world. Mindedness emerges as a kind of adaptive integration with one's environment, including especially the social and cultural worlds that are so important to human cognition.²² Discovering and detailing the particular physical characteristics and environmental integrations that shape and support the various aspects of mindedness is, in my judgment, the central project of cognitive science, which I call the physical grounding project. It encompasses questions ranging from the particular influence of physical or neurological structures on the contents of (higher-order) experience (as might be demonstrated in the case of color-vision); to the simple interactions with the physical environment which aid in calculation, memory, and decision-making (some of which have been mentioned already); to the more complex case of symbol grounding—of how we give abstract, generally linguistic symbols concrete meaning—something which involves supporting integrations not just with the physical environment (as I have argued in detail elsewhere²³), but also, and perhaps especially, with the social world; all the way to the extremely difficult question of how to understand the very formation, in its social and physical context, of subjectivity and self-hood. (And given this emphasis on integration, what of the critical distance from the world which is central to social progress? For proponents of the enactive view, metaphors of distance are automatically suspect, and it is an important challenge for the enactive view, therefore, to articulate the possibility of criticism without alienation²⁴;

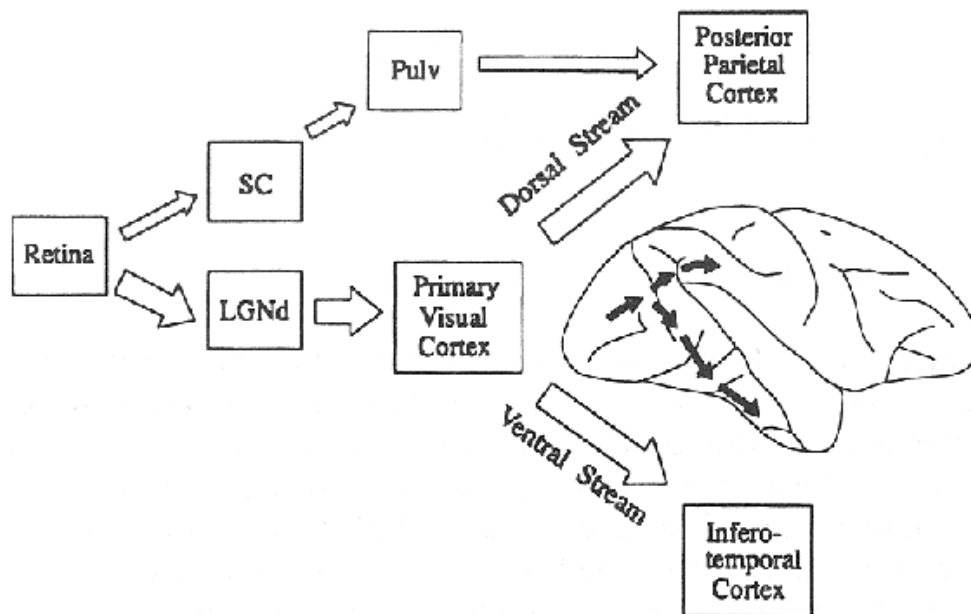
²² William Clancey (1997) *Situated Cognition: On Human Knowledge and Computer Representations*, Cambridge University Press.

²³ Michael O'Donovan-Anderson (1997) *Content and Comportment: On Embodiment and the Epistemic Availability of the World*, Rowman and Littlefield Publishers.

²⁴ Richard Schmitt (1995) *Beyond Separateness: The Social Nature of Human Beings—Their Autonomy Knowledge and Power*, Wesview Press.

still, it is an illusion to suppose that this capacity is any less mysterious on the Cartesian view.) Cognitive science therefore sits at the junction of biology, psychology, philosophy, and the various humanistic sciences, including anthropology, sociology and cultural studies, with the hope that a vision of mindedness which insists from the outset at *staying* at this critical intersection can help to unify—or at least make consistent—the myriad anthropologies of these various fields.

Appendix 1: Schematic diagram showing major routes whereby retinal input reaches dorsal and ventral streams. The inset [brain drawing] shows the cortical projections on the right hemisphere of a macaque brain. LGNd, lateral geniculate nucleus, pars dorsalis; Pulv, pulvinar nucleus; SC, superior colliculus. (From Milner & Goodale 1995)



Appendix 2: The Tichener Circles illusion. The center disk is the same size in all three groupings.

