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Embodiment and Human Development

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Abstract

We are recognizing increasingly that the study of cognitive, social, and emotional processes must account for their embodiment in living, acting beings. The related field of embodied cognition (EC) has coalesced around dissatisfaction with the lack of attention to the body in cognitive science. For developmental scientists, the emphasis in the literature on adult EC on the role of the body in cognition may not seem particularly novel, given that bodily action was central to Piaget's theory of cognitive development. However, as the influence of the Piagetian account waned, developmental notions of embodiment were shelved in favor of mechanical computational approaches. In this article, I argue that by reconsidering embodiment, we can address a key issue with computational accounts: how meaning is constructed by the developing person. I also suggest that the process-relational approach to developmental systems can provide a system of concepts for framing a fully embodied, integrative developmental science.

Keywords

embodiment; development; meaning

It is becoming increasingly accepted that the study of cognitive, social, and emotional processes must account for the embodiment of these processes in living, acting people (1–3). Within cognitive science, how bodily factors play a role in mental life is often considered through the lens of embodied cognition (EC), which has become a major area of study in adults (4). Although the wider EC literature features different theoretical emphases, embodiment challenges the notion that the body simply provides input for a mind that operates as an isolated central processor of information. Instead, one key theoretical concept in EC is that the body plays a constitutive role in cognition (5). A related theme is that cognition is not confined to a specific location but that it arises from the couplings among brain, body, and environment (6).

Although developmental aspects of embodiment have been discussed (7, 8), developmental scientists may remain confused about the meaning and implications of this construct. To some, the suggestion that the body plays a role in cognitive development may not seem novel and may, in fact, be somewhat limiting. Bodily action played a central role in Piaget's theorizing about cognitive development, yet the influence of this line of thinking has diminished. Instead, much theorizing in cognitive development has turned toward

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information processing and computational approaches that tend to downplay a role for embodiment. That said, it could be argued that aspects of bodily action have been part of various lines of developmental research using dynamic systems methods (9, 10). However, these approaches have often neglected to address a key aspect of what embodiment entails: how the developing organism constructs its known world.

In this article, I briefly trace the history of EC and show how embodiment challenges conventional theorizing about the nature of cognition. Drawing partly on the biologically oriented perspective of enactivism, I then suggest that considering how meaning is made can facilitate an integrative view of embodiment in the context of human development. Next, I propose that the theoretical framework of process-relational developmental systems (11) can provide a system of concepts for a truly embodied developmental science. In the final section, I consider the wider implications of embodiment and highlight how to apply an embodied approach to human development.

The Origins of Embodied Cognition in Psychological Science

Broadly speaking, the origins of research on EC can be traced to dissatisfaction with the primary direction of cognitive science over the second half of the 20th century. This period was characterized by a revolution in cognitive science that was supposed to return the study of the human mind to psychology after decades of focus on behaviorism. In part through increasing awareness of the work of Piaget, a renewed focus on mental life also brought with it the prospect of studying an active, agentive person's construction of meaning. However, the view of mental processes that emerged from the cognitive revolution did not realize this opportunity (12). Instead, the predominant conceptualization of mind was influenced by the developing discipline of artificial intelligence, with mind becoming viewed as an isolated information processor. This approach, which became known as cognitivism, aimed to make mental processes more transparent by modelling them on computers. In this way, the aim of cognitive science became to develop algorithmic routines that would solve specific, highly constrained problems, with little regard for the way in which people—as active agents—might actually solve problems.

The cognitivist focus on algorithmic problem solving was based on a view that computational models were the optimal level of analysis in a machine-oriented cognitive science. Marr's influential levels-based framework (13) placed computational mechanisms at a level of representation and algorithm located between a higher, more abstract level outlining the general nature of the problem or task at hand and a lower level of implementation that specified the physical means (i.e., the kind of hardware) through which the computations would be realized. Although considering all three levels would seem important, various factors conspired to remove questions about implementation from cognitive science. Whether or how the computations of interest would be implemented in living systems was deemed unimportant, leading to a neglect of brain and body in cognitive science (14, 15). Scholars have argued that this misstep precluded progress toward an integrative science of mind (16, 17).

The tenets of embodiment expose the limits of an observer-scientist positing a problem and specifying a computational solution, without regard for how that solution might be implemented physically. However, taking an embodied approach involves more than simply paying lip service to the level of implementation. When the metaphor of the cognitivist machine is dismantled, a tidy separation between Marr's levels of analyses cannot be maintained (18). As Clark stated, "our notions of what top-level task needs to be performed, and what kinds of algorithms are adequate to perform it, are deeply informed by reflection of details of bodily implementation, current needs, and action-taking potential" (19, p. 96). The ramifications of this blurring of levels are central to contemporary debates about how to frame embodied models of cognition (20). At the heart of these debates are questions about the concept of representation, or specifically, how the organism comes to represent its world. This is closely related to an important, but often neglected, issue in cognitive science that an embodied approach can help address: how that world comes to have meaning for the individual.

