On the possibilities of a comprehensive developmental structuralism: the natural, the normal, and the normative

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> "So we can speak of auto-regulation, but only at the risk of its being confused with life itself."
> -Piaget, 1971a p.148
>
> "But truth is not a biological property."
> -Smith, 2002 p.516

Preface: all roads lead to Geneva (or should at least pass through it)

This paper takes a new look at some of Piaget's biggest ideas. But this is more than a testament to "the mighty dead." I have certain systematic theoretical intentions that I think are best approached in terms of a quasi-historical reconstruction of Piaget's vision. In particular, the framework developed in this paper aims to bring some unity to the fragmentation of current Neo-Piagetian theory and research. It seems that we have each taken up some part of Piaget's research program and jettisoned the comprehensiveness of his genetic epistemology. I'm suggesting that we revisit the big picture and remind ourselves of just how big it is. Piaget was ambitious. From the early theoretical musings found in *Recherche*, to the mature syntheses found in *Biology and Knowledge,* Piaget sought to outline dynamic and developmental explanatory constructs that cut across multiple perspectives: biological, psychological, sociological, and epistemological. Formulating such a comprehensive developmental structuralism remains an important task. But I am *not* issuing the call: "Back to Piaget!" We must approach things differently than Piaget did, even if we follow his lead. Instead of offering hopes for a single unified discourse I suggest a framework for facilitating interdisciplinary endeavors traversing the *natural*, the *normal*, and the *normative*.

Introduction: an indelible ambition

Near the end of Chapman's (1988) *tour de force* on the development of Piaget's thought he suggests that Piaget be ranked among those who articulated perspectives that gave new meaning to human life in the context of evolutionary change. He mentions several thinkers with comparable visions, including Bergson, Teilhard de Chardin, Jantsch, Waddington, Polanyi, and Whitehead. To this list could be added, J.M. Baldwin, C.S. Peirce, Aurobindo, and Wilber. The common denominator here is not a shared worldview (although their views are similar, there are important differences) but rather a shared ambition to reposition humanity in relation to our growing fund of scientific knowledge about the natural world.

Piaget first grappled with this ambition as a young man when he drafted an autobiographical novel, *Recherche*, confessing his desire to foster the integration of religious values and scientific knowledge (see Piaget, 1977, for a partial translation). He approached the problem in terms of two related sets of concerns. On the one hand, he offered a principled classification of the sciences with the intention of organizing knowledge and ensuring interdisciplinary quality control. On the other hand, he offered a provisional but comprehensive explanatory framework involving evolutionary processes thought to regulate the development of both the natural world and of human cognition and civilization. He would later chide himself for his "adolescent metaphysical speculations" (Piaget, 1952) and as he began work in psychology his concerns about the integration of science and religion faded.[1] However, the broad research program he outlined in his youth remained intact (Smith, 2002; Chapman, 1988). His principled

[1] Although see Chapman 1988, p.68-73 where Piaget's mature religious views are reconstructed out of a series of topical essays Piaget wrote in the late 1920's, revealing a system of beliefs similar to those espoused in his youth, e.g. "immanentism…. The tendency toward higher forms of organization provides humanity with higher values… God is identified with *directionality* and our striving to realize the ideal… thus to struggle for the good and the true…is to collaborate with God." See also, p.432-437, where Chapman suggests that Piaget's religious views continued to serve as a real source of motivation throughout his life.

classification of the sciences reappears repeatedly in his work, largely unchanged (e.g. Piaget, 1971b; 1970c). As does his desire to articulate a comprehensive explanatory framework involving developmental processes that cut across biological, psychological and epistemological perspectives (e.g. Piaget 1972; 1971).

Importantly, both of these sets of concerns, which I will come to label as concerns about *methods* and *models* respectively, eventual came to be articulated in terms of a *comprehensive developmental structuralism*. This phrase is not Piaget's; he labeled his research program as *genetic epistemology* or *genetic structuralism*. But the newer label more aptly serves to signify the scope of Piaget's vision to contemporary audiences, who are likely to misunderstand the term genetic as being about genes and to take structuralism as some narrow and distinctly French approach to cultural studies (and one particularly chastised by post-modernists). The truth is that the broadest contours of Piaget's insights are still remarkably relevant. We can learn a great deal from how he approached, in terms of single research program, both the epistemological relationships between different methods and the construction of developmental models that cut across a variety of seemingly incommensurable perspectives and levels of analysis (from mitochondria to mathematics).

This paper aims to *reconstruct* some of the key principles and distinctions that constitute the backbone of Piaget's comprehensive developmental structuralism. So the paper is in part an account of some of the broad themes that Piaget addressed over the course of his career. But this is not strictly an exercise in exegesis. I offer *reconstructions* and *interpretations* that are geared into to a variety of contemporary issues. In particular, I have a stake in debates about competing "meta-theories" of human development (Overton, 1998; Wilber 1999; Habermas, 1990), and in debates about the role of *normativity* in human development (Smith & Voneche 2006; Habermas,

1984; 1987).[2] Specifically, I suggest that a great deal of clarity can be brought to contemporary discourse by a meta-theoretical orientation that explicitly frames human development in terms of dynamic-structural constructs that function differentially across the *natural*, the *normal*, and the *normative.* And while the brief arguments below are at best suggestive and provocative, they should at the very least serve a heuristic purpose by framing some important issues that deserve more careful treatment.

