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Abstracts

Stepping Off the Pendulum: Why Only a Thoroughly Action Based Approach Can Fully Transcend the Nativist-Empiricist Epicycles and Ground Mind in the Natural World.

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In the wake of the backlash against the “mad dog” nativism of the 70’s, a number of subsequent proposals have shared (though for different reasons) in their rejection of the nativist-empiricist debate as misguided or altogether incoherent (Elman, et. al. 1996; Thelen & Smith 1994; Karmiloff-Smith, 1992; Overton, 2004; Newcombe, 1999, 2002; Russell, 1999). The notion that both nativism and empiricism are misguided or incoherent is based, in large part, on the fact that all behavior is the result of genes in interaction with their environments (Spelke & Newport, 1998). However, issues concerning whether there are “interactions all the way down” is orthogonal to the possibility of a substantive distinction between nativism and empiricism. The central thesis of this paper is that, in ignoring or dissolving the distinction between nativism and empiricism, researchers have failed to accomplish the shared goal of transcending the limitations inherent to each of their respective positions.

Nativism and empiricism are distinct positions precisely because they disagree on the nature of the interaction between biological and environmental factors; not because they deny that the interaction exists altogether. Nativism and empiricism are opposing positions about the source of knowledge. For the nativist, “the intrinsic structure of the organism determines what structured features of the environment will be transferred within” [p. 12] “forms… preexist … and are forced to materialize under appropriate conditions” [p.13] (Piattelli-Palmarini, 1980). In asking whether an ability is innate, one is asking whether it is independent of learning (Spelke & Newport, 1998). For empiricists, the structure comes from the environment and imprints itself upon us (consider the canonical signet ring imprinting in wax). While contemporary accounts of such imprinting (i.e. transduction) are not as simple, involving processes of abstraction and induction, the function of such processes is still, ultimately, to transfer the structure of the external world into the mind.

While inherently different with respect to their sources of knowledge, both nativism and empiricism share in their commitment to an anti-constructivism; more importantly however, they also share in their commitment to foundationalism (i.e. that knowledge is built up from a foundation). It is precisely this aspect that constitutes the fundamental error concerning our attempts to understand the developing mind. In the context of foundationalism, nativist and empiricist positions can be seen to differ simply with respect to the “richness” of the innate *representational* foundation they presuppose (Fodor, 1981; Cowie, 1999). Empiricists want to presuppose as little initial representational structure as possible in their account of mind (hence the *general* learning mechanisms) while nativists take seriously the principled arguments for why such a paucity of structure is insufficient and propose a much richer set of innate structures for their foundation (Fodor 1975, 1983). Having to *presuppose* copious amounts of structure explains why researchers have an intuitive distaste for nativist positions: it is because they leave too much in need of further explanation.

The standard rejoinder is that evolution is not part of the domain of developmental psychology and so accounting for the presupposed foundations need not concern us (Spelke et al. 1992; Fodor, 1980, 1981). The problem with such a move is twofold: first, a developmental perspective presupposes that our understanding of how knowledge is acquired can importantly influence our assumptions about its ontology. Second, and more important, is that the principled arguments against learnability (Fodor, 1975, 1980, 1981) apply equally to evolution (Bickhard & Campbell, 1987) and as such they constitute arguments against natural emergence altogether. Consequently, if no natural origins are possible, then the ontology must be incorrect. That is, the nature of knowledge must be different than what we assume it to be.

The only alternative to some form of foundationalism has been some sort of action-based approach inspired by Peirce. What made Piaget's third way qualitatively different from all prior foundationalist attempts was precisely his action orientation. Piaget allowed for innate structure but the key move was that this structure was non-representational, and from action alone he attempted to construct the representational mind. Unfortunate misinterpretations of Piaget's account (Chapman, 1988; Lourenco & Muchado, 1996) and the competence-performance corollary of nativist arguments (Chomsky, 1965) united with the yes/no methodology of preferential looking in developmental psychology to "refute" Piaget; and with him, what we take to be his most important insights (an anti-foundationalist action orientation) concerning the origins of knowledge.

