Commentary

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A Challenge to Constructivism: Internal and External Sources of Constructive Constraint

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Models in which representations are understood as impressed by the environment into a passive mind have been dominant in Western thought since at least the signet rings pressing into wax of Plato and Aristotle [Bickhard, in press]. Contemporary models of light being 'transduced' into encoded representations in the retina involve at best a merely a technological update of the metaphor. They contain not one iota of conceptual advance regarding how any such process is possible. In one sense, this should not be surprising, because such models suffer inevitable fatal problems [Bickhard, 2004], but, historically, alternatives have been absent.

Peirce, however, introduced an action framework for understanding mind, and this new Pragmatist perspective has been developed most thoroughly in psychology by Piaget, with the historical path of influence from Peirce and James to Baldwin to Piaget. If we assume that representation is some sort of copy of, or correspondence with, the world, then we may (still) be tempted by models in which the world impresses itself into a passive mind, but there is no such temptation to assume that the world can impress a competent action system into a passive mind. Action systems bear no particular structural or atomistic correspondence with the environmental conditions with which they are competent to interact. Signet rings in wax, and all more modern equivalents, are inconsistent with any action based approach to cognition. Action systems must be constructed.

Furthermore, unless this construction is somehow prescient, those constructions must be tentative and subject to error, and, therefore subject to error correction. Action approaches to cognition must involve an evolutionary epistemology

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[Campbell, 1974], one in which constructive processes that entail the elaboration of variation and selection are well specified [for example, in the case of perception, see Bickhard, 1992; O'Regan & Noë, 2001; in the case of heuristic problem solving and learning, see Bickhard & Campbell, 1996].

Piaget's notion of scheme began as a description of the organization of task competencies, and then became an explanation of those competencies – the internal locus of control of organism interactions [Campbell & Bickhard, 1986]. Schemes must be constructed (though Piaget maintained an unfortunate resistance to variation and selection in his constructivism [Bickhard, 1988]). Clearly, this constructive process must be in some sense guided by successes and failures of interactions that are controlled by the scheme as it has been constructed at any given point in time.

But schemes are not forms pressed from a signet ring; rather, they are organizations of an active interacting mind. That is, a pragmatist, action orientation to cognition not only forces a model of the organism interacting with its environment, not just passively perceiving its environment, it also forces the modeling constraint that that mind must be active in at least three senses: (1) it must *guide* those external interactions; (2) it must *construct* those guiding schemes, and (3) it must *deploy* those guiding schemes appropriately to the situations that are being interacted with (interacting with a ball as if it were a key might be a form of creative play, but it won't open the door).

That is, Piagetian schemes are not only guides for environmental interactions, they are also themselves activities: they are internal processes, not just static controls of interactive process. Furthermore, they must not only be constructed in learning and development, they must also be made available in the moment as appropriate to the interactive situation of that moment.

Conceptual Disruptions from Computer Models

Making sense of these three kinds of activity and of their interrelationships is important, but doing so is disrupted by habits of thought derived from thinking of mind as a computer. I will address some of these conceptual barriers explicitly as a means of attempting to gain some clarity about the issues involved in understanding the three kinds of activity. In a computer, the activity that is controlled is the activity of the central processing unit(s). This control is guided by the program stored in current memory. Relevant parts of the program are retrieved from memory and used to set-up the central processing registers to engage in some form of processing, perhaps a fixed point add, perhaps a floating point multiply. This retrieval and set-up process is the computer version of *deployment*: The appropriateness of the way in which the processing is set-up is controlled by the overall control flow of the program – if it works well, it will set-up the processing unit to do the right kinds of things in the right kinds of circumstances. If the program logic is in error, that control flow will initiate the wrong set-up, the central processing unit will engage in inappropriate activity for the task at hand, and the program will not work.

The computer version of *construction* is programming, but there are serious disanalogies with the case of organisms here. In an organism, the *failure* of interactive activity is intrinsic to the organism itself: An action that fails to reach its goal, or that produces pain, fails (to that extent) for the organism. This is not the case in a

computer: the failure of the program is only relative to the programmer's or user's goals; the computer does not care if it fails to perform a correct statistical analysis or word processing manipulation. In an organism, there is feedback from interactive failure to the specifics of the schematic guides for that interaction; there is selection against such a guide, such a scheme that has produced an error. Again, this is not the case in a computer: such feedback does exist, but only via the programmer recognizing the failure and attempting to correct the code that produced it.

