

Reviews

How the Body Shapes the Mind

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Embodied cognition (EC) is growing up, and *How the Body Shapes the Mind* is both a sign of, and substantive contributor to, this ongoing development. Born in or about 1991 (the year of publication of seminal works by Brooks, Dreyfus, and Varela, Thompson & Rosch), EC is only now emerging from a tumultuous but exciting childhood marked in particular by the size and breadth of the extended family hoping to have some impact on its early education and upbringing. As family members include computer science, phenomenology, developmental and cognitive psychology, analytic philosophy of mind, linguistics, neuroscience, and eastern mysticism—just to name a few—EC has both benefited and suffered from a wealth of different and often incompatible ideas about who and what it is, what it should do with its life, even what language it should speak. Gallagher brings some cohesion and consistency to this situation, not by surveying and synthesizing these competing approaches, but by carefully marshalling the evidence and developing the vocabulary to thoroughly consider a few fundamental issues.

Gallagher's investigation relates to what is perhaps the single most important substantive claim of the EC paradigm, *the physical grounding hypothesis* (PGH) (although note Gallagher himself does not use this term, which appeared originally in Brooks, 1990). PGH says that the contents and operation of the mind are grounded in an agent's physical properties and embodied experience. In this context, 'grounded in' means not just 'only possible in virtue of', but at a minimum, 'substantively influenced by'; however, PGH is not a claim about the *nature of the influence* of the physical on the mental, but about the *variety of properties* implicated in any adequate explanation of cognition. Thus, the hypothesis is arguably compatible with both physicalism and psychophysical supervenience, but not with functionalism, since the attributes of some mental states or cognitive operations might *not* be adequately accounted for by their functional roles (i.e., implementation matters). In addition, PGH must be distinguished from psychoneural reductionism, for it is central to EC that the content and operations of cognition are determined by the (whole) body in virtue of many different material characteristics, structural features, relational

properties, dynamic attributes, organizational levels, and developmental stages; cognition cannot be explained by brain operations alone. In the context of EC, then, PGH says that cognition supervenes on many different *kinds* of facts (material, functional, relational, dynamic) and a broad *range* of facts (not just brain facts) about the body and its relation to an environment. Identifying these various significant aspects of embodiment, and their specific cognitive impact, is one of the most important research projects in EC. It is to this latter project that Gallagher's book makes its largest contribution.

Gallagher divides his interest in this project into two parts. The first part revolves around whether and how *awareness* of the body influences experience: "In regard to embodiment, I want to explore to what extent and in what way an awareness of my body enters into the content of my conscious experience? . . . Does intentional action, for example, involve an explicit or implicit awareness of the body?" (p. 2). The second part concerns whether and how the body shapes experience by structuring the mechanisms *supporting* experience: "To what extent, and in what ways, are consciousness and cognitive (noetic or mental) processes, which include experiences related to perception, memory, imagination, belief, judgment, and so forth, shaped or structured *prenoetically* by the fact that they are embodied?" (p. 2). It is clear from the outset that here Gallagher's main interest is in this second issue, and much of the book is spent establishing the claims found in its first paragraph:

In the beginning, that is, at the time of our birth, our human capacities for perception and behavior have already been shaped by our movement. Prenatal bodily movement has already been organized along the lines of our own human shape, in proprioceptive and cross-modal registrations, in ways that provide a capacity for experiencing a basic distinction between our own embodied existence and everything else. As a result, when we first open our eyes, not only can we see, but also our vision, imperfect as it is, is already attuned to those shapes that resemble our own shape. More precisely and quite literally, we can see our own possibilities in the faces of others. The infant, minutes after birth, is capable of imitating the gesture that it sees on the face of another person. It is thus capable of a certain kind of movement that foreshadows intentional action, and that propels it into a human world. (p. 1)