Three sections follow. In the first I give a schematic reconstruction of Piaget's comprehensive developmental structuralism. I proceed by relating his early speculative work to his later writings concerning interdisciplinarity and equilibration processes. Then I discuss certain contemporary methodological approaches to human development in light of the key principles and distinctions outlined in the first section. I conclude with some reflections on what it would mean to adopt a comprehensive developmental structuralism in today's academic environment, with particular emphasis on the implications of systematically including normative issues in the study of human development. All in all, I offer a series of arguments suggesting that Piaget's ideal of a comprehensive developmental structuralism, when properly conceived, is both admirable and feasible, despite the need to jettison certain claims.

[2] Tangentially, I also have a stake in some issues surrounding evolutionary metaphysics and cosmology (Whitehead, 1978; Lazlo, 1972; Peirce, 1992; Wilber 1995). As Chapman (1988) notes, Piaget's vision is of some relevance in these debates, especially concerning the place of the normative in nature. But these metaphysical debates are secondary to the issues at hand, which specifically concern *methods* and *models* in human development. However, certain metaphysical issues are lurking in the background throughout, as will be clear in some places, like when we discuses the limits of meta-theories based on dynamic systems approaches.

Piaget's vision: toward a comprehensive developmental structuralism

Methods and models, the early years.[3] As noted above, Piaget was a young man when he first traced the contours of the problems and approach that would shape his career. In those days his reflections on the organization of different methods took off from Comte's famous classification of the sciences. However, where Comte saw a strict hierarchy of relationships between the sciences, with mathematics at the bottom, physics in the middle, and sociology at the top, Piaget saw a "circle of sciences" bound together via symbiotic relations.[4] Physics is not foundationless; to insure quality control it must engage in epistemological reflections of a logical-mathematical type. Epistemology in turn requires psychology and sociology to remain grounded and these must be in dialogue with biology. And of course, biology shades into physics, which as already noted, is not foundationless. And so the circle of sciences closes back in on itself. This may appear like a vicious circle, but Piaget construes it as a spiral, with the different sciences progressing in concert and collaboration.

This basic view would serve Piaget for the rest of his career. But as we will see below, what began as a speculative endeavor would end up as a methodologically sophisticated stance about the nature of interdisciplinarity, grounded in a synoptic view of the intellectual landscape. For now we should note the systematic place he gave to normative considerations (i.e. epistemology) and the intimate relations between those considerations and psychology, and in turn between psychology and biology.

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[3] The following account of Piaget's early views is based on Piaget 1952, Piaget, 1977, and Chapman 1988.

[4] In this respect Piaget's approach is unique as compared to other "modern" approaches to the classification of the sciences, e.g. Bacon, Comte, Peirce (see Braun & Baribeau, 1984, for a relevant overview of approaches to this often neglected meta-theoretical task). Piaget's is perhaps most comparable to Wilber's (2006) *Integral Methodological Pluralism*, which also entails a kind of cooperation and symbiosis between various methods, as opposed to hierarchy.

Alongside these reflections about methods Piaget also began to sketch an ambitious explanatory framework targeting ubiquitous evolutionary processes common to both biological life and the life of the mind. With reference to Bergson and Aristotle, Piaget laid out a proposal for a science of "forms" that would traffic in extremely general models of self-organization and development. Roughly, this would be a science offering explanations predicated upon the continuity of life and mind and capable of explaining the *form*s of intellectual development in terms analogous to the *forms* of biological evolution. Even at this early juncture Piaget identified *equilibration* as a process fit to this task. Biological life and evolution are governed by a tendency towards equilibration between organism and environment. This same tendency characterizes the life of the mind as it develops toward an equilibration between subject and object. Thus models of equilibration processes should have great explanatory power, cutting across biological, psychological, sociological, and epistemological perspectives.

It is no secret that equilibration processes maintained a central place in Piaget's explanations of cognitive development. What is less well known, and will be discussed below, is just how much explanatory power he attributed to this concept. In fact, he never really relinquished the bold hypotheses of his youth. He always maintained that certain very general explanatory constructs could be used to explain the evolution of biological organisms and the development of intelligence at all levels. However, what began as a set of metaphysical beliefs about the continuity of life and mind and the directionality of evolution itself would end up as a grounded meta-theoretical stance informed by a variety of interdisciplinary endeavors.

Before going on to discuss Piaget's mature views a few things should be noted about the musings of his youth. The ideas about methods and models sketched above were offered as part of a larger project aimed at creating a new discourse capable of positioning human values and norms in the natural world. In particular, Piaget was

looking to resolve a crisis of faith that left him torn between the knowledge endorsed by scientific worldviews and the strong ethical convictions that are the fruits of religious beliefs. His solution was a complex view of evolution in which human cognition and civilization could be understood as the creative and autonomous extensions of universal developmental processes. According to such a view we can in some ways identify the ideals we strive for, be they truth or justice, with the trajectory of evolution in general.