Crudely, then, the mind incorporates its own programmer, both in the normative sense of having criteria for and the ability to (fallibly) detect error, and in the sense of attempting corrective alterations to the schematic guides of interactions that encounter error. This is crude in multiple ways: the mind is not discrete; the mind is massively concurrent and in parallel; the normativities of the mind (the kinds and conditions of success and failure) are intrinsic and are themselves central domains of learning and development, and there is nothing in the computer metaphor that can begin to capture such normative phenomena [Bickhard & Terveen, 1995]. Nevertheless, comparison with the computer model helps to emphasize that the sense in which schemes guide interactive processes with the environment is *not the same sense* as that in which schemes are themselves activities, and neither one is the same as the processes by which schemes are (1) constructed ('programmed') or (2) made available ('deployed' in the language above - 'activated' is sometimes the term used, though what that should mean is seldom clear).

Scheme-Scheme Interactions

It is clear that schemes are constructed and that that construction is at least in part guided by selections from interactive failure. Actions that yield pain tend not to be repeated. But, if schemes are themselves internal activities, themselves internally constructed and internally 'activated,' and if mental activities are massively concurrent and in parallel, the possibility is opened up that schemes might perhaps act on each other. Perhaps, for example, the activities of concurrently deploying two different schemes will interact to yield somewhat different schemes than would be produced otherwise: deployment might be, in that sense, context dependent. Furthermore, such context dependencies in deployment might alter the schemes that will be produced in later situations: that is, *deployment* interactions might alter the *construction* of the schemes. Piaget clearly assumes that this occurs, and it is the nature of the *guidance* of that internal inter-activity that Becker's paper focuses on. Thereby, he highlights the issue of the nature of that activity *per se* – the issue that I am focusing on.

The problem is that the interactions *between* schemes cannot be the same sort of activity as the *interactions with the environment* that schemes guide. But, what then is it? The problem might perhaps be taken as perplexing – after all, computer programs do not relevantly interact with each other – and we might be best advised to drop the question as ill-conceived. But there is nothing straightforwardly incoherent about the notion, and it does seem clear that schemes do in some sense adjust to each other without necessarily involving the mediation of incompatibility of the schemes with each other in their respective guidances of environmental interactions. We do sometimes, perhaps a lot of the time, learn and develop via internal

processes, perhaps internal 'failures' of some sort, but, in any case, not always in direct consequence of environmental interactive failure. Again, how does that work?

There was a caveat above about computer programs interacting with each other. One program can act upon another, or even on a part of itself, but this is crudely akin to one program taking another as its interactive environment. It is not akin to two or more programs inherently adjusting to each other as they lie inert in their memory store. Programs do not have the right kind of nature for that. They are codes, not processes, and certainly not activities (*activities* require inherent normativity). They cannot manifest the kinds of mutual adjustments that are at issue.

A different and perhaps more helpful metaphor might be that of soap films adjusting to each other. They will be modified in their adjustments by external factors such as the ambient breeze, but there is nevertheless an inherent dynamic of adjustment, that results from everywhere-all-at-once local tension adjustments, that yields an overall global surface with specifiable characteristics.

But we need not only a model, or metaphor, of a dynamic process that could manifest the sort of mutual adjusting that seems to occur among schemes, we need that dynamic to somehow honor or manifest the cognitive and representational and action properties of the schemes that we are attempting to model. A physical or brain process that manifested local to global characteristics per se, but was strictly a biochemical process – arbitrary relative to cognitive and action properties – could at best give us a model of some kinds of deterioration and demise of the mind. The local to global synchronization of an epileptic seizure would be an example of the kind of process that is *not* relevant. It cannot address the constructive and productive further integration of mental activities.

So, we need a model of processes of mutual adjustment among schematic processes that guide organism-environment interaction. Such adjustment processes must honor the action and cognitive properties of the schemes that are involved in the adjusting process. Such inter-scheme adjustment is *not* the same as schematic guidance of interaction: it is the cognitively sensitive adjustment *among* such schemes.