In computational approaches, assumptions about what is meaningful for a cognitive system are often projected onto that system by an observer—the person who develops the computational model. In early work on artificial intelligence, this issue proved an insurmountable obstacle to constructing computational systems that could tackle anything other than highly constrained, disembodied problems such as a chess game (21). This changed in the early 1990s, when greater visibility of alternative, more embodied directions in robotics challenged cognitivist approaches by emphasizing the importance of links between perception and action (22). Despite these advances, the problem of how a computational system can make sense of its environment continues to challenge the manifestation of autonomous intelligence by artificial cognitive systems (23). In a different context, this same problem—of making meaning—also presents a significant issue in the context of computational approaches to human cognitive development. It is here that a biologically oriented view of embodiment can help suggest a route toward a more integrative developmental science. Central to this endeavor is the notion that the known world is constructed through the embodied actions of the developing individual.

Embodiment and the Construction of Meaning

Within the study of human development, the idea that meaning is constructed through embodied action is associated with Piaget's work (24). However, Piaget's influence lessened with the turn toward information-processing approaches in American psychology and with many related misinterpretations of his position that emerged from the cognitivist framework (25). As a result, and also to counter nativist alternatives, developmentally oriented scientists became preoccupied with how computational approaches such as connectionism could be used to explain learning and cognition (26). More recently, other computational accounts have gained traction, particularly hierarchical Bayesian multilevel models (27). Although the Bayesian approach allows for an abstract contribution of the activity of the individual, this account omits the role of the fully embodied organism in relation to processes of thought and reasoning. Put simply, the solely mechanical basis of computational accounts precludes a consideration of how the world comes to have meaning for the living person; understanding the biological embodiment of mental life can shed light on this omission.

How exactly can the notion of embodiment help us move from a focus on the mechanical processing of information to a focus on constructed meaning? Clues to answering this question can be found in Overton's definition of embodiment:

> "… embodiment is the claim that perception, thinking, feelings, desires—the way we behave, experience, and live the world—is contextualized by our being active agents with the particular kind of body we possess. In other words, the kind of body we have is a necessary precondition for having the kind of behaviors, experiences, and meanings that we have" (28, p.1).

To unpack this definition, it helps to think about embodiment in the broader biological context of all living organisms. This wider view suggests that the way different species of animals experience the world likely differs depending on characteristic aspects of their bodies, such as the presence or absence of limbs (and their number and specific configuration) and the type of sensory receptors. Taking this idea further, the nature and extent of the interactions an organism can have with its environment depend on bodily morphology and capacities for action. In turn, this raises the idea—as suggested by Overton's definition—that what is meaningful for an individual organism depends on the nature of its embodiment. In the literature on EC, this idea has become part of the enactivist approach, which states that the range of relevant possibilities for action and interaction that is afforded by embodiment gives rise to the particular world that is enacted or brought forth by the activity of an individual organism (3, 29).

The enactivist line of thinking carries some profound implications. In particular, the idea that the world experienced by an organism depends on its own embodied activity challenges the notion that mental life requires the internal capturing of an image cast by the external world. Instead, the enactivist approach features the knower and the known world mutually specifying each other, or arising together through the activity of living (30). Therefore, the connection of the organism to the world is reframed, replacing the notion of an independent, external world that needs to be represented with the concept of structural coupling between organism and environment. Debates about the nature of this coupling are central to current discussions and to considerations in the EC literature of the implications of embodiment.

According to some views, especially those inspired by dynamic systems theory, the nonlinear nature of the coupling between organism and environment requires that we reject completely the concept of representation (10, 20, 31). However, one risk of moving in this direction is that the identity of the individual is lost in a diffuse web of dynamic couplings, with considerations of how the world becomes meaningful for that individual pushed to the background. How, then, should we reconcile these radical ideas from the literature on EC with the idea that the developing individual constructs its known world? Adopting a particular theoretical framework—that of process-relational developmental systems—can recover the notion of an individual cognizer as a center of activities and perspectives.

Embodiment in the Process-Relational Developmental Systems Approach

Key to the view outlined here is that embodiment bridges the physical body and the body as a form of lived experience (28). In this view, the body is not merely an object among other

objects, but is the lived body or “the situation from which our world and experience flows” (32 [AU: Please add page number for quote]). Therefore, embodiment encompasses both a subpersonal level of ongoing physiological activity and acts that function at a personal level, that is, intentional, goal-directed activity that is instrumental, adaptive, expresses meanings, and comes to constitute the world as known, felt, or desired (33). This recognition is consistent with recent calls to refocus on the centrality of action in developmental theorizing (34). As framed by Overton, action entails the projection of person-centered meaning that transforms the objective world into the world the individual actually experiences (28). However, this world of constructed meanings is clearly not isomorphic with either mechanical computational procedures or strictly biological mechanisms. From an embodied perspective, the kind of explanation allowed by these procedures or mechanisms makes sense only when combined with a more abstract factor—pattern explanation (35, 36).

