# 3 Developmental normativity and normative development

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Development is guided by multiple norms, and further normativities emerge in development. This should be a commonplace observation – after all, it characterizes the core dialectic of developmental processes – but normativity is instead a perplexing and sometimes desperately ignored aspect of development. I will address some reasons why normativity is so perplexing, reasons that begin with Parmenides, and, therefore, that have a rather long history. Within the framework of that historical and conceptual diagnosis of the problem, I explore a model of the emergence of normativity. Finally, I will illustrate with several examples of emergent normativity in learning and development.

These emergent normativities include the normativity of truth and falsity that constitute representation and the – so I argue – related instrumental normativity of motivation, that of success and failure that guide learning, and the positivity and negativity of emotions. Within that outlined framework, I show how higher level motivations, such as curiosity, aesthetic motivation and competence motivation, emerge.

Studies of the mind and person – including psychology, including especially developmental psychology – suffer from a problematic conceptual framework that stems from the pre-Socratics, has dominated Western thought since that time and that makes fundamental theoretical understanding, especially regarding the mind and persons, impossible. I will outline this problematic framework, and show how it renders the normativity of mind and development naturalistically inscrutable. I begin with Parmenides.

## Change and substance

Parmenides argued that change cannot occur: For A to change into B, A would have to disappear into nothing, and B would have to emerge out of nothing, and those are impossible (Campbell, 1992). The difficulties with ‘nothing’ were taken seriously and, in fact, are still with us today: How can you point to nothing? How can you encode nothing? – or What is this thing ‘nothing’ that ‘nothing’ refers to?[1]

In fact, Empedocles proposed his metaphysics of earth, air, fire and water as a response to the Parmenidean argument: earth, air, fire and water do *not* change, and thus satisfy (sort of) Parmenides. Only their locations and mixtures change, and the world can be accounted for in terms of these more superficial kinds of change. Similarly, Democritus’ atoms do not change, only their locations and relationships.

This substance or atomic form of metaphysics has, in multifarious forms and guises, dominated Western thought since then. But it creates fundamental problems, problems that are most especially focused in attempting to understand minds and persons (Bickhard, 2003b).

## Metaphysical perplexity

Substances and atoms ‘solved’ the Parmenidean problem, solved it so apparently successfully that they have remained the basic framework for metaphysics since then. But they create a hierarchy of metaphysical aporia that have never been solved, and, arguably, cannot be solved within that framework.

The first level of this hierarchy is that substances are, in themselves, inert and passive. Activity and motion – process – require additional forms of explanation. Self motion, in the case of animals, for example, seems clearly to exist, but, at best, it requires special elaboration to try to account for it (Juarrero, 1999). So, stasis is the default, and process requires explanation.

The second level of the problematic hierarchy is that emergence is not possible. Earth, air, fire and water can change position and mixture, but they cannot change themselves and no new, fifth, substance can come into being. It was such emergence that they were designed to avoid in the first place.[2]

[1] Frege gave us a means of avoiding some of the problems of these issues (Coffa, 1991; Hylton, 1990), but they have not gone away. We still do not have a consensual naturalistic understanding of encoding (Bickhard, 2003b).

[2] Aristotle, for example, proposed a model in which earth, air, fire and water could change into one another, but these were not the metaphysical foundations for Aristotle, and those foundations did not change (Gill, 1989). Aristotle also, arguably, allowed for a form of emergence (Caston, 1997), but Aristotle was not a pure substance metaphysician, as is mentioned later in the text.

The third level is that substance is actual and factual, a bearer of properties, and that is the extent of the world that can be accounted for within this framework. One issue that this renders aporetic, but that required over two millennia to become explicitly problematic, is that of relations (Brady, 2000; Coffa, 1991; Hylton, 1990; Olson, 1987): properties may in some sense inhere in their bearers, but how do relations attach to their relata?

More deeply, however, the factual world of substance has no natural place for phenomena of intention, of modality, of normativity. A substance metaphysics splits such phenomena into a separate realm that is dirempted from the rest of the world. How to account for such phenomena – phenomena of minds and persons – has remained among the deepest perplexities in Western thought since then.

## Metaphysical options

Given this metaphysical split, there are only a few general options available. One can accept the split as fundamental, and posit a metaphysics of two realms as the basic nature of the world. Thus, for example, Aristotle posited both substance and form; Descartes proposed two dedicated substances for the two realms; Kant argued for a noumenal realm and that of the transcendental subject; and the logical positivists proposed that science deals with the world of facts while philosophy is concerned with that of normativity constituted in language and social practices.

A second possibility is to try to account for everything within just the 'mental' side of the split. This yields an idealism or panpsychism. Hegel, Green and Bradley are powerful examples.