But Piaget's vision of unity was as far from a crude teleology as it was from reductionism. As his principled classification of methods makes clear he was careful to differentiate the natural from the normative, even while he posited their continuity. This differentiation entails, strictly speaking, that questions concerning normative issues (such as those in epistemology and in some psychology) cannot be addressed by methods devised for explaining and describing natural phenomena, and vise versa. He was indeed looking for a single comprehensive discourse (his proposed "science of forms") but he was not looking to expand biological categories beyond their proper range of application or to bring mental and normative categories to bear in explaining things best explained by the natural sciences. Thus he was looking for a kind of *tertium quid* (Smith, 2002), a kind of *third discourse* capable of transcending but including the differentiation of the *mental* and the *physical* and the *natural* and the *normative*.[5] As we will see below, this ambition played out in his mature views in terms of a comprehensive developmental structuralism, which was a radically interdisciplinary endeavor.

Methods and models: the later years. In the late 1960s Piaget was involved with UNESCO's ambitious efforts to characterize the nature and status of interdisciplinary endeavors worldwide. Out of these efforts he produced a trio of slim volumes (Piaget

[5] The possibility (and impossibility) of exactly such a *third discourse* has been cropping up in recent debates in the neurosciences (Changeux & Ricoeur, 2000; Damasio, 2003) , meta-theory (Wilber, 1999), and social philosophy (Habermas, 2007). This is a point we will return to.

1970a; 1970b; 1970c). In my mind this work represents his most concerted attempt at elaborating the epistemological structure of interdisciplinary knowledge production. And in these three books we find the 'circle of sciences' he elaborated in his youth reconstructed and justified in relation to a wide variety of considerations. In effect he offers a series of complex reflections, both sociological and philosophical, on what different methods and approaches have to offer, on their points of convergence, and their contrasts.

In particular he lays out principled arguments about important and fundamental *similarities* between explanatory models from very different disciplines (e.g. dynamical systems modeling), while at the same drawing clear *distinctions* between certain broad knowledge domains (e.g. the human sciences and the natural sciences). This is the same tension that characterized the speculations of Piaget's youth. Key differentiations between distinct domains and methods are subsumed within a broader vision of unity. This unity is conceived in terms of certain universal developmental processes, which unfold differentially across distinct domains, from the biological to the psychological and epistemological.

Unfortunately, the framework Piaget lays out in these three books is difficult to grasp. His writing is always more evocative than it is explicative. So I offer one reading and do not claim to have crafted a definitive exegesis. Figure 1 is an attempt to impose some clarity and explicate certain key distinctions. This figure reconstructs Piaget's account of a comprehensive developmental structuralism as he detailed it in the works we have been discussing (Piaget 1971a; 1971b, 1971c). This figure serves only a heuristic purpose, and I hesitate to codify Piaget's account in this way. The nuance and sophistication of his arguments are mangled in this schematic presentation. But the benefits of clarity outweigh my concerns about oversimplification.

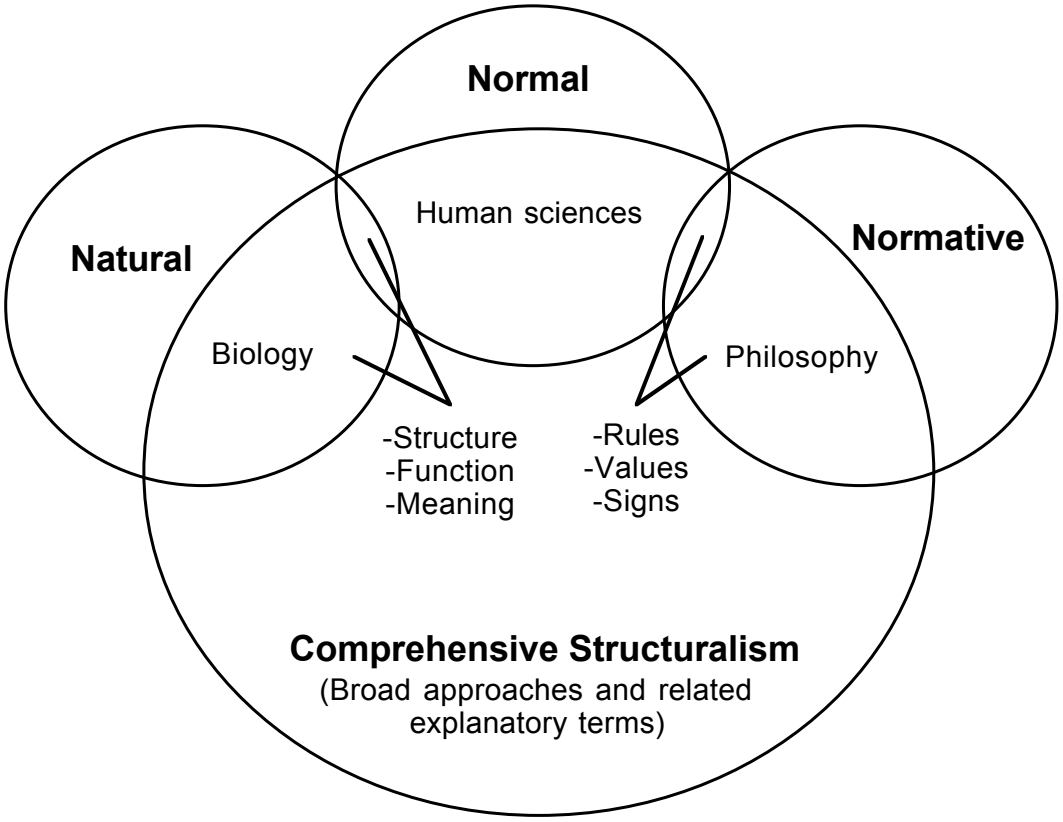

Figure 1: Model of Piaget's Comprehensive Structuralism

At a very general level, Piaget makes distinctions between three broad approaches: Biology, the Human Sciences, and Philosophy. These are rough divisions that refer to deep epistemological issues that Piaget struggles to make clear. He tries a variety of tactics and appeals tangentially to philosophical debates surrounding certain primordial epistemic (and methodological) differentiations: understanding vs. explanation (1970c); natural sciences vs. human sciences (1970c p.60); descriptions vs. prescriptions (1970a p.53); causality vs. entailment (1970b p.18). Based on a sweep of the recent philosophical literature about these distinctions[6], I've retrofitted a complimentary set of categories (the natural, the normal, and the normative) that are