The intent of my comments is to further delineate the problem that Becker's paper has highlighted, and to emphasize its importance. Constructivists must ultimately address this issue – and the connected issue, of central concern to Becker, of the relationship of the internal adjustment process to consciousness.

I will not attempt here the presentation of a model that arguably solves the problem. Nevertheless, I would like to point out what seems to me to be the appropriate dynamic realm in which the solution is to be found. Schemes must be ongoingly 'set-up,' deployed, as forms or organizations of functioning. This setting-up is itself a process. Elsewhere, I have suggested that an appropriate term for this process is *microgenesis* (this is not the microgenesis of studying short term development, though, I would argue, they are related – it is, however, strongly related to Werner and Kaplan's notion of microgenesis: see, for example, Bickhard & Campbell [1996]). Microgenesis will be ongoing concurrently and in parallel over the entire brain, setting-up appropriate, or at least mostly appropriate, modes of schematic functioning, likewise concurrently and in parallel. Such microgenesis processes will necessarily involve local adjustments in virtue of their forming a kind of field process: overlapping microgenesis processing cannot be dynamically inconsis-

tent, without destabilizing one or both or all of the microgenesis processes involved. Such destabilization, in turn, forces adjustments (whether they are unforesighted or are heuristically guided is a further issue, as well as how any such heuristic guidance could emerge and occur).

Still further, microgenetic adjustments *will* honor cognitive and action properties because it is schematic processes with those properties that microgenesis constructs. That is, microgenetic processes construct cognitive processes, so alterations in microgenesis will alter cognitive processes, and such alterations will tend to cognitively coherent (which is not necessarily to say that they will correct, only that they will still constitute cognitive processes, they will still be processes in which representation, cognition, and action guidance are inherently emergent [Bickhard, 2003]). Microgenesis, then, seems to be the realm in which internal schematic adjustments are to be modeled.

Conclusion

Becker has done an important service in focusing on several issues that are of central importance, even though massively overlooked, to all constructivists. In this comment, I have focused even more narrowly on the nature of internal schematic mutual adjustments, and have set aside the issues of the guidance of such adjustments and the nature of the involvement of consciousness in that guidance. I have attempted to point out some of the complexities in this issue, and suggested that microgenesis might be the proper locus within which to model the phenomena.

Most important, however, at least in my judgment, is that these issues are not just issues of Piagetian exegesis, but are issues that must be addressed by any action-based, therefore constructivist, approach to understanding the mind and development. Piaget is still one of our most sophisticated thinkers in this framework, and so Piagetian exegesis remains of fundamental importance. But, as Becker argues, it is not enough to just try to determine what Piaget proposed. We want to correct and go beyond his work; we would like to transcend the mostly arid wasteland of contemporary developmental theorizing.

Pragmatist action based approaches are the future: they are the only kinds that do not suffer fatal conceptual problems [Bickhard, 2001]. Such approaches force a constructivist approach to development. There are myriads of interesting and important problems to be addressed within such perspectives, with Piaget as one of our deepest exemplars and guides to the issues. Just rescuing the problem definitions from the contemporary incoherence of guiding theoretical assumptions can itself, hopefully, be a contribution. Becker has helped to illuminate a central locus of problems in action based approaches to cognition.

References

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

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

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. (in press). Interactivism: a manifesto. In Campbell, R.L., Ó Nualláin, S., & Bickhard, M.H. (Eds.), *The study of mind: Toward inter- and intra-disciplinary cooperation*. Philadelphia, PA: J. Benjamins.
Bickhard, M.H. (2004). Process and emergence: normative function and representation. *Axiomathes – An International Journal in Ontology and Cognitive Systems*, *14*, 135–169.
Bickhard, M. H. (2003). Some notes on internal and external relations and representation. *Consciousness and Emotion, 4(1)*, 101–110.
Bickhard, M.H., & Campbell, R.L. (1996). Topologies of learning and development. *New Ideas in Psychology, 14(2)*, 111–156.
Bickhard, M.H., & Terveen, L. (1995). *Foundational issues in artificial intelligence and cognitive science: Impasse and solution*. Amsterdam: Elsevier Scientific.
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: Karger.
O'Regan, J.K., & Noë, A. (2001). A sensorimotor account of vision and visual consciousness. *Behavioral and Brain Sciences, 24(5)*, 939–1011.