The third possibility is to make the opposite election, and try to account for everything within just the substance, factual side of the split. Hobbes, Hume, Mill and Quine exemplify this framework.

These three options exhaust the possibilities, so long as the basic split is assumed. We are currently living in a historical period in which the third orientation – that of materialism in some form or another – is presupposed as background truth.[3] This is so much so that issues about

[3] The logical positivists (and continental philosophers alike) attempted to derive modality, in the form of necessity, from structure, especially logical and mathematical structure, and then to account for normativity using this as a primary resource (Rouse, 2002). This attempt fails, though there are still threads (and puddles) of such orientations throughout contemporary work.

the normativity of, for example, representation, can seem non-scientific, 'mystical'. After all, as Hume showed, normativity is fundamentally distinct from factuality, and cannot be derived from fact.

## Emergence?

One might want to try to account for the *emergence* of normativity in the world, but the impossibility of emergence is among the basic 'accomplishments' of substance or atomistic frameworks in their origins and motivations. Furthermore, Hume's argument that norms cannot be derived from facts actually has the broader consequence that nothing new can emerge. Ontological emergence cannot exist. In that respect, Hume's argument codifies the Parmenidean split.

Hume actually didn't provide much of an argument, simply commenting that authors do not account for how normative terms can be derived from factual terms and that it seems 'altogether inconceivable' that they could do so (Hume, 1978; see also Smith, this volume, Chapter 1). The argument that is derived from these points, however, is based on how new terms *can* be validly based on others.

In particular, if the introduction of new terms must be by definitions making use of already available terms, then, so the argument goes, any terms in a valid conclusion can in principle be back-substituted through their definitions, each of which uses only prior terms and those available in the original premises of the argument. We can continue such a substitution of what a term abbreviates for each term until there remain *only* terms that were in the premises. At that point, by assumption, we have only factual terms, no normative terms, and no valid argument could introduce any normative terms if none was available to start with. Of course, with an empiricist conception of knowledge and perception, all initial premises will contain only factual terms, and so normativity cannot be validly introduced.

Notice, however, that the form of the argument, if sound, precludes introducing *anything* new. *No* term that is more than a structure of abbreviations for phrases using only terms in the premises can be validly introduced. That is, among other consequences, there can be no emergence. Facts are dirempted from modality, intentionality and normativity, and no valid argument can put them back together.

Fortunately, Hume's argument is itself unsound. Emergence is possible (Bickhard, 2000b, 2003b). The false assumption is that the only valid way in which to introduce new terms is via abbreviatory definition. If that were correct, then the Hume-inspired argument would be sound. Instead, however, there is implicit definition.

The basic notion of implicit definition is that a set of axioms implicitly defines the class of models that satisfy those axioms. Hume didn't know about implicit definition, but it was powerfully introduced in Hilbert's development of geometry around the turn of the nineteenth into the twentieth century. Schlick, Carnap and others worked with implicit definition, but did not recognize that it rendered Hume's argument unsound. They continued to accept the fundamental split between facts and norms.

Implicit definition blocks the argument because back-translation through the definitions is not possible: implicit definitions do not abbreviate anything constructed out of previously available terms. So new terms can be validly introduced that cannot be reduced to the terms in the premises.

Hume's argument against deriving norms from facts, and, more generally, against any kind of emergence, is unsound. The presumed in-principle barrier to an emergence account of normativity is removed. But that does not provide any model of any such emergence. To defeat the claim that such a model is impossible leaves the task of actually constructing such a model intact.[4]

## The emergence of normativity

Normativity, I propose, is derived from a fundamental asymmetry in thermodynamics. In particular, among organizations of process that manifest a temporal stability, we find two fundamentally different kinds. Some process organizations are stable in virtue of their existing in an energy well, such that a change in the organization would require an input of energy to disrupt that organization. So long as sufficient energy for disruption is not encountered, energy well stabilities can remain stable for cosmological time periods – e.g. atoms.

If such energy well organizations are isolated, they simply go to thermodynamic equilibrium and continue in the same organization. There is another class of stable process organizations, however, that are *essentially* far from thermodynamic equilibrium. Such processes react very differently if isolated: they *must* engage in continuous interchange with their environments to maintain their far from equilibrium conditions, and, if isolated, those interchanges cannot proceed. Consequently,

[4] Furthermore, Hume's argument 'merely' codifies the split introduced by the substance-particle response to Parmenides' argument. That split cannot be transcended unless such a substance metaphysics is replaced with a process metaphysics (Bickhard, 2000b, 2003b).

the processes go to equilibrium, and the necessarily far from equilibrium processes cease to exist. Stability for such far from equilibrium organizations of process, then, requires environmental interchanges, while stability of energy well organizations of process does not. This is the fundamental asymmetry.

