ELSEVIER

New Ideas in Psychology 23 (2005) 166–173

NEW IDEAS IN PSYCHOLOGY

www.elsevier.com/locate/newideapsych

Functional scaffolding and self-scaffolding

Mark H. Bickhard*

Department of Philosophy, Lehigh University, 15 University Drive, Bethlehem, PA 18015, USA

Available online 9 June 2006

Abstract

Models of the nature of representation and cognition ground and constrain models of the construction of representation in learning and development: models of what is being constructed ground and constrain models of the processes of construction. Insofar as the notion of scaffolding is intended to refer to particular kinds of supports for learning and development, it too will be variously enabled and constrained by underlying assumptions concerning representation and cognition. I will argue that action based models of representation, which have their own powerful supports, also make possible a functional notion of scaffolding that, in turn, makes sense of processes of self-scaffolding as a central field of development.

1. Introduction

There are two primary orientations to the nature of representation in the literature today. The dominant approach, and the historically oldest, takes representation to be some sort of encoding of what is being represented. This has roots in the ancient Greeks, with, for example, Aristotle's analogy between perception and the impression left in wax by a signet ring. Modern versions tend to focus on some special sort of correspondence between a mental representation and what it represents. That special correspondence most commonly takes a passive model of visual perception as its paradigm: the light reflected from, say, a table, strikes the retina, is transduced into neural activity, and generates further nervous system activity that represents the table. The activity evoked in the retina and optic path is taken to constitute "sensory encoding" (Carlson, 2000), and the

*Tel.: +1 610 758 3633.
E-mail address: mark@bickhard.name.
URL: http://www.bickhard.ws/.

0732-118X/$ - see front matter
doi:10.1016/j.newideapsych.2006.04.001

representation of the table is supposed to be constituted in the causal or the lawful (nomological) or the informational (covarying) relationship between the nervous system activity and the table (e.g., Fodor, 1990a, 1998, 2003).

It should be noted that connectionist, or parallel distributed processing, models are taken by many to constitute an alternative to classical "transduction" models of representation. The trained activation vectors that are supposed to constitute representations in connectionist literature, however, are still taken to be representations in virtue of their special correspondences with what is represented. They are still encoding models. Their strength is that the special correspondences are trained rather than transduced, but that does not alter the assumption concerning the basic nature of representation (Bickhard & Terveen, 1995).

The second orientation is historically much younger and still very much a minority position. It is a generally pragmatist orientation, in which representation is taken to emerge in action and interaction systems, rather than in passive processing of inputs. This orientation originated with Peirce's pragmatism, and is represented in psychology mostly strongly by Piaget's model. Neither pragmatism in general, however, nor Piaget in particular, are well understood in contemporary psycological literature (Chapman, 1988).

I have previously argued against encodingist models and in favor of interaction-based models at length (Bickhard, 1993, 1996, 2001, 2003, 2004a, b; Bickhard & Terveen, 1995). Here I will just mention a couple of considerations: If representation is constituted as some sort of special correspondence, then, if the correspondence exists, the representation exists and it is correct, while if the correspondence does not exist, then the representation does not exist. These are the only two possibilities, yet there is a third representational status that must be modeled: that the representation exists but is incorrect. There has been a minor industry attempting to solve this problem of accounting for the possibility of representational error in the last decades (Cummins, 1996; Dretske, 1981, 1988; Fodor, 1987, 1990a, b; Hanson, 1990; Loewer & Rey, 1991; Millikan, 1984, 1993), but, even if any of them are taken to solve the problem (they do not), they do not even address a stronger and crucial criterion: account for the possibility of system or organism detectable representational error. If organism detectable error is not possible, then error-guided behavior and error-guided learning are not possible. We know that such error guidance occurs, therefore any model that makes it impossible or cannot account for it is refuted.