In the last 10 years, many of the most influential nativist experiments of the 80's (Baillargeon 1987a, 1987b, 1986; Kelleman & Spelke, 1983) have come under attack (Rivera et al. 1999; Shilling, 1997, Meltzoff, 1998; Kagan, 2002; Bogartz et al. 1998). The general outcome of this attack has been to demonstrate that the original experiments neglected to adequately control for perceptual alternatives. Some of the strongest nativist claims have come from experiments concerning number and math ability (Wynn, 1992, 1995). But again, alternative perceptual interpretations abound (Cohen et al. 2002; Mix, 2002; Wakeley et al. 2000). Simon (1997) points out that while infant looking preferences are consistent with arithmetic operations, that certainly does not necessitate such an interpretation. Reznik (2000) makes a similar point in noting that detection of some category does not constitute an understanding of the conceptual basis for it.

What might explain the lack of perceptual controls from these researchers? Hindsight - no; their design methodology and interpretations were highly motivated by an anti-perceptual, anti-constructivist stance (i.e. their nativism). Experimental outcomes that turn on conceptual features necessarily contain perceptual elements (but not the other way around). Given such co-occurrence of the perceptual with the conceptual, and given a "conceptual" experiment that lacks perceptual controls, conceptual interpretations were always going to be possible (even if looking was in fact driven by perception). In short, their thinking was premised on the presupposition that because an infant is looking at an object, it must be "seeing" it as such. More generally, this anti-constructivist presupposition illustrates a commitment to an underlying naïve empiricist assumption that, whatever the structure of the world, that is the structure to which our knowledge corresponds. The irony, then, of an anti-constructivist nativism is that it motivates a naïve empiricism; however, this precisely begs the question against non-representational constructivist interpretations. So the ultimate problem with the developmental nativist is that their methodology and interpretation of the data presupposes their position.

In sum, Fodor's impossibility arguments turn on issues concerning the inherent anti-emergence stance of foundationalism, and developmental nativists begging the question turn on a naïve empiricist assumption about our epistemic relationship to the world. To conclude the central thesis of this paper, it is the assumptions of foundationalism and an anti-constructivist, naïve empiricism about the world, that must be rejected in order to fully transcend the history of epicycles.

From Parmenides to Persons

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Presents an overview of the Interactivist framework, beginning with the Pre-Socratics and ending with a model of the social ontology of persons.

The Brain Doesn't Work that Way

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Argues that what is known about how the brain functions on a microscale implies an anticipatory-interactivist model.

Internalized Activities

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I will argue in this talk that interactivist processes in humans (and possibly other animals) have a natural tendency to replay internally and cyclically, a typical example being the tunes that run 'in our head' for hours.

The existence of these 'internalized activities' will be shown from simple introspecting experiences, which will also reveal that they occur for all sensory modalities, and from perception to more abstract activities.

This phenomenon accounts for an assimilating behavior 'a la Piaget', with its subsequent properties of accommodation and learning.

When an activity is actually performed by an agent, I argue that a synchronization phenomenon makes previous similar activities run in an internalized way in parallel, and that they help to guide the real activity, providing interactive potentialities in real time. When I make a basketball shoot, previous internalized shoots run at the same time, guiding my current shoot.

Now some of these similar previous activities ended successfully, while others did not. In order to be guided only by successful activities, I argue for the existence of a phenomenon of 'forward thinking', consisting of a fast and rough run of these similar

internalized interactions. Since internalized activities are not enslaved to reality, they can run at any pace, especially faster than in real time, which allow them to anticipate expected future events.

More precisely, a goal such as a successful shoot can be initially present in the agent's mind as an internalized activity, with a well defined beginning and ending, and an undefined gap in between. Achieving the goal consists in filling this gap, and I will show in detail how the synchronization mechanism and the phenomenon of 'forward thinking' can explain it.

These ideas have been applied for the construction of a computer model of how an agent represents the routes he or she knows in a town, how a place to reach is represented by the internalized activity of being there, and how internalized activities of the relevant subroutes coordinate and create in a mobile way a route to the goal.

Physicalism, Emergence, and Downward Causation

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The development of a defensible and fecund notion of emergence has been dogged by a number of threshold issues neatly highlighted in a recent paper by Jaegwon Kim. We argue that physicalist assumptions confuse and vitiate the whole project. In particular, his contention that emergence entails supervenience is contradicted by his own argument that the ‘microstructure’ of an object belongs to the whole object, *not to its constituents*. And his argument against the possibility of downward causation is question-begging and makes false assumptions about causal sufficiency. We argue, on the contrary, for a rejection of the deeply entrenched assumption, shared by physicalist and Cartesians alike, that what basically exists are things (entities, substances). Our best physics tells us that there are no basic particulars, only fields in process. We need an ontology which gives priority to organization, which is inherently relational. Reflection upon the fact that all biological creatures are far-from-equilibrium systems, whose very persistence depend upon their interactions with their environment, reveals incoherence in the notion of an ‘emergence base’.