[6] Concerning these important distinctions: understanding vs. explanation (e.g. Apel, 1984; von Wright, 1971); natural sciences vs. human sciences (e.g. Taylor, 1985; Habermas 1988); descriptions vs. prescriptions (e.g. Sellars, 2006); causality vs. entailment (e.g. Habermas, 2007).

slightly broader than Piaget's disciplinary divisions. I feel these categories help to clarify the thrust of Piaget's thinking and serve to update and generalize his account slightly.

The natural, the normal, and the normative are the general categories that must be subsumed by a truly comprehensive developmental structuralism. Thus, echoing his early desire for a "science of forms" common to life and mind, Piaget suggests that there are dynamic developmental processes that cut across all three categories. He brings his own work on the dynamic development of structures of intelligence into view along side work concerning processes of self-organization in theoretical biology and we begin to see the contours of his proposed framework. Appealing to Waddington and von Bertalanffy, Piaget notes the wide applicability of models that represent structured and self-regulating wholes. Dynamic systems models in biology offer formalized structural accounts of the regulations and interactions between organisms and environments. These models are remarkably analogous to the models Piaget produced to explain processes of intellectual development. However, and this is a crucial point that is often overlooked, these types of models are *analogous*, not identical.

As Figure 1 displays, while researchers in biology and some areas of psychology build their models in terms of *structures*, *functions*, and *meanings*, researchers dealing with higher-order psychological and epistemological phenomena build their models in terms of *rules*, *values*, and *signs* (Piaget 1970b pp.12-18). These two sets of terms are meant to display the *isomorphism* between explanatory constructs used in all three categories. Structures and rules are both relevant in explaining *regularities* of *organization and form*. Functions and values concern the *dynamics responsible for the maintenance and transformation* of organized forms. Meanings and signs concern the *exchanges of information* necessary to maintain and transform organized forms. But in all three cases the later of the two terms does not, strictly speaking, refer to biological processes.

Of course, Piaget often speaks of biological, cognitive, and social structures in a very general way. In most cases when Piaget (or anyone) offers a structural explanation it entails appeals to both the functioning of self-maintenance and the exchange of information in terms of meanings. But to make his points here Piaget disentangles the three moments of such an explanation (i.e. organization, maintenance, exchange). And he uses this nuanced account to differentiate biological models from models of human cognition and society. The point is that when we model cognitive processes we must often appeal to explicitly followed and interpreted rules, values, and signs, whereas when we model biological processes we can make no such appeals.

It is useful to see this difference in terms of the status and role of *norms* in behavior and cognition. The distinction between *normative facts* and *natural facts* is crucial. [7] Rules, values, and signs can be appealed to in the explanation of norm-laden behaviors and cognition because they are reflected upon *as such* by the organism being studied. When we observe a child making a judgment we have before us a *normative fact*. The child follows a rule that is deemed valuable and that will eventually be amenable to explicit statement, revision, and reflection. As Piaget explains:

> The term "normative facts" has been happily introduced in to the general vocabulary…to describe that which constitutes a norm for the subject and, at the same time, an object of analysis for the observer engaged in studying both the behavior of the subject and the norms he recognizes…. [For example] normative facts are studied in genetic psychology when the question is to discover how subjects who were originally insensitive to certain logical norms come to regard them as essential through a process depending partly on their life in the community and partly on the internal structure of the action envisaged (Piaget, 1970c p.8-9).

[7] See Smith, 2006a, 2006b, on this important distinction.

However, biological structures, functions, and meanings are not like the 'normative facts' that confront us when we study human cognation and behavior. When we study the regularities a paramecium's reaction to its environment we have before us a *natural fact.* The structural, functional, and informational antecedes of the paramecium's behavior are not understood or reflected upon by the paramecium itself. Natural facts are those that can be understood irrespective of the intensions and consciousness of the thing being studied. This distinction between normative facts and natural facts relates back to the primordial epistemic (and methodological) differentiations noted above: e.g. natural sciences vs. human sciences; causality vs. entailment.

The *normal* is the middle category, as it were, stuck between the natural and the normative. It involves both natural and normative facts, depending upon what is being studied. As Kant (1790/2000) noted long ago, there are many biological phenomena that seem best understood *as if* they were conforming to rules. Their functioning *seems* to imply standards of normalcy to which they conform, and yet we are looking at merely natural facts. For example, the canalization of instincts and the reliable differential responsiveness of sense organs can be evaluated as normal or abnormal, over and above assessments of their mere dysfunction. Some biological processes exist within parameters of success and failure that entail more than the integrity of the organic substrate. Inversely, there are some consistent regularities in the development of human behavior. Many are normative facts that *appear* to be naturally determined. For example, there are a wide array of norm-laden behaviors that normally [sic] do not need to be explicitly taught and can be assessed in terms of simple milestone. From language learning to the development of cooperative play, what's normal can be studied as such. But as figure 1 makes clear, we employ different terms and appeal to different processes when we study what is biologically normal as opposed to what is psychologically so.