An (inter)action-based model of representation, in contrast, necessarily focuses on potential actions and interactions. What constitutes representation is most immediately indications or anticipations of what sorts and organizations of interaction might be possible (Bickhard & Campbell, 1989; Bickhard, 2003, 2004a, b). This future orientation contrasts strongly with the past orientation of encoding models, in which the organism is a spectator attempting to look backward down the stream of inputs (Smith, 1987; Tiles, 1990). The modal future orientation also makes accounting for the possibility of error and of organism detectable error relatively simple: the anticipation of potentialities exists or not, thus the representation exists or not, and, if it exists, the anticipations of interactive potentiality may be true or may be false. Furthermore, if the anticipated interaction is engaged and turns out to not flow within the anticipated range of possibilities, then it is not only false, it is falsified for the organism, and that falsification is available for the guidance of further behavior and of learning. Just this consideration alone is sufficient to show that representation cannot be created by signet rings pressing into wax, or transduction, or induction, and any other passive model.

2. Construction and epistemology

The primary difference between the two orientations that I will focus on here is the contrast between the passivity involved in impressions in wax, notions of transduction, or notions of induction (scratching patterns into the wax over time), with the constructive activity necessarily forced by action and interaction-based models. That is, the inherent passivity in encoding models of representation motivates a passivity assumption in models of learning. There is no temptation to assume, however, that the world could impress an interactively competent system into a passive mind. Interaction systems must be constructed; pragmatist models of representation require active constructivisms of learning.

Furthermore, unless we assume some kind of prescience or foresight about what constructions will be the "correct" ones, such constructions must be tentative and must be subject to selection by encountering error—error that is detectable by the organism. Interaction-based models of representation, then, force a variation and selection constructivism, an *evolutionary epistemology* (Campbell, 1974).

It should be noted that Piaget's model is consistent with this entailment from action-based models to constructivisms (Bickhard & Campbell, 1989): Piaget's is a constructivist model, among the first. Piaget, however, held for additional reasons that variation and selection per se was insufficient—too weak—to account for the development of rationality and necessity, so, although his was an evolutionary epistemology in a strict sense, he placed greater emphasis on an (unexplained) inherent tendency for "groping" as the basis for rational development. I have argued that Piaget's reasons here were inadequate (Bickhard, 1988).

3. Recursive constructivism

In sufficiently complex organisms, learning constructions will not only be in the context of prior learning, they will also make use of prior constructions as resources and components for variation and construction. This constitutes a kind of recursivity of construction: making use of prior constructions in current constructions.

Recursive constructivism has a number of powers and important properties beyond a simple constructivism. For example, as an organism learns more about a given domain, the resources for further construction in that domain become greater, and further learning, therefore, may well become easier (Campbell & Bickhard, 1992). On the other hand, if those previously constructed resources happen to lead in a constructive direction that is ultimately inadequate, they may become a burden or barrier to further learning.

The sensitivity and even dependency of constructions on prior constructions in recursive constructivism is what constitutes *development*. Learning focuses on in-the-moment constructions; development focuses on dependencies in trajectories of construction over time.

Piaget's model was both constructivist and recursively constructivist. He was clear about the possibility of making use of prior constructions in later constructions.

Most of what I wish to discuss from this point on turns on properties of recursive constructivism. So, it will hold for any models of representation, learning, and development that are recursively constructive.

In a limited sense, even encoding models can be recursively constructive: they can posit the construction of new representations out of already present representations, beginning with some innate base of representational atoms, and making use of prior constructions in later constructions. Such a model, however, leaves the nature of representation a mystery, and the constructivism is poorly motivated by the underlying passivity assumptions—it is an ad-hoc addition to the basic encoding framework.

There is, in fact, at least one further sort of constructive power, which might be called meta-recursive constructivism. This would be constituted by the possibility that the procedures for construction are themselves recursively constructable. Once the point is made, this clearly occurs, but Piaget's model had no particular place for it: equilibration remained equilibration throughout development. Meta-recursive constructivism is important for the details of functional scaffolding as I discuss it below, but not for the basic ideas.

4. Functional scaffolding

Within a constructivist framework, some constructions will be more complex and difficult than others. Constructions that are complex at one point in development, however, may become simpler and easier later on if more relevant resources have in the meantime been constructed. Such resources could be new potential components or bases for variations, or even more powerful constructive procedures if we consider a meta-recursive constructivism.