Challenges for Interactivist-Constructivist Robotics

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The interactivist-constructivist (IC) approach to cognitive systems (Bickhard, 1993; Bickhard and Campbell, 1996; Indurkhya, 1992; Christensen and Hooker, 2000)

offers a sound framework for understanding cognition and representation and for designing genuinely intelligent artificial systems. Motivated either by theoretical considerations, by the problems of classical artificial intelligence and robotics or by biological inspiration, there is now a substantial body of work that is guided by principles similar to the IC ones, directed towards the development of intelligent embodied agents that learn by interacting with the environment. This body of work, mostly accumulated during the last decade, is probably best represented by the biannual International Conferences on the Simulation of Adaptive Behavior (e.g., Meyer and Wilson, 1991; Nolfi et al., 2006). However, we still lack artificial systems capable of representing the world, in the IC sense, or artificial systems that feature genuine, adaptive intelligence. Why it is so? The purpose of this presentation is to pinpoint the factors that still prevent us to build such systems and to give a speculative suggestion on how we can overcome the present impasse.

Towards a Formal Theory of Complex Systems

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We develop concepts from information theory, dynamical systems and stochastic processes in order to formalize and make amenable to quantitative analysis concepts including complexity itself, autonomy, closure, differentiation and others. We thereby hope to lay some foundations for a deeper understanding of autopoietic systems that can reliably maintain their internal processes in a complex, unpredictable, and perhaps even hostile environment on which they depend for energy, raw materials, and information.

An Autonomous Mental Development Architecture Implemented in a Scalable Database System

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In this paper we will present further development of a previously proposed cognitive architecture by adding signal pre-processing and classification and by implementing several parts of it into a scalable and robust distributed database system.

The architecture is tested in an EyeSim simulator, a mobile robot simulator with 3D maze-like environments.

Various cognitive phenomena like expectations, planning, curiosity, analogy-making, self-motivation and attention are encountered by the model. The knowledge about the environment is represented in a pseudo conceptual graph whose parts can be activated at different levels of activation. The nodes of this graph are formed on the basis of the sensory inputs, while the links are formed on the basis of the motor actions. Generally the actor has three main subsystems: a contemplating, a behavioral and an emotional subsystem. The contemplating subsystem is responsible for detecting patterns and for problem-solving, while having little or no influence from the environment. The behavioral subsystem is responsible for the execution of the pre-selected behavioral plans. The emotional subsystem is responsible for generating goals and for judging the relevance of each part of the pseudo conceptual graph all the time, in that way influencing both the contemplating and the behavioral subsystems.

Epistemic Objects as Interactive Loci

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Contemporary process metaphysics has achieved a number of important results, most significantly in accounting for emergence, a problem on which substance metaphysics has foundered since Plato. It also faces trenchant problems of its own, among them the related problems of *boundaries* and *individuation*. Couched in the particular process vocabulary most often found in the interactivist literature, these problems may be described as consequences of the fact that far-from-equilibrium systems have no well-defined spatiotemporal boundaries. They are continuous and dynamic, not *discrete*. They bear little resemblance to *things*, as traditionally conceived, and prospects for reconstructing things, and ontology, within process metaphysics, thus appear highly doubtful.

Historically, the quest for ontology may thus have been largely responsible for the persistence of substance metaphysics. But as Plato was well aware, an ontology of substantial things raises serious, perhaps insurmountable problems for any account of our *epistemic access* to such things. Physical things are subject to *change*, and as such, they are poor objects of knowledge—if knowledge is to be more reliable than mere opinion. The flight to a theory of immutable forms doesn't help matters, as Plato revealed in such dialogues as the *Sophist*, *Theaetetus*, *Parmenides*, and *Cratylus*. Epistemic subjects are themselves mutable, and their knowledge expands. There is thus no way of avoiding the application of temporal predicates to objects of knowledge, insofar as such objects are capable of interaction with epistemic subjects in the first place.

There is a reading of Plato's *Theaetetus* on which knowledge may be understood as a relation between an epistemic subject and a *logos*, where *logoi* are intrinsically *dialectical*, and where *dialectic* is a kind of intersubjective activity. Insofar as this epistemology may be attributed to Plato, the project of this paper is Platonic in spirit. It is also, in a sense, Kantian, in that it divorces ontology from the search for things-in-themselves, redirecting our attention from *things* to *objects*: epistemic objects.

Objecthood, in the sