

The Creativity of Development and the Development of Creativity

Mark H. Bickhard

Lehigh University
mhb0@lehigh.edu
<http://www.bickhard.ws/>

Abstract

An action based model of representation, and, thus, of cognition, does not support a passive mind model of epistemology, such as transduction or induction: impressions from the world cannot construct competent action systems. An action based model, thus, forces a constructivism. That constructivism, in turn, — baring prescience about what constructions to undertake — must be some sort of variation and selection constructivism, an evolutionary epistemology.

To model the dynamics of such processes, both the variational processes and the selection processes must be addressed. Variations will, in general, be generated by various heuristics (which require their own dynamic models), while *internal* selection principles constitute the organism's knowledge of what constitutes error.

Generation of novel but heuristically plausible variations constitutes a tentative model of individual level creativity. While, insofar as the selection criteria capture socially and scientifically relevant and important criteria, satisfaction of those criteria constitutes a tentative model of social level creativity.

Cognition as Activity

Models of learning and development that assume a passive mind into which the world impresses itself — such as transduction, induction, internalization, and so on — leave little room for creativity: everything that is impressed into the mind stems from the world, and only by some ad hoc addition to the model can the possibility of creative constructions *by* the mind be accommodated. Some posit of an active constructive mind must be made.

On the other hand, if it is recognized that the mind is *inherently* active, that mind is emergent in ongoing process in interaction with the environment, then no such ad hoc addition need be made. Active mind models are in fact *forced* by the ontologically open nature of all living things, and the emergence of mental phenomena in such living processes (Bickhard 2003a, 2009a). If a living process ceases, then it is no longer living, and, correspondingly, any mental phenomena emergent in those processes also

cease. In these respects, life is like a flame: mind and cognition *are* processes.

Further, if it is recognized that representation and cognition (in particular, among mental phenomena) are emergents in organizations of such activity, then:

1. Passive mind models are not viable: the world cannot impress an interaction system into a passive mind,
2. Minds must construct interactive organizations internally: a constructivism is forced, and
3. Baring prescience about what constructions will work, such constructions must be part of a trail and error, or variation and selection, process — they must realize an evolutionary epistemology (Campbell 1974, 1990).

In particular, representation emerges in active agents (Bickhard 2009b). Agents must have some functionally available indications of what further actions in and interactions with the environment are possible in the current situation, among which it can select what to do next. The processes that engage in such selections constitute the subject matter of motivation (Bickhard 2000, 2003b). The indications of what is possible, among which the selections are made, constitute the origin of representation. In particular, such indications might be false: an indicated interaction possibility might not in fact be possible, and that might be discovered if the interaction is attempted. This yields the emergence of truth value.

Truth value of indicated interaction possibilities is a minimal sense of representation, though, arguably, it is the most important sense: it captures the fundamental normativity of representation — the possibility of being true or false. More complex, and more familiar, forms of representation can be constructed on the basis of such indications, roughly in a manner that Piaget has presented (Piaget 1954).

The key to modeling more complex representations is that interaction indications can branch — a frog, for example, might have two flies and a worm all simultaneously available as targets for tongue-flicking and eating — and they can iterate — a frog might be able to move to the left, thereby bringing into range a new possible interaction with a different worm. Branching and iterating indications can form complex webs of interactive

potentiality. More familiar kinds of representations, such as of small physical objects, can be modeled in terms of sub-webs with certain special organizational properties (Bickhard 2009a).

Process models of mind and cognition, thus, force a variation and selection constructivism. If new constructions can make use of previous constructions, either as units of construction or as loci for variations, then we have a *recursive* constructive process. If the processes of construction themselves can be constructed, then we have a *meta*-recursive constructivism; this clearly is the case for human beings — see Campbell and Bickhard (1992).

A recursive constructive process can manifest various trajectories of construction over time, with some constructions made easier if certain kinds of prior constructions have taken place, or if certain kinds of scaffolding support are available or are themselves constructed by the agent (Bickhard 1992, 2005, 2007). I argue that the subject matter of learning is the short time scale properties of such constructive properties, while the subject matter of development is the longer time scale enabling and constraining relations among various trajectories of construction (Bickhard 2003b, 2006).

The Creativity of Development

Learning and development, thus, are aspects of basic variation and selection (meta-)recursive constructive processes. There are two parts of such processes that I will focus on: 1) the processes by which new constructions are generated, and 2) the processes by which they are selected (or selected out).

Construction processes may or may not be deterministic, but, so long as they sample the space of possible constructions — possibly heuristically — they will provide a source of variations. They will not, in general, be algorithmic: if they are algorithmic, then they constitute knowledge of what construction is the appropriate one, and no variation and selection process — no learning — is needed.

There are two senses in which processes may be non-algorithmic, and both may be manifest, perhaps simultaneously. The first sense is that a constructive process may not guarantee a correct result. This is the usual sense of ‘heuristic’, and constructive processes will in general be heuristic in at least this sense. There are many forms of heuristics, and they too must be learned, that is, constructed. Powerful kinds of heuristics might constitute, for example, metaphorical or analogical forms of construction.

A second sense in which a constructive process might be non-algorithmic is that the steps of the process, or the

course of the process, may not be well defined. Here lies the most basic locus of creativity. Consider, for example, a process in which emergent representational forms are self-organized within an ongoing dynamic process. The self-organized forms can constitute variations within an evolutionary epistemological process. Such self-organization will not, in general, be algorithmic. If it is chaotic, then the products of the construction may be unpredictable in principle, and, if indeterministic, then the overall process will be both unpredictable *and* indeterministic — a candidate for free will (Bickhard 2011). Arguably, most constructive processes are partially heuristically guided self-organizing processes.