Gallagher spends a good deal of time discussing intermodal perception, basically the capacity for experience in one perceptual modality to influence or inform another. For instance, in an experiment in which infants were allowed to suck on one of two different pacifiers (one smooth, the other nubbed), and then shown both, the infants looked significantly longer at the pacifier they had felt (Meltzoff, 1993). More striking is the evidence that infants are capable of imitating facial gestures at birth (Meltzoff & Moore, 1977). They don't have to learn to see, much less learn to interpret what they see in terms of their own motor possibilities; the motoric equivalent of a visually perceived facial gesture is already a part of their experience. Evidence of this sort appears to support three important findings: first, that organized perception is possible from birth; second, that there is natural, intermodal communication

between different perceptual streams; and third, that experience in one sense modality can educate and inform other sense modalities.

One interesting payoff from Gallagher's review and discussion of this evidence is a new, empirically grounded answer to Molyneux's question to Locke: "Suppose a man born *blind*, and now adult, and taught by his *touch* to distinguish between a cube and a sphere . . . Suppose then . . . the blind man be made to see: *quaere*, whether *by his sight*, before he touched them, he could now distinguish and tell which is the globe, which the cube?" (Locke, 1690/1959, p. 186). The answer turns out to be yes, in principle (due to intermodal perception) but no, in fact (because of neuronal degeneration that occurs in the absence of visual stimulation).

As intriguing as this is, in isolation it amounts to little more than a critique of the empiricist position that first perception (initial experience in a given modality, e.g. neonatal vision) consists of meaningless and unorganized sensations. For such evidence to play a role in supporting an embodied alternative to this view, Gallagher must go further, and establish that perception is intermodal *in virtue* of the fact that conscious perception is grounded in and structured by the physical and motoric capacities of the body. Insofar as there is little if any prenatal visual experience (but plenty of prenatal movement), then bodily movement and the structures supporting it do appear to be good candidates for the original agent of perceptual organization. Moreover, the most likely alternative would seem to be an innate, but nonmotoric organizational framework for perception that develops at the same time as motor control, but in the absence of much if any experiential input *other* than that relating to motor control (touch, proprioception, etc.). Thus, if it can be shown (a) that the motor system has an organizational framework, (b) that it is innate and present at birth, and (c) that it is capable of serving as the organizational framework for perceptual awareness, then parsimony alone would tend to favor the embodied account of perceptual organization. Evidence that (d) it in fact *serves* this latter function would only strengthen the case.

Although the book can hardly be said to end the conversation, it must be admitted that Gallagher does a good job establishing claims (a)–(d). The support for (a) centers around a construct called the "body schema." The body schema is a system of sensory-motor capacities, encompassing all of the nonconscious aspects of motor control—including subcortical, premotor, and motor processes in the brain, as well as the information systems required for these processes to function properly. The body schema is to be sharply distinguished from the "body image," which is an artifact of perceptual awareness of the body and therefore plays a different role in the conscious experience of the subject. Gallagher distinguishes the two not just conceptually, but with an empirical double-dissociation: in lateral neglect, a patient will ignore perceptions of one side of the body, not washing nor grooming nor dressing the neglected side. Yet, motor abilities such as walking, or bimanual tasks like knot-tying, can remain unaffected, which suggests that while the body image is altered or damaged, the body schema remains intact and functioning. Likewise, subjects who have lost all tactile and proprioceptive input below the neck cannot use the body schema for motor control. However, it is sometimes possible for them to

learn to guide action using visual feedback, pressing the intact body image into new service.

The case for (b) is surprisingly involved, and centers primarily on the possibility of aplasic phantoms, i.e., the *experience* of a limb in cases of congenital *absence* of that limb. It is clear that if the body schema is innate, then aplasic phantoms should be possible; but although there are reports of aplasic phantoms, the evidence behind them turns out to be in various ways problematic. For instance, in a majority of cases the phantom limb is first reported many years after birth (often after surgery, injury or other significant bodily event), complicating the claim that the phantom is a result of an innate body schema. Gallagher points out that first report doesn't necessarily correspond to first experience, and reminds us that conflicts between proprioception (which might indicate the presence of a limb) and vision (which would not) are generally resolved in favor of vision; this could block experience of a phantom until some salient event allows it to emerge. He then offers a developmental story regarding the nature and origins of aplasic phantoms that permits them to be products of an innate body schema, while accounting for the available data. Gallagher's treatment of aplasic phantoms is interesting but not entirely conclusive; however, his discussion is a model of philosophically astute examination of empirical evidence, and is worth reading on these grounds alone.