Importantly, Piaget's big point is that normative facts (e.g. acts of judgment), natural facts (e.g. regularities of reaction), and everything in between are best explained in terms of dynamic self-regulating processes that maintain wholeness, facilitate emergence, and tend toward equilibration. Thus, as noted above, the comprehensive developmental structuralism Piaget has in mind would be composed of dynamic and developmental explanatory constructs that generate isomorphic theoretical models in each of the three categories. Figure 2 displays one such explanatory construct that is central to Piaget's account: *equilibration*.

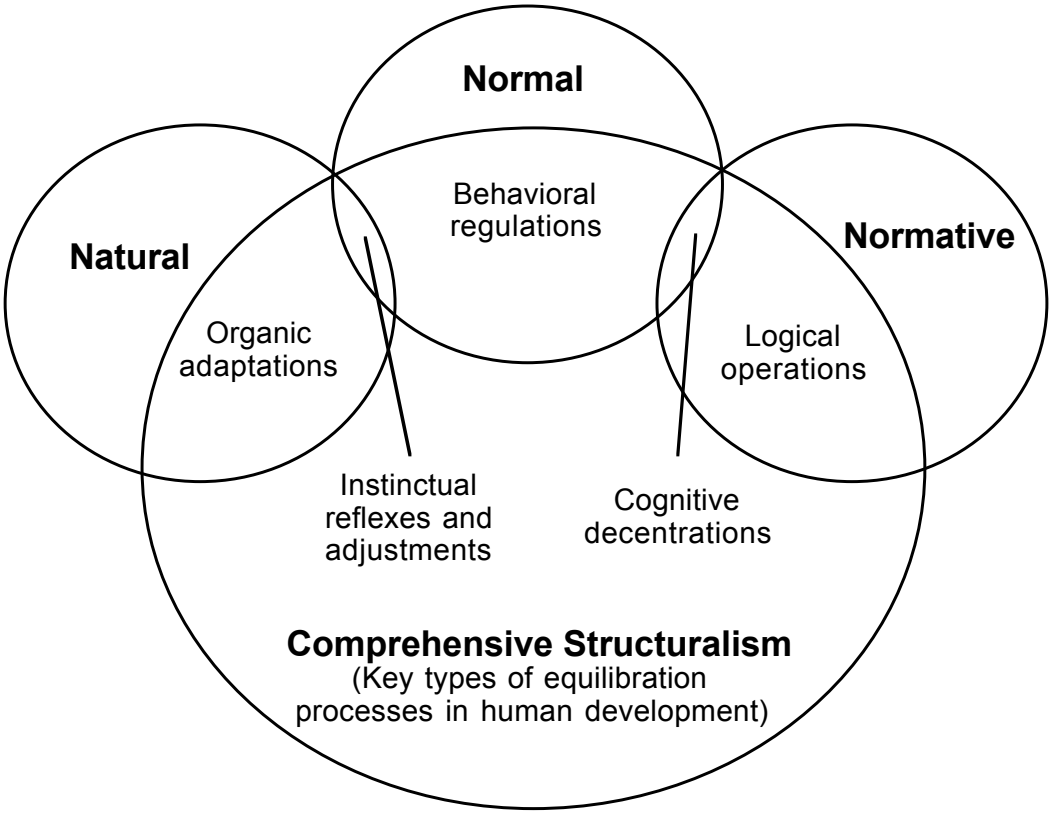

Figure 2: Model of application of explanatory principle of comprehensive structuralism (e.g. equilibration)

The various *equilibration processes* displayed in Figure 2 are a central theme in *Biology and Knowledge* (Piaget, 1971a). This work cashes in on the extended methodological reflections discussed above. Here Piaget carries out an ambitious project of interdisciplinary model building during which he is careful to follow his own advice about how to reconcile the continuity of explanatory approaches with their concomitant categorical divisions. Here I will briefly touch on the set of isomorphic processes sketched in Figure 2. Of course, the devil is in the details I omit. But the success of the arguments offered in *Biology and Knowledge* is not at issue here. My goal is to the highlight the scope and structure of the vision offered. I hope this justifies my broad brushstrokes.

Organic adaptations refer to the dynamics responsible for biological morphology during ontogeny and phylogeny. The main idea here is that the most basic processes of biological evolution can be understood as "dynamic learning processes" governed by the self-organizational responsiveness of the epigenetic system as a whole. Piaget references his own work (and Baldwin's) concerning idea of "organic selection" and the heredity of acquired characteristics. He also leans heavily on Waddington (especially his notion of "genetic assimilation") and work more generally in embryogenesis that moves towards dynamic systems models of very basic epigenetic processes.

Instinctual reflexes and adjustments refer to the structured activities of the organism that aim at self-maintenance while remaining "imminent parts of a structure's functioning" (Ibid, p. 164). He references his own work on instincts and reflexes, ethologists, and psychologist who study things like vision and innate knowledge structures. The key to these explanations are the processes of auto-regulation that enable the refinement of an organism's "instinctual" repertoire of basic responses; a "logic of the organs" that remains tied to (i.e. immanent in) the actual physical organic structure being exercised and maintained.