Far from equilibrium processes can be maintained in their far from equilibrium conditions by completely external means – perhaps pumps maintaining a far from equilibrium mixture of chemicals in a vessel of some sort. For my purposes, however, those process organizations that make contributions to their own far from equilibrium stability – that are *self maintaining* – are central. A canonical example is a candle flame: a candle flame melts wax so that it can percolate up the wick, it vaporizes wax in the wick so that it can burn, it induces convection which brings in oxygen and removes waste. A candle flame is self maintaining in multiple respects.

A candle flame, however, cannot do anything different if conditions change. If it is running out of wax, it cannot detect that nor adjust its processes accordingly. It cannot maintain its condition of being self maintaining across variations in conditions. Some system organizations, however, can do that. They are ***recursively*** *self maintaining* – they maintain the condition of being self maintaining across variations in their relationships with their environments. A canonical example is that of a bacterium that can swim, and continue swimming if it is heading up a sugar gradient, but will tumble if it finds itself swimming down the sugar gradient (Campbell, 1974, 1990). Swimming is self maintaining, but only if it is oriented towards higher sugar concentrations. Otherwise, swimming would detract from the bacterium's self maintenance.

There are two kinds of normativity emergent in the bacterium. One is that of biological function: swimming is functional for the bacterium, if it is oriented up a sugar gradient, in the sense that it makes a contribution to the stability, the continued existence, of the far from equilibrium system (Bickhard, 1993, 2003b; Christensen & Bickhard, 2002). If it is oriented down a sugar gradient, swimming is dysfunctional. And if the bacterium swims up a saccharin gradient, that too is dysfunctional.

The second kind of normativity is the emergence of a primitive kind of truth value. If the processes in the bacterium select swimming as the activity to engage in, there is a functional presupposition that that is the functional thing to do, that swimming will in fact contribute to far from equilibrium stability. That presupposition will be true under some circumstances, such as being oriented up a sugar gradient, and false under others, such as being oriented up a saccharin gradient.

But truth value is the fundamental normative aspect of representation. The bacterium's swimming inherently presupposes that the current conditions are among those that make swimming a functional activity. *We* know that one of those kinds of conditions is orientation up a sugar gradient; the *bacterium* knows nothing of sugar or gradients. Nevertheless, its presuppositions can be true or false, with the conditions for being true being implicit in the chemical and other relationships between the bacterium and its environment. I propose this primitive truth value emergence as the emergence of primitive representation.

## More complex representation

Primitive it is, however, and, if a claim that this is foundational to all representation is to be sustained, it must be at least indicated how more complex and more familiar sorts of representation might be accounted for on this base. More complex representation involves resources of differentiation and complexity, already present *in potentio* in this primitive case, that evolution has exploited over time into the possibilities of more familiar sorts of representation.

In the bacterium, detection of a sugar gradient orientation triggers the appropriate interaction. This relation of *triggering* has two aspects that become differentiated in more complex organisms. A frog, for example, may have several interaction potentialities to deal with at one time – perhaps a fly in one location, another fly in another location, a worm and the shadow of a hawk approaching. The frog must select which of these to engage in, and, in order for such selection to be possible, they must all in some functional sense be indicated as possibilities available to be selected. The direct triggering relation has become differentiated into an indication of potentiality and a selection among potentialities indicated.

Both aspects are interesting and important, but, for current purposes, the focus is on the indications. First, note that the indications have the same kinds of functional presuppositions, thus truth values, as the triggerings: if selected, they either interactively flow as indicated, or not – they are being indicated as potentialities of interaction between the organism and the environment, and those indications are either true or false. Second, note that, even when there is no fly in some particular location, the infrastructure is still there in the frog to set up the appropriate indication should the relevant visual scan take place. That is, the conditional relation between engaging in such and such a visual scan and indicating a correspondingly appropriate interactive potentiality is present in the frog even when it is not being used. Such conditional indicative relations of interactive potentiality are crucial to more complex representation.

In particular, in more complex organisms, those conditional indications can branch from each other and iterate. There may be multiple possibilities indicated on the basis of current conditions (branching), and some of the indicated potentialities may be potential only conditional on other intermediate interactions taking place first so as to create the conditions for the next interactive potentialities (iterating). In organisms such as humans, such branching and iterating of conditionals of interactive potentiality create vast webs of indications of interactive potentiality based on other interactive potentialities. It is in special organizations of sub-webs in such overall webs that we find more familiar representations, such as of small manipulable objects.