This brings us to the case for (c) and (d), which takes up the bulk of the volume. Gallagher presents evidence for the role of the body schema in a range of perceptual and cognitive functions including the differentiation of self and other, awareness of agency, interpersonal communication and intentional interpretation ("mind-reading"). As might be expected, a good deal of the discussion involves the *spatial* organization of perception, and the integration of the perceptual and motor space necessary for coherent action. Gallagher argues: first, that the fact that perception is perspectively spatial depends on an implicit reference to the spatiality of the body; second, that this implicit reference to the spatiality of the body cannot be based on perceptual awareness of the body, on pain of regress; and finally, that the body schema, along with proprioceptive, nonperspectival awareness of the body, can provide the required grounding.

Gallagher has been working on this topic for more than ten years, and it shows. Indeed, many researchers will wish they had had this volume before publishing their own work, not because it presents startling new findings that will undermine what has come before, but because the work is so precise, and lays out the terrain so clearly, that it is now possible to see what should have been said all along. This is at least in part because among the more valuable things that Gallagher offers here is a language with which to speak, including a set of carefully made distinctions and precisely formulated questions that will drive research forward for some time.

As I noted at the outset, the analytical framework and disciplinary vocabulary that Gallagher develops in the course of his investigations is both a sign of, and contributor to, the maturation of EC as a research field; other signs, such as the appearance of EC-friendly journals and degree programs, point to the same transition from revolutionary to normal science. Nevertheless, as EC continues

to age, we should expect a series of fights over identity and independence, as its many parents seek to limit and control how it spends its time, who its friends are, and when (if ever) it gets the keys to the car. We can only hope that this process is moderated and influenced by work as careful, serious, and substantive as Gallagher's.

References

- Brooks, R. (1990). Elephants don't play chess. *Robotics and Autonomous Systems*, 6, 3–15.
- Brooks, R. (1991). Intelligence without representation. *Artificial Intelligence*, 47, 139–159.
- Dreyfus, H. L. (1991). *Being-in-the-world: A commentary on Heidegger's Being and Time, Division 1*. Cambridge, MA: MIT Press.
- Locke, J. (1959). In A. C. Fraser (Ed.), *An essay concerning human understanding*. New York: Dover, (Original work published 1690).
- Meltzoff, A. (1993). Molyneux's babies: Cross-modal perception, imitation, and the mind of the preverbal infant. In N. Elian, R. McCarthy, & B. Brewer (Eds.), *Spatial representation: Problems in philosophy and psychology* (pp. 219–235). Oxford, England: Basil Blackwell.
- Meltzoff, A., & Moore, M. K. (1977). Imitation of facial and manual gestures by human neonates. *Science*, 198, 75–78.
- Varela, F., Thompson, E., & Rosch, E. (1991). *The embodied mind: Cognitive science and human experience*. Cambridge, MA: MIT Press.

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Neural Engineering: Computation, Representation, and Dynamics in Neurobiological Systems

CHRIS ELIASMITH & CHARLES H. ANDERSON
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This is a brilliant and puzzling book. It is brilliant in its application of a variety of sophisticated mathematical formalisms to the modeling of neural systems. It is puzzling because, even though it is clearly a very significant work, it is unclear just what its significance is.

First, a warning concerning the brilliance of this book: if you are put off by pages of complex formulae, wiring diagrams, information processing architectures, etc., this book is not for you. It *can* be profitably read by someone who (like me) has only the rudiments of the mathematics and sciences involved, but who is also willing to