These considerations yield a possibility of a functional notion of scaffolding. If a construction necessary to a given task is too complex, it is unlikely that the organism, the child perhaps, though not necessarily a child, will hit upon the required complexities, and, therefore, unlikely that the task will be mastered, the learning accomplished. Furthermore, if the task requires complex constructions and simpler constructions that might serve as resources for those complex constructions are in general not viable within the variation and selection process, it will be to that extent unlikely that the child could construct useful resources that might allow the later mastery of the task or accomplishment of the learning—constructions that might otherwise serve a useful function as a base for further constructions will not survive because they are not themselves competent to satisfy the relevant selection pressures. Consequently, the task may not be solved, the learning not accomplished.

If, however, some of those selection pressures can be blocked, set aside, then some of the constructions that could be useful for later development might become viable within the environment of those blocked selection pressures. The blocked selection pressures, if relevant, will be among those that would otherwise (if not blocked) eliminate the simpler constructions, thus interrupting the constructive path toward some full task competence. Conversely, with those selection pressures blocked, a trajectory of not too complex constructions that are both useful in developing further in that trajectory and that can survive selection, because the relevant selection pressures are blocked, may be created. Blocking such selection pressures, then, may *scaffold* the constructive development of full task competence. It may permit the trajectory of constructions to be traversed because necessary intermediate constructions can survive in the scaffolded environment that otherwise could not. Once the full competence has been constructed, the scaffolding of the blocked selection pressures may no longer be needed. Or, perhaps,

the constructive trajectory is created by differing selection pressure blocks at differing points in the developmental path, with prior blocks being no longer needed for later points in the trajectory. Or perhaps the potential constructive trajectories form some sort of lattice or weave, and scaffolding would need to be sensitive to multiple possibilities at any given point in the space of possible constructions.

In any of these cases, scaffolding learning and development can make constructive developments possible, perhaps even easy, that would otherwise be difficult or impossible. Functional scaffolding, then, is the blocking of selection pressures in the service of making the (recursive) construction of competence or knowledge easier, or, perhaps, possible.

This model of functional scaffolding is both convergent with and different from the original notion of scaffolding based on Vygotsky's zone of proximal development. In this original model, skills that are available to the child are coordinated by a more competent person, and the coordinative knowledge is interiorized by the child, so long as the complexity of that coordination is not too far beyond the child's current competence (Bruner, 1975a, b). Provision of (coordinative) knowledge that the child does not currently have is certainly one way to block selection pressures that would otherwise be free to operate, but the constructive aspect of notions of internalization or interiorization are at best minimal—these notions are in fact manifestations of underlying encoding intuitions, in both Vygotsky and in Piaget—and, therefore, give at best minimal guidance to any richer notions of scaffolding.

Blocking of selection pressures for a recursive constructivism, in fact, provides a much richer notion of scaffolding, as well as being consistent with a likely property of learning and development—that is, recursive constructivism—instead of adverting to a mysterious impression of the world (signet ring?) into a mind via internalization or interiorization. It is richer in the first instance in that there are many other ways in which selection pressures can be blocked than just by providing otherwise absent knowledge. In particular, selection pressures can be blocked by choosing simple cases to work on first, by moving to idealizations, by breaking down into subproblems, by making use of resources that are currently available but may not always be available, and so on. All of these can succeed in blocking or reducing selection pressures, and they do not require the provision of knowledge not otherwise available.

5. Self-scaffolding

It is precisely this latter point that makes sense of the notion of self-scaffolding. A person cannot provide to him or her self-knowledge that is otherwise not available. Within the classic model of scaffolding, it is simply an internal contradiction to assume that such knowledge is available (to be provided) but not available (for the task). Self-scaffolding is, then, a strict impossibility so long as the classical model is strictly honored (actually, even some of Bruner's original examples, such as parents going to great lengths to try to understand what an infant is attempting to communicate, do not fit well with models of internalization—the intuition went beyond the model).

But self-scaffolding is perfectly possible if simple cases, idealizations, moving to subproblems, and so on are recognized as forms of scaffolding. An individual may well be able to do these sorts of scaffolding for him- or her-self.

6. Learning to learn

In fact, considering that virtually all learning involves such phenomena—it is rare that we approach a problem with no relevant heuristic skills—it becomes clear that the development of skills of self-scaffolding is at least central to, if not identical to, *learning to learn*. The development of self-scaffolding skills is a fundamentally important field of development, a kind of development that is at the core of essentially all domains. It is knowledge of how to approach problems in a domain—though it can differ from one domain to another.