Consider, for example, a child's toy block. It affords multiple visual scans, manipulations, chewings, droppings on the floor, and so on. Furthermore, each of these possibilities is reachable from any of the others, perhaps with appropriate intermediary interactions. A visual scan of the back of the block, for example, will require an intermediate manipulation of the block to bring that back to the front. Finally, this overall internally reachable organization of interaction potentialities remains invariant under a large class of further interactions. The block can be left in the room when the child leaves, it can be put in the toy box, and so on, and the organization of interaction possibilities remains, so long as the appropriate intermediate interactions are engaged in, such as going back into the room and opening the toy box.

This is 'just' Piaget's model of the representation of small objects, translated into the interactive model (Piaget, 1954). It is possible to steal models from Piaget in this manner because both are models of representation as emergent in action systems. Piaget's model and the interactive model differ in multiple respects (Bickhard, 1988, 1992d; Bickhard & Campbell, 1989), but they are both pragmatist models in the sense of proceeding from a framework of action systems rather than from a framework of passive input processing.

Piaget's model is also relevant to another challenge to the interactive model: perhaps it could account for representation of the physical world, but how can it account for representations of abstractions, such as numbers? What is the world that is interacted with in such cases?

A system interacting with the world might have properties that would themselves be worth representing. A heuristic strategy, for example, might organize interactions with 'try three times before giving up'. Such a strategy would instantiate the property of 'three'. An interactive system cannot represent itself: the relationship is asymmetric. But a second level system interacting with the first could very well represent the property 'three' in the organizations of the first. Such a reflective second level system, in fact, could represent and transform first level organizations and their properties in potentially powerful ways. Furthermore, a second level system would have properties that could be represented from a third level, and so on. These levels constitute levels of epistemic reflective abstraction, close to, though not identical with, the Piagetian notion (Piaget, 2001). They are important for many considerations, including that of development, which must honour the sequencing of such levels in its constructions: it is intrinsically impossible to construct an interactive system at level N+1 if there is no system already constructed at level N for the new system to interact with. This is not a causal constraint, from the environment or from the genes: it is intrinsic in the ontology of the levels.

The hierarchy of potential levels is unbounded, though humans generally remain in the lowest few of them. The point of central relevance to the representation discussion, however, is that the interactive model has rich resources for modelling the representation of abstractions. The primitive emergence of truth value in the triggering of interactions in bacteria remains a powerful candidate for the origin of all representation.[5]

## Representation and motivation

Any autonomous agent faces the problem of selecting next actions and interactions. In the simple case, the next interaction is simply triggered. The differentiation of the function of indicating potential interactions and that of selecting those indicated begins to distinguish between two aspects of this function of interaction selection, creating distinct infrastructures for indicating and for selecting. They both, however, continue to serve the more general function of interaction selection.

I have explored how representation emerges in the indication of potentialities aspect of interaction selection. An examination of the selecting function shows that it constitutes an early form of motivation: representation and motivation emerge as differentiated aspects of one single underlying function, that of selecting the course of the agent's interactions.

[5] I am not elaborating in this chapter the multiple and wide-ranging arguments against alternative models of representation (Bickhard, 1993, 2003b, in preparation). If those are taken into account, then the interactive model is the *only* remaining viable model of representation.

There is one conceptual barrier to understanding this point that I will address briefly. The problem of motivation is often construed as the problem of what makes the system do something rather than nothing, what energizes or stimulates the organism into activity. This cannot be a correct characterization of motivation: living systems are intrinsically far from equilibrium, and intrinsically must be engaged in interactions with their environments in order to survive. Any organism that does nothing dies. So activity is the background for motivation, not that which is to be explained. The problem of motivation has to be what determines what the system will do next, not what makes it do anything at all. And the selections of next interactions are precisely the determination of what the system will do next.

Representing and motivation are differentiated aspects of the same underlying process (Bickhard, 2003a). And, as we shall see, they continue to be tightly interrelated throughout development.

## Learning and development

If we assume that representation is a matter of the world impressing itself into an otherwise passive mind or brain, perhaps by transduction or induction, then action and interaction may make *use* of representation, but they are not *necessary* to representation. Representation can be purely a matter of input processing, beginning, for example, with the 'transduction' of light in the retina. The logic of such approaches is essentially not different from the signet ring pressing itself into the wax of the mind of Plato and Aristotle (Plato, 1892; Aristotle, 1908), and the informativeness of the models is also equal – no one has any idea of how light hitting the retina could create a *representation* of that light or of anything else (e.g. Fodor, 1987, 1990a, 1990b, 2003; see Bickhard, 1993; Bickhard & Richie, 1983).

If we assume, on the other hand, that representation is emergent in systems of interaction, then action and interaction are no longer irrelevant to representation, and, further, no one is tempted to think that a competent interaction system could be impressed into an otherwise passive mind or brain. Representation must be constructed, internally constructed, and, barring prescience, those constructions must be tested and checked out, and eliminated if not successful. An action base for the emergence of representation forces an evolutionary epistemological constructivism.

How might this work? The central nervous system of a complex agent is not 'hard-wired' with separate wiring for each of the interactions of which it is capable. That would be enormously wasteful and unnecessary. Instead, the nervous system can function in one manner or mode at one time, and a different manner or mode at a different time. It can look for food at one moment, and consider a problem of arithmetic a moment later, both with the same parts of the nervous system. The difference between differing modes of functioning is akin to the setting up of a computer processing unit register to do an integer add at one moment and a floating point multiply the next: it is the same register, and the same circuitry, but it is set differently in the two cases – the parameters are different. Similarly, in the continuous case of the oscillations in the central nervous system and their mutual and reciprocal modulations, setting different local parameters of ion and transmitter concentrations, for example (or, more realistically, creating temporal trajectories of such local conditions), will induce differing kinds of local processing. This process of setting up local conditions is that of *microgenesis* (Bickhard, 2000a, in preparation; Bickhard & Campbell, 1996).

Microgenesis is, in the first instance, a dynamic continuous 'reprogramming' of local nervous system functioning that greatly expands the capabilities of neural organizations. It has evolved in a co-evolution with faster and more local processes (Bickhard, in preparation). If we assume, however, that the microgenesis for a form of interaction that fails – for which the flow of interaction does not remain within the bounds of what the dynamic parameter trajectories are prepared for – is thereby destabilized, we have, in addition, a primitive form of learning. If successful interacting involves stable microgenesis, while unsuccessful interacting induces destabilization, then failure will induce variations in how the interaction will proceed the next time, and success will increase the probability that it will proceed in the same manner as the currently successful one. As before, we have a simple evolutionary epistemology of interaction construction.[6] The normativity of learning is success in anticipating the course of interaction in microgenetic set-up for that course of interaction.

Learning, then, is a constructive process, a variation and selection constructive process. Learning, however, is not a context-independent process. The constructions of learning are made in the context of and using the resources of previous constructions already made: learning is a *recursive* constructive process. Furthermore, the processes of construction, not just what is constructed, are themselves subject to further

[6] More complex processes are required for more sophisticated learning, such as heuristic learning; though, it turns out, they still deeply involve microgenesis (Bickhard, in preparation; Bickhard & Campbell, 1996).

construction, recursive construction. That is, (human) learning is constructive, recursively constructive, and meta-recursively constructive (Campbell & Bickhard, 1992). All such constructions are context sensitive not only on whatever is being interacted with in the moment, but also on the legacy of all previous constructions. Construction, then, is highly dependent on its own past history: it is highly historistic.

One immediate consequence is that some tasks may require constructions that are too difficult unless other simpler constructions are available from previous experience to serve as enabling constraints and resources for the new constructions. Some constructions may *require* certain kinds of prior histories of construction. ‘Learning’ is the investigation of moment to moment constructions, while ‘Development’ is the consideration of learning constructions in their historistic framework and with their historistic properties.

For example, if we can block selections for some constructions, allowing attempts to master a task to temporarily work even though they are not competent to the full task, then we may enable a constructive trajectory of more and more competent constructions, culminating in a full task capability, even though the intermediary constructions would be selected out under ‘normal’ conditions in which the selections were not blocked. This perspective provides a functional notion of the *scaffolding* of learning and development: scaffolds block selection pressures in order to make successful constructive trajectories more likely. This notion converges with standard conceptions of scaffolding as the provision of knowledge (e.g. coordination) that the child may not already have, but goes beyond in that, for example, it makes perfectly good sense, in this view, for an individual to engage in self scaffolding. This is an internal contradiction if scaffolding is constituted in the provision of knowledge, but an individual can block selection pressures for him- or herself, such as by breaking down problems into sub-problems, moving to ideal cases, setting aside one or more problem constraints, making use of some resource that may not be available in general, and so on, without having to already have the knowledge that is to be constructed (Bickhard, 1992a, 1992b, 2001, 2003c).

Another consequence is that, as an individual comes to know more about a domain of knowledge, there will be richer resources available for further learning and development within that domain. This can soon manifest a domain-specific competency – for further learning as well as for interaction – that is itself developed (Campbell & Bickhard, 1992), not something that is innate.

Developmental trajectories will be forced to honour various kinds of constraints. It is difficult, for example, for a construction to proceed that makes use of some resource before the resource is itself available. Such constraints may force various kinds of developmental trajectories, or perhaps some small set of possible such trajectories.

One constraint that is imposed on all development is that of the levels of reflection. No construction can skip levels. All ascent through the levels, if it occurs at all, must be sequential. This imposes a stage-like organization on possible development, except that there are no domain-general structures involved, and (with one exception[7]) no domain-general shifts in the possibilities of construction at a new level. The individual, then, can be in differing levels, or stages, in differing domains of development.

## Microgenesis and emotion

An organism as modelled to this point is capable of interaction and of learning, and, if the constructive processes are sufficiently complex, of historistic learning, or development. It is clear that learning increases the ability of an organism to successfully interact with varying environments: if it does not already know how to interact with an environment, then it has a possibility of learning how to interact with it.

There is, however, at least one significant deficiency in an organism capable of interaction and of learning and development. If it encounters a new condition, it can make variation and selection learning attempts, and will inherently do so in the destabilization of the microgenesis of interaction attempts, but it cannot learn or develop general heuristic ways of interacting with various kinds of novel conditions. It cannot learn or develop heuristic kinds of interaction strategies for kinds of microgenetic uncertainty conditions. An interacting and learning organism in a novel situation will be *in* a condition of microgenetic uncertainty, but will be unable to *interact* with that condition.

This could create unfortunate situations, such as engaging in variation and selection trials of various behaviours upon first encountering a large cat in the jungle. Having the capability of generic heuristic means of interacting with uncertainty situations would be advantageous.

There is a relatively simple way in which evolution has provided for this capability. But to model this process, I must first explore a little further how the learning model works and interacts with motivational considerations.

[7] An initial maturational enabling of development beyond the first interactive level (Bickhard, 1980, 1992d; Campbell & Bickhard, 1986). This is, however, an enabling of further construction; it is not that further construction itself nor does it guarantee that such construction will occur.

### *Forms of learning and motivation*

Like the organism as a whole, the nervous system is always active, always doing something. The question is what to do next, and what determines what to do next. One kind of determination of what to do next is created by the receipt of an input stream. The nervous system is always engaged in activity, and receiving an input stream will modulate that activity, inducing microgenetic uncertainty unless and until there is successful anticipation of the course of interaction with those kinds of inputs. But interactions can do more than merely passively anticipate input streams, and, in general, will do so. Instead, induced interactions will have *consequences* for those input streams: there will be an *inter*action.

If, for example, a pure tone is received, the stable interaction that will ultimately be settled upon is to create an output flow that anticipates the input flow, and subtracts that input flow to the point of eliminating it. The tone will be habituated. For simple tones, this may ultimately all occur in the first cochlear nucleus; for more complex tones, it may require some small portion of temporal lobe. Note that such habituation requires that the nervous system be organized so that the crucial neural 'subtraction' processes are possible.

Suppose, however, that the input flow crosses modalities. Suppose it begins as a tone, and finishes as a shock, where pain consists of inputs for which no successful interactions are possible, no neural subtraction organizations exist. Under such conditions, any interaction with the input trajectory that yields the pain will be unsuccessful, and will remain unstable. An interaction that will succeed with such an input, however, is one of jumping off of the shock grid. Learning a successful interaction in this case, then, is generally called classical conditioning, but it involves precisely the same microgenetic dynamics as habituation.

Suppose now that an input flow is generated by something that responds to an internal condition, perhaps low blood sugar, and for which no habituation interaction is possible. In this case, the only stable kind of interaction is one that will result in raising the level of blood sugar – eating. Eating, in turn, will depend on multiple additional considerations of context, environment, and so on, so the learning in this case may be unbounded with respect to such contextual considerations. In this case, we have instrumental conditioning.

And so on. The general attractor of successful microgenetic anticipation suffices to model all learning, including those not addressed here, such as incidental learning (Bickhard, 2000a, in preparation). And one way in which this process can be activated is by input flows under various conditions of what kinds of interactions would in fact be potentially successful with those kinds of inputs. So, the interactive, the learning and the motivational aspects of such processes are just aspects, not separate processes.

### *Interacting with microgenetic uncertainty*

Microgenetic uncertainty already is involved in learning, so the problem of being able to interact in general heuristic ways with such conditions depends on the existence of input flows from such uncertainty. Thus, just as input flows generated by low blood sugar can induce appropriate learning and interaction, so also can input flows generated by microgenetic uncertainty induce appropriate learning and interaction.

In these cases, appropriate interaction will depend on the nature, the kind, of the uncertainty situation. These, in general, will vary from basic evolutionarily reliable sorts of conditions and interactions to subtle social and cultural conditions and interactions. Interactions with microgenetic uncertainty situations constitute *emotions* (Bickhard, 2000a).