Behavioral regulations refer to those behavioral processes that begin to "emerge from their imminence in the living organization" (Ibid). With these behaviors we witness the beginning of learning and cognition, properly speaking. The auto-regulation of reliable differential responsiveness gives way to the self-regulation of behavioral responses, which are grasped and consciously exercised, eventually in a quasi-experimental manner. Piaget references comparative work done with animals. He also notes his own work on sensorimotor processes of assimilation and accommodation in very young children prior to the emergence of the semiotic function. In both cases the developmental processes of assimilation and accommodation take center stage.

Cognitive decentrations refer to processes that "reconstruct and extend" behavioral learning processes in terms of operations carried out on representations, enabling learning via the pre-correction of errors through inference and deduction. With the emergence of the semiotic function we face, for the first time, the possibly of explicit rule following and linguistically mediated perspective taking. Normative facts emerge as central with the transition from success to understanding. He references his own work on the development of intelligence and the importance of language and the inter-subjectivity of rule governed judgments and behaviors.

Logical operations refer to behaviors carried out on representations that are characterized by reversibility and universality and accompanied by "claims and feelings of necessity [e.g. entailment]" (Ibid). Here he references philosophical work on the formalization of logical and mathematical systems and his own work on the development of logic and reason. It is important to account for the critical and rule-generating processes that accompany the pursuit of necessary knowledge.

Note that this sweeping account is similar to the various stage models Piaget offered. That is, we are looking at the development of processes of assimilation and accommodation from basic behaviors through abstract reasoning. However, as opposed

to his empirically grounded accounts of psychological development, the overall model offered in *Biology and Knowledge* (and alluded to elsewhere in Piaget's work) also specifies certain processes responsible for biological evolution and morphology. *Equilibration* is thus an explanatory construct that ties the development of human cognition and civilization to the evolution of life itself; what catalyzed it catalyzes us. And so the radical hypothesis of Piaget's youth looms large in his mature vision.

And yet Piaget emphasizes the "isomorphism" between models of equilibration across the different categories. He tempers his unifying thrust with cautions about both *reductionism*, i.e. "the tendency which consists of suppressing the original characteristics of the higher order and reducing them…to the processes of the lower orders" (Piaget, 1971 p. 39), and *projection*, i.e., "the tendency which leads people to project onto the phenomena of inferior orders the characteristics of phenomena of the higher orders" (Ibid, 38). Thus, despite instances where he offers an *ontology* of process and development, he never entirely neglects the reflective engagement with methodological perspectives that framed the categorical distinctions traced above.

In the end, I read his claims about the *isomorphism* of models across different categories as attempts to suggest the existence of certain ubiquitous evolutionary processes, ones best thought of as universal "forms" governing the development of the entire universe. But he never exactly puts his metaphysical cards on the table. Although, I think he does prophesize a single unified discourse fundamentally geared into these primordial developmental processes (Piaget, 1971d). One gets the impressions that Piaget takes the variety of *structuralisms* he inventories in his interdisciplinary reflections as harbingers of some single *structuralism* that would disclose the formal structure of all things. It is this claim that we must jettison if we want to bring his comprehensive developmental structuralism up to date.

Comprehensive developmental structuralism as a kind of methodological pluralism respecting the natural, the normal, and the normative

We have seen the general contours of Piaget's vision. The relevance of this vision remains an open question. Figure 3 offers a very rough sketch of how we can superimpose the broad contours of Piaget's vision to organize current methodological approaches in human development. Once again, please forgive the broad brush-strokes. My goal is to reveal the advantages of framing things in terms of a meta-theoretical orientation of this type. But I suggest some different conclusions about the implications of this classification of methods. As opposed to prophesizing some unified discourse that transcends but includes certain categorical distinctions, I suggest that this meta-theoretical orientation should serve us in facilitating a *problem focused methodological pluralism* (Stein & Fisher, in prep; Dawson, Fischer, & Stein, 2006).