The notion of a pattern explanation is tied up with a way of thinking about systems, in particular, living systems, which create, organize, and maintain themselves in a way that differs from nonliving things (37). Specifically, a living organism is an autopoietic system (38), meaning that it creates and actively maintains its own organization (as the pattern or relation between components of the system) in the face of perturbations in the coupling between the individual organism and its environment. A living organism recursively creates, organizes, and maintains itself, in the sense that the organizational (or structural) properties of that system emerge from the endogenous activity of the system itself. However, rather than simply viewing these structural properties as a causally inert outcome arising from the activity of lower-level processes, allowing for a pattern explanation means accepting that the organization (pattern) of a living system plays more than a descriptive role. As such, a thoroughly embodied approach must consider not only how higher-order pattern emerges from lower-level processes, but also how the emergent pattern constrains the activity of those processes (35). Although related ideas have been discussed in other contexts (39), this notion of circular causality has been neglected in much of contemporary developmental science. One reason for this is that an overarching system of theoretical concepts has not yet provided a lifespan developmental framework in which to elaborate the implications of embodiment. I suggest that the process-relational developmental systems account (11) provides such a framework.

The process-relational developmental systems account is a metatheoretical perspective that, as a starting point, disavows the splits that have typically characterized mainstream psychology (e.g., mind versus body and nature versus nurture). In the context of development, this perspective turns away from a simple interactionism that relies on the additive combination of discrete influences on the developing individual. Instead, the approach draws on Aristotle and Kant to provide a more holistic, integrated view through a developmental systems framework that emphasizes emergence and relates many kinds of explanations. The account is not tied to one set of methods but provides a metatheoretical umbrella under which more specific theories and their associated methods can be nested. Within a particular area of study, coherence among more specific theories and the broader metatheoretical perspective is established through their identification with the core concepts of system, action, and embodiment (40). Through these concepts, the process-relational developmental systems account frames an ontology of becoming that allows the construction

of meaning through the embodied activity of the individual (11). As such, it provides a developmental framework for the enactivist view of embodiment that, instead of picking up a fixed, objective reality, codetermines the knower and the known world (30).

Toward an Embodied Developmental Science

In recent decades, psychological scientists have recognized increasingly the embodied nature of mental life, and they have grown dissatisfied with the Cartesian separation of life and mind encouraged by the cognitive revolution. What are the implications of this shift for developmental scientists? To answer this question, it helps to return to the central challenge that embodiment presents to the cognitivist emphasis on cognition as an isolated level of algorithmic problem solving. Put simply, processing information and making meaning can only be understood in the context of the activity of the fully embodied individual. Alongside this point, an embodied view of mental life challenges the cognitivist notion of an objective, outer world that must be represented by the organism. Although some computationally inspired theorizing has begun to grapple with these issues (41), a full consideration of embodiment has yet to pervade such accounts.

Another key implication of a biologically oriented approach to embodiment comes from considering the self-organizing processes that characterize the development of living organisms. Research in developmental biology has shown that the body and brain are not assembled according to a simple genetic blueprint. Instead, form emerges from—and constrains—complex coactions between genes and cells across spatial and temporal scales. Such insights have implications for developmental psychology by illustrating the futility of attempting to distinguish genetic and environmental influences on behavioral development (42). By acknowledging the complex and dynamic interplay between levels of influences, the framework of process-relational developmental systems is consistent with these biological insights. As such, this framework contrasts sharply with approaches that see human behavior and cognition as the products of separable, additive contributions of genes and environment. The value of the process-relational perspective is apparent in research on cognitive development that eschews the notion of fixed abilities and instead acknowledges plasticity and the need to consider many coacting influences on children’s development (43).

Current work across the field of EC is driven by the premise that cognition cannot be considered independently of bodily activity and sensorimotor experience. In studies of adults, this premise has driven much research on sensorimotor influences on language processing. Developmental scientists have also begun to reconsider the question of how the body shapes conceptual and language development (44). Work in this area has gone beyond the predictions of information-processing accounts to show how sensorimotor experience and activity influence young children’s learning of words. Other work with infants shows how considerations of the developing body can inform theorizing about how infants learn from, and relate to, other people (45). From an embodied perspective, research with infants is important to the question of how intentionality, in terms of symbolic, reflective knowledge, feeling, and meanings, emerges from engaged and embodied actions. The construct of embodiment is relevant to this question by affirming that from the beginning, bodily acts constrain and inform the nature of intentionality (28). That said, the view I have

outlined suggests that embodiment is important not just for one stage of the lifespan but is fundamental to the study of human development more broadly.

Accepting the embodied nature of cognition opens new vistas for lifespan developmental science. A fully embodied account of mental life allows for the lifelong construction of personal meaning by combining a rich social and cultural context with the activities allowed by the body and brain that characterize *Homo Sapiens*. At a deeper level, it becomes evident that considerations of embodiment are not only relevant to the ontogeny of the individual but are also interwoven with the evolution of brains, bodies, and minds. Although I have focused on cognitive development, a wider acceptance of these deeper understandings about embodiment should inform and connect research across domains of development. If this can be achieved, a biologically based view of embodiment and human development can help forge a truly integrative science of life and mind.

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