Emotion is a massive subject, and I can address only a few properties of it here. What is most relevant are some of the interactions between emotion and motivation. First, however, I need to show that this model of emotion is consistent with a basic distinction between positive and negative emotion. All interaction, including emotional interaction, is anticipative. Emotional interactions, to be successful, interact with uncertainty inputs in anticipated ways that maintain the condition of successful anticipation. So, any interaction can involve an anticipation of microgenetic uncertainty, and, therefore, of some appropriate kind of emotion, and this includes emotional interactions themselves.

Note that emotional interactions are interacting both with the original environmental conditions and with the internal condition of microgenetic uncertainty. That internal condition is part of what characterizes the situation for the organism, and helps determine what sort of interaction will be engaged and what sort of further anticipations will be involved.

If the anticipations of an emotional interaction are for eventual success in resolving the uncertainty, then the anticipations will be of an ultimately successful interaction. If the anticipations of an emotional interaction are for further uncertainty about how to deal with the original uncertainty, and then to deal with that double uncertainty situation, and so on, a runaway positive feedback of uncertainty can result. This is canonical of a negative emotional interaction, an anticipation of interactive failure. In this case, possibly a panic attack.

The differentiation between positive and negative emotion, then, turns not directly on the uncertainty input flow, but on the anticipations that are set up by that flow in the kinds of conditions that the organism categorizes itself as being in. Given kinds of environmental conditions, then, might be experienced positively by one organism, perhaps a child, and negatively by another, depending on their learning experiences. If algebra is an opportunity for exploring and eventually resolving various kinds of uncertainties about how to solve this problem, then it may be experienced positively. If, on the other hand, it is an opportunity for yet another confirmation of my incompetence, perhaps even with social shame, then it will be experienced negatively.

### Some emergent motivations

At this point, I again take up the point that the organism and the central nervous system are always active. The issue of motivation is what determines what will be engaged in next, not whether or not something will be done rather than nothing. This point holds as well for the emotional aspects of interactions.

If there are sufficiently strong modulations of internal and interactive activity from the body or environment, then those will, in general, constrain further interaction to deal with those sources of input flow. Hunger, for example. If there are no strong 'external' modulators of activity, however, the system will not do nothing. Instead, it will select what to do within the range of kinds of interactions that are anticipated to be successful. This point includes the emotional aspects of interactions.

So, unless otherwise motivated, the organism will tend to select kinds of interactions that induce emotions that are anticipated to be successfully resolved. This means that the organism will tend to select, will be motivated to select, kinds of interactions that will induce uncertainty – so they will involve novelty and some form and degree of lack of full mastery – but of a kind that is anticipated to be resolved successfully – so the anticipation is that the uncertainty will be removed by learning, the lack of full mastery will be made good. That is, there will be a tendency to manifest what we variously call curiosity, mastery motivation, competence motivation or play. One special version of this is aesthetics: situations, music, mathematics, and so on that reliably induce uncertainty, perhaps massive uncertainty, but uncertainty which, it has been learned, can be (potentially) massively resolved.

Such motivations will depend not only on the phenomena being interacted with, but also on what the person brings to the phenomena.

A toddler may enjoy playing with grass, but the available novelties are exhausted relatively quickly. If that toddler, however, grows up to be a botanist, grass may again bring satisfying uncertainties to explore. Avant-garde jazz may not be enjoyable for someone who has not learned how to listen to it, to approach and resolve the kinds of uncertainties in it. Again, mathematics can be a deeply aesthetic field, or a deeply upsetting field. And so on.

In this model, cognition and motivation develop together. New motivations that are crucial to learning and development are themselves emergent in this co-evolution of cognition and motivation. They emerge out of the interplay of cognition, learning and emotion. Motivations like curiosity are not distinct innate modules; they are inherent in human forms of the emotional influences on motivation with respect to cognitive and interactive phenomena. New normativities emerge from the historistic developmental and interactive interplay of already extant normativities.

## Values

In a system interacting with its environment, some interactions will be organized around satisfying the conditions detected (or represented) by other interactions. In particular, the detections or representations (detection does not require representation: the hypothalamus may detect low blood sugar, but it doesn't represent it) will function as set-points or goals for other interactions. This can hold for interacting *per se*, as when obtaining an ice cream cone is the goal, but also for learning, as when an input flow is encountered that the organism does not know how to interact with. Such novelty will evoke emotional reactions and learning attempts to try to successfully interact with the situation.