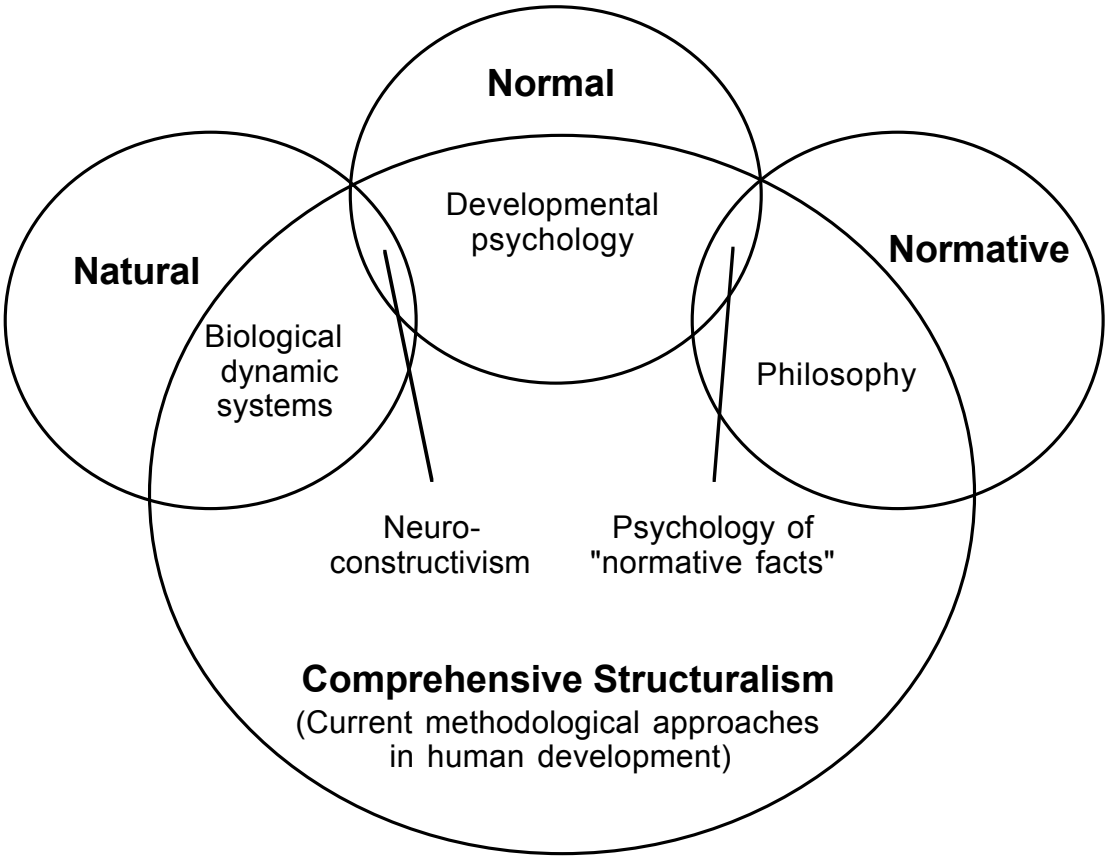

Figure 3: Model of current methods amenable in integration in terms of a comprehensive structuralism.

Figure 3 displays a set of current methodological approaches in the study of human development and organizes them in terms of the key categorical distinctions outlined by Piaget's comprehensive developmental structuralism. This set is not meant to be exhaustive. And this organization is not meant to be unambiguous. Each method is far too rich to be pigeonholed. As we will see below the main purpose of offering such an explicit classification is to make key differences explicit and thus circumscribe the various methods, positioning them in relation to each other in order to foster collaboration and interdisciplinarity.

Biological dynamic systems methods include neural network modeling (Elman, 1993) and dynamical system models (van Geert 1994; Fischer 2006) that explain general developmental trajectories, patterns, and variability in terms of universal patterns and tendencies of biological self-organization. These modeling techniques serve as powerful explanatory tools on a variety of fronts. Since their inception (von Bertalanffy, 1968) dynamic systems approaches have been touted as theories of everything because of their generality. But as Piaget (1971a p47-53) notes, abstract models can be developed irrespective of the *substrate* or *domain of phenomena* to which they refer. So they can seem to account for things they can't. This echoes contemporary concerns about both the biological feasibility of neural network models and the range of psychological behavior they can reasonably be expected to explain. It also reminds us that dynamic systems models of behavior can be devised to fit the data while the real mechanisms are left unspecified. Moreover, in the conclusion we will see that meta-theoretical orientations that appeal to the generality of these kinds of models systematically distort or ignore normative issues (Habermas, 1984; 1987).

Neuro-constructivism refers to a set of methods and models that aim to apply principles of biological development and brain function to the genesis of certain basic capabilities in ontogeny (Mareschal et al, 2007; Karmiloff-Smith, 1993). These

approaches lean heavily on current brain science methods and advances in behavioral genetics to explain both the normal and abnormal development of universal psychological phenomena, e.g. vision, representation, theory of mind, language. Of all the methods organized above these are least amenable to categorization. While these promising approaches look to neural network models and developmental psychology, they bring it all back to a mode of explanation that privileges constructs of a biological nature, e.g. physiological constraints on adaptation, constructive canalization and modularization. The same points about epistemological humility and normative inadequacy offered with respect to dynamic systems approaches can be offered here.

Developmental psychology refers methods for studying the dynamic development of ubiquitous skills and capabilities in terms of manifest performances (Case, 1992; Fischer 2006; Tomasello 1999; 2007). These approaches explicitly supervene on biological ones. Not that they don't take account of the brain and genetics (in fact, Fischer and Case have a great deal to say about these issues). But they grant a certain amount of primacy to developmental methods geared into overt performances and behaviors at various levels of complexity. That is, they take the full range and richness of human behavior as data to be analyzed. Just because it can't be modeled or tied to a biological substrate (yet) doesn't mean it can't be rigorously analyzed in dynamic developmental and structural terms. And so we get various learning sequences and cognitive processes offered to explain and describe the development of a wide range of abilities.

The *psychology of normative facts* refers to approaches that study the development of acts of judgment and reasoning as norm-laden and thus subject to evaluation and epistemic critique (Baldwin, 1906; Piaget, 1972; Kohlberg, 1981). These approaches are related to developmental psychology and philosophy. But what sets these approaches apart is that they deal with the development of normative reasoning in

terms of empirical analysis *and* reflections concerning the norms governing the domain being studied. From moral reasoning to logic and mathematics, the study of the development of normative facts is the study of the emergence of new obligations and norm-laden behaviors as such. Here development entails the progression of autonomous reasoning and of abilities to justify the movement from lesser knowledge to greater knowledge. These developments proceed over and above adaptation via the natural or assimilation to the normal.

Philosophy refers to a wide range of endeavors including developmental epistemology (Smith, 2006b) and critical theory (Habermas, 1984; 1987), which aim to address the normative dimensions of developmental theorizing. This is perhaps the least well specified but most important of the methods categorized above. Roughly speaking, there are a variety of approaches that construe classic philosophical issues in developmental and evolutionary terms. From Peirce and Dewey through Sellars to Habermas it has been repeatedly echoed: "objectivity is a process not a state" (Piaget, 1971a p.64). The same could be said about justice (Habermas, 1990). And so these philosophical approaches serve to supplement the empirical study of natural and normative facts by offering normative philosophical orientations that are developmental and processual.

This sweeping overview of methods only meant as a heuristic. A couple things should be pointed out. The first point concerns the relations between the different methods. I address this below. The second point concerns the unique status of normative issues in the comprehensive developmental structuralism outlined here. This receives separate treatment in the conclusion.

I hope it is clear that questions concerning the "isomorphism" between models across different categories are still relevant in today's theoretical climate. These different methods do offer *similar* models. There is a common emphasis on e.g., the dynamics of

developmental processes, self-regulating structured wholes, and hierarchical integrations. But the strong stance maintained by Piaget that these similarities are all harbingers of some more fundamental explanatory framework does not seem warranted. My reservation here stem from arguments that reach deep into the philosophy of science.

As radical as Piaget's views are on the nature of science and epistemology, I do not think he takes seriously enough the linguistic and pragmatic turns that have reverberated through post-modern philosophical discourse. Following Sellars and Habermas (who like Piaget followed Kant, but unlike Piaget read him in light of Peirce) I think we need to emphasize the further '*decentrations'* that result from viewing scientific methods and models in richly pragmatic and social terms. This view suggests that methods and models be understood in terms of a linguistically mediated *multi-perspectivalism*. Such a notion casts doubts on Piaget's prophesy of *single* explanatory framework subsuming the natural, the normal, and the normative.

But I don't think these doubts entail that we should abandon Piaget's vision of a comprehensive developmental structuralism. Instead, I suggest that we envision it as a very general meta-theoretical orientation, one with the potential to serve a discourse regulative function and to insure quality control at the interdisciplinary level (Stein, 2007). I think that adopting such an orientation would ultimately result in a kind of *problem-focused methodological pluralism* (Stein & Fisher, in prep; Dawson, Fischer, & Stein, 2006) that respects the natural, the normal, and the normative. Thus we move away from an explanation of everything and towards a set of orienting generalizations that might insure comprehensiveness and quality control.[8] Importantly, this meta-theoretical framework, unlike some others (e.g. Overton, 1998) makes room for the normative.

[8] See Wilber (1995; 2006) for a comparable set of orienting generalization and a related type of methodological pluralism.

Conclusion: finding a place of the normative in nature

I have covered quite a bit of ground and made quite a few big claims. We have seen that Piaget's vision of a comprehensive developmental structuralism remained remarkably consistent over the course of his career. As it was progressively refined its most general contours become clear. Developmental processes are ubiquitous. But we must categorize them in terms how we understand them. The natural, the normal, and the normative signify a set of epistemologically deep-seated distinctions that can be used to categorize different types of methodological perspectives. And while Piaget suggested we might hope for the emergence of some new discourse geared into the primordial developmental processes that cut across these perspectives, we are inclined to think otherwise. Skeptical about the possibility of a unified discourse explaining all developmental processes, I suggested that we pursue a certain type of interdisciplinarity. With Piaget's comprehensive meta-theoretical orientation in mind I think we could begin construct more adequate interdisciplinary research programs. The key to this claim is the insight that we must find some way to systematically deal with normative issues in human development (Smith & Voneche, 2006; Wilber, 1999; Habermas 1990; 1984; 1987).

We may need to jettison some of Piaget's speculative claims but we cannot continue to ignore his desire to find a place for the normative in nature. There are a variety of meta-theoretical orientations that lean heavily on dynamic systems models and emphasize the primacy of context and dynamism over mechanistic forms of reductionism (Overton, 1998; Lazlo, 1972; Mareschal et al, 2007). These are great; but they don't deal with the normative. As Habermas (1987) has made clear, the major liability of dynamic systems approaches in the human sciences is their inability to deal

with the full complexity normative issues. And like Piaget, he suggests that this inability is built into the basic methodological perspectives on which they rely.

Understanding an obligation (either epistemic or ethical) entails accounting for both its necessity and its efficacy. The latter may involve causal regularities accompanying socialization, but the former involves concerns about the *validity* of the obligation. Irrational obligations cannot be necessary despite any efficacy resulting from their social currency, while rational obligations are necessary and binding despite social pressure to the contrary. If the only categories we have are the objective ones offered by a system theory, how do we make distinctions between what is and what ought to be? The goal of an equilibration between organism and environment must itself be justified when discussing human development in cultural and social contexts. Post-conventional moral identities are worthy of pursuit but not because they bring persons into an equilibrium with surrounding cultural expectations. The point: if the only discourses we engage in involve only the categories of the natural and the normal we'll never get form *is* to *ought* without committing the naturalistic fallacy.

This fallacy would not haunt interdisciplinary approaches carried out in light of the comprehensive developmental structuralism outlined above.

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