In this respect, the development of self-scaffolding skills, the scaffolding of the development of self-scaffolding skills, should be a primary goal of education (Bickhard, 1992a, b, in preparation-a). But standard ways of thinking about education and scaffolding inhibit the recognition of this.

It must also be kept in mind that what constitutes self-scaffolding skills may vary widely from one domain to another. In this sense, self-scaffolding does not constitute a unified domain of development in its own right. That is why I have called it a *field* of development, rather than a *domain* of development, using the difference in the two terms to mark the difference regarding the internal unity or lack thereof of the skills involved.

7. Further scaffolding models

Functional scaffolding introduces a much broader notion of scaffolding, and one that makes sense of the notion of self-scaffolding. Elsewhere, I have argued that this broadened notion is also involved in the development of attachment, where attachment is understood not just as a kind of relationship, but also as a kind of skill in making use of resources of relationships with adults (or others)—assuming that the available adults constitute good and reliable such resources (Bickhard, 1992a)—and also the perhaps related phenomena of identification and mentoring.

Still further, functional scaffolding enables models of ongoing self-scaffolding of the sort that we engage in all the time with external notes, supports, reminders, intellectual and physical prostheses, and so on. And, finally, it makes sense of the notion of permanent scaffolds, which may make possible various interactions and task accomplishment that simply would not be possible otherwise, and for which the scaffolds need to be permanently available. I have argued that there is a deep sense in which social organization and language have properties of such permanent scaffolding (Bickhard, 1992b, in preparation-b).

8. Conclusion

An action base for cognition forces an evolutionary epistemology, which, in turn, yields the strong usefulness of functional scaffolding to aid the construction process. Further, functional scaffolding yields the possibility of self-scaffolding, an important field of development and of education. It also connects with broader phenomena such as attachment, ongoing self-scaffolding in our daily lives, and the possibility of—or, arguably, the necessity of—permanent scaffolds for crucial aspects of our lives (Bickhard, 1992b, 2004a, b, in preparation-b).

It seems clear that these phenomena are important to our understanding of development, and of education, and of the manners in which we support our activities throughout our lives. It should also be clear that notions of scaffolding depend crucially on the underlying assumptions about the nature of representation and cognition. I have argued that this rich notion of functional scaffolding and its multiple further elaborations grows out of a pragmatist, action and interaction based, model of representation and cognition. Such pragmatist models have much in their favor directly and because of the ultimate incoherences of encodingist models as the historical alternative (Bickhard, 1993, 1996, 2003, 2004a, b; Bickhard & Terveen, 1995); they also have much in their favor because of the further model elaborations that they permit, enable, and motivate, such as functional scaffolding and its own further elaborations.

There is a theoretical package here. Pragmatist models are thin in the current literature, with Piaget as the primary example, though a poorly understood example: he is commonly interpreted and dismissed on the basis of empiricist, encodingist distortions of his actual model. I do not think that Piaget got everything correct (Bickhard, 1988; Bickhard & Campbell, 1989; Campbell & Bickhard, 1986), but I would urge that action and interaction models in general are the correct direction to explore, with functional scaffolding just one of the theoretical, and practical, benefits to be made possible.

References

Bickhard, M. H. (1988). Piaget on variation and selection models: Structuralism, logical necessity, and interactivism. *Human Development*, *31*, 274–312.

Bickhard, M. H. (1992a). Scaffolding and self-scaffolding: central aspects of development. In: L. T. Winegar, J. Valsiner (Eds.), *Children's development within social contexts: Research and methodology*. Erlbaum (pp. 33–52).

Bickhard, M. H. (1992b). How does the environment affect the person? In: L. T. Winegar, J. Valsiner (Eds.), *Children's development within social contexts: Metatheory and theory*. Erlbaum, (pp. 63–92).

Bickhard, M. H. (1993). Representational content in humans and machines. *Journal of Experimental and Theoretical Artificial Intelligence*, *5*, 285–333.

Bickhard, M. H. (1996). Troubles with computationalism. In W. O'Donohue, & R. F. Kitchener (Eds.), *The philosophy of psychology* (pp. 173–183). London: Sage.

Bickhard, M. H. (2001). Why children don't have to solve the frame problems: Cognitive representations are not encodings. *Developmental Review*, *21*, 224–262.

Bickhard, M. H. (2003). Some notes on internal and external relations and representation. *Consciousness & Emotion*, *4*(1), 101–110.

Bickhard, M. H. (2004a). Process and emergence: Normative function and representation. *Axiomathes—An international Journal in Ontology and Cognitive Systems*, *14*, 135–169. (Reprinted from: Bickhard, M. H. (2003). Process and emergence: Normative function and representation. In J. Seibt (Ed.), *Process theories: Crossdisciplinary studies in dynamic categories* (pp. 121–155). Dordrecht: Kluwer Academic).

Bickhard, M. H. (2004b). The social ontology of persons. In J. I. M. Carpendale, & U. Muller (Eds.), *Social interaction and the development of knowledge* (pp. 111–132). Mahwah, NJ: Erlbaum.

Bickhard, M. H. (in preparation-a). *Learning is scaffolded construction*.

Bickhard, M. H. (in preparation-b). *The whole person*.

Bickhard, M. H., & Campbell, R. L. (1989). Interactivism and genetic epistemology. *Archives de Psychologie*, *57*, 99–121.

Bickhard, M. H., & Terveen, L. (1995). *Foundational issues in artificial intelligence and cognitive science: Impasse and solution*. Amsterdam: Elsevier Scientific.

Bruner, J. S. (1975a). The ontogenesis of speech acts. *Journal of Child Language*, *2*, 1–19.

Bruner, J. S. (1975b). From communication to language—A psychological perspective. *Cognition*, *3*(3), 255–287.

Campbell, D. T. (1974). Evolutionary epistemology. In P. A. Schilpp (Ed.), *The philosophy of Karl Popper* (pp. 413–463). LaSalle, IL: Open Court.

Campbell, R. L., & Bickhard, M. H. (1986). *Knowing levels and developmental stages. Contributions to human development*. Basel, Switzerland: Karger.

Campbell, R. L., & Bickhard, M. H. (1992). Types of constraints on development: An interactivist approach. *Developmental Review*, *12*(3), 311–338.

Carlson, N. R. (2000). *Physiology of behavior* (7th ed). Boston: Allyn and Bacon.

Chapman, M. (1988). *Constructive evolution: Origins and development of Piaget's thought*. Cambridge: Cambridge University Press.

Cummins, R. (1996). *Representations, targets, and attitudes*. Cambridge, MA: MIT Press.

Dretske, F. I. (1981). *Knowledge and the flow of information*. Cambridge, MA: MIT.

Dretske, F. I. (1988). *Explaining behavior*. Cambridge, MA: MIT Press.

Fodor, J. A. (1987). *Psychosemantics*. Cambridge, MA: MIT Press.

Fodor, J. A. (1990a). *A theory of content*. Cambridge, MA: MIT Press.

Fodor, J. A. (1990b). Information and representation. In P. P. Hanson (Ed.), *Information, language, and cognition* (pp. 175–190). Vancouver, BC: University of British Columbia Press.

Fodor, J. A. (1998). *Concepts: Where cognitive science went wrong*. Oxford: Oxford University Press.

Fodor, J. A. (2003). *Hume variations*. Oxford: Oxford University Press.

Hanson, P. P. (Ed.). (1990). *Information, language, and cognition*. Vancouver: University of British Columbia Press.

Loewer, B., & Rey, G. (1991). *Meaning in mind: Fodor and his critics*. Oxford: Blackwell.

Millikan, R. G. (1984). *Language, thought, and other biological categories*. Cambridge, MA: MIT Press.

Millikan, R. G. (1993). *White queen psychology and other essays for alice*. Cambridge, MA: MIT Press.

Smith, J. E. (1987). The reconception of experience in Peirce, James, and Dewey. In R. S. Corrington, C. Hausman, & T. M. Seebohm (Eds.), *Pragmatism considers phenomenology* (pp. 73–91). Washington, DC: University Press.

Tiles, J. E. (1990). *Dewey*. London: Routledge.