A similar point holds for higher levels of interactive knowing, except that the detections and representations are about lower level process and organizations, not about the external environment. Higher level 'goals' of this sort, whether evoking interactions *per se* or learning or emotions, constitute *values*. In organizing interaction and learning and emotion, values are motivating, inherently so. I would like to address a few properties of values as they function in development.

### *The unfolding of values*

Higher level values can constrain lower level activities and constructions, but lower level organizations impose an interesting constraint on the construction of higher level values. Values will be constructed to interact with, to represent, aspects and properties that are already instantiated, and, thus, available for interaction, in lower levels. That is, the construction of values will *unfold* values that are already implicit in lower level organization and process. This constraint, however, is not a full determination because there may be multiple values that might be unfolded.

Once a higher level value is constructed, however, it serves not only to constrain further lower level activity, it also serves to make explicit some aspect of what was before only implicit. A value may be satisfied by the organization from which it unfolded, but, once explicit, may be found to contradict some other aspect of lower level functioning. Or two higher level values may contradict each other. The value of being the toughest kid on the playground may not fit well with the value of being liked.

Values will always lead development in this sense of being unfolded into explicitness, constraining further activities and constructions, and making implicit conflicts explicit. Values are the leading edge – the leading *normative* edge – of development. They give direction to development, and their conflicts both force further development and, potentially, inhibit it. Values are motivating in both the interactive sense and the learning sense, and their satisfaction, or lack thereof, is an emotional issue – satisfaction is a kind of successful interaction, and failure of satisfaction is failure of interaction.

### *Self-referential values*

There is one special kind of value that I would like to elaborate a little further. Values that refer to the whole person, not just to one or more lower levels, can induce a particular kind of difficulty. A value about how the entire person should be in the world is a value about how the entire person should be spontaneously. But to take such a value as something to be approached instrumentally is to create a self-imposed double bind. It is to give oneself the command to be spontaneous (in a certain way). There is no way to obey such a command – to obey it is to be not spontaneous. So, I cannot decide to be at peace in the world, or to feel kindly towards others, and instrumentally adopt appropriate strategies that succeed in doing so. Any such strategies will be adopted *by* myself, and, thus, will not be the spontaneous actions of my whole self. Instead, my *central* spontaneous activity will be to be concerned about obeying the command of this value, which is not the same as living the value in itself.

On the other hand, it is certainly possible to cultivate the *development* of ways of being in the world, so such a value, even though a trap if taken as something to be approached strictly instrumentally, may well serve as a useful guidance for kinds of activities to seek out and kinds of reflections to engage in. Particular versions of self-referential assumptions about oneself, however, can be especially difficult to deal with in any way, and can constrain the development of rigid pathologies (Bickhard, 1989, in preparation).

### *Intrinsic motivational values*

Finally, I address the development of values that are concerned with the emergent intrinsic motivations mentioned earlier. The emergence of curiosity and aesthetic motivations will, in general, be relatively specific to various domains of interaction. The aesthetics of mathematics is not the same as the aesthetics of photography, and the development of one may not carry over to the other. Such motivations, then, will be learned as values about particular kinds of domains of interaction.

These values can ground continued pursuit of valued domains throughout the lifespan. They found potentially fulfilling and creative involvements with the relevant domains. Such values are among the most important developments of education.

## Conclusion

Development is an inherently normative process, involving normativities at multiple levels and of multiple emergent kinds. Representational normativity of truth value is intertwined with motivational normativities. Learning involves normativities of successful interactive anticipations. Emotions arise from interactions with interactive uncertainties in pursuit of more powerful ways to resolve such uncertainties.

Development occurs within the constraint and framework of a hierarchy of interactive representational levels, of levels of interactive knowing. Among the most important aspects of this multi-levelled development is the unfolding of values. Such values lead development. They are the normative leading edge, constraints on further interaction and construction, and the locus of the unfolding of value conflicts.

Among the important kinds of values are those of emergent intrinsic motivations and the appreciations and involvements that they reflect. These can range from music to mathematics to a sense of aesthetic appreciation of one's own life. The scaffolding of the development of such values, and of the development of self-scaffolding skills of such involvements, is among the more important accomplishments of education.

Normativity saturates all of development. There is no possibility of understanding development without understanding the normativities and the normative emergences involved. Yet normativity is today still suffering the consequences of a bad metaphysics, a metaphysical framework that makes issues of normativity seem unscientific, even mystical. But science addresses the world as it is, and the world of development, of mind and person more broadly, is normative through and through. It is normative in its basic ontology. Science must ultimately address these issues of normativity, but will not be able to do so until it has abandoned the Parmenidean, Empedoclean, Aristotelian heritage that sets all matters normative aside and outside of the natural world.