Heuristics, even of the “well-defined-steps” kind, require some sort of topology — nearness and farness, or similarity, relations — on the space of constructions, and modeling how such topologies form and are revised is itself a significant modeling task (Bickhard and Campbell 1996). In most models, these topologies are hand-constructed in terms of functions on feature lists, which makes the origin of the features and the origin of the functions mysterious, and makes nearly impossible any dynamic model of how such topologies might be created or transformed (feature list models generally construe the topologies as metrics, but that much structure is not strictly necessary).

Simple variation and selection models can leave the selection processes to the environment, relative to ‘innate’ criteria in the organism. It might be, for example, the production of pain that constitutes, or signals, error. But agents capable of reflection, such as, among others, human beings, can learn not only heuristic modes of construction, but also can learn what constitutes error, and can construct internal error constraints or error criteria (Bickhard 2001). Error criteria are themselves knowledge that must be constructed, and, thus, are themselves subject to the possibility of error — and, thus, to their own criteria of what constitutes error or error-criteria (Bickhard 2002); meta-criteria. Internal error criteria serve as internal constraints — boundary conditions — on self-organizing variational processes, or perhaps as explicit selection criteria on constructions already created. Insofar as such internal criteria are accurate, they permit false or unsuccessful constructions to be avoided or eliminated without the risk and cost of trying them out in the external environment.

Development, in this model, is the process of meta-recursive construction, the constructions that are produced, and the constructive trajectory relations among them. Development is inherently a matter of an evolutionary epistemology, and, thus, inherently involves creative construction processes in the face of new situations and problems. Infants, toddlers, and adults can become more creative with regard to any or all aspects of these

processes: they can develop better heuristic construction processes, deeper and more accurate error criterial guidance, better topologies to guide heuristics and means of generating and transforming new such topologies, and so on. Development is intrinsically creative, and can become more so.

There are also, of course, similarly multiple ways in which creativity can become narrower with development. Heuristics can be poorly developed; heuristics can become deeply entrenched, and, thus, misleading for some new kind of problem for which the entrenched heuristics are inappropriate; the cost of error can be too great to risk, thus severely constraining creative constructions; error criteria can be wrong, poorly developed, and resistant to change (for various reasons, including psychopathology: Bickhard, 1989); and so on.

So, creativity can flower or wither with development, but it is an intrinsic aspect of development, and of the course of development.

The Development of Creativity

Multiple aspects of an internal evolutionary epistemology can contribute to creativity. These include:

- The power, relative to the constraints, of the heuristics guiding the self-organizing generation of variations;
- The topologies of the space of possible constructions that support those heuristics;
- The heuristics for generating and altering those topologies;
- The depth of the constraints and selection criteria; and
- The power of the self-scaffolding heuristics that have been developed.

Self-scaffolding heuristics can include, for example:

- Heuristics for breaking problems down into sub-problems;
- Moving to ideal cases;
- Temporarily setting aside some constraints;
- Using metaphor and analogy to generate new constructions, and perhaps new topologies in the space of constructions, and so on.

Another aspect is the power of available reflective processes that might affirm, infirm, or alter the principles of constraint and selection. This possibility is illustrated by Einstein's recognition that the extant mathematical definition of the black body radiation problem was mathematically inconsistent, and could not possibly be solved. He was able to change the definition and solve the altered problem (for which he won the Nobel prize) (Nickles 1980).

Evolutionary epistemology is operative at multiple scales: evolution, development, and culture, among them. In this respect, all of the properties, principles, and processes that contribute to creativity at the individual level are also present at the cultural-historical level. That is, heuristics and constraints undergo historical development as well as individual development — and the two are clearly interrelated, especially for socio-cultural level creativity.

The development of socio-cultural level creativity in the individual, thus, requires the nurturing of the development of cultural inventions of constraints and heuristics — the scaffolding of the development of skills and intuitions of self-scaffolding processes, constraints and criteria, topologies, heuristics for changing topologies, and reflective critical skills regarding all of the above.

Very few of these processes are algorithmic. One consequence is that they cannot be 'taught' by rote: their development must be nurtured as a growth of and from internal processes. This is far from the notion of education as pouring knowledge into the empty bucket of the mind (Popper 1972). One aspect of such nurturing that is quite different from standard approaches to education is that learning what counts as error, what has historically discovered to be in error, and by what criteria they are in error, is a crucial aspect of such nurturing. There is not point in 'creatively' constructing old errors, nor in creatively constructing something that is, in specifics, new, but is nevertheless in error by the same criteria of error as have been discovered previously. Contemporary education pays essentially no attention to the 'learning of error'.

Another aspect of contemporary creativity is that much creative research today, both empirical and theoretical, occurs in group processes, not just in individual processes. Groups permit multiple perspectives to be brought to bear, multiple heuristics to be in play simultaneously, a wide range of constraints that might be relevant to be considered, and so on. Groups can enhance both the variation and the selection aspects of creative work.

At the full socio-cultural level, similar principles of nurturing apply. In brief, both variation and selection must be encouraged and nurtured. Criticism is one of the most important social levels of creative process: it is the social level equivalent of constraint and selection processes. These, in turn, are at the root of the generation of new means and heuristics for avoiding critical errors. Principles of error criticism, thus, form the backbone of rational creativity (Bickhard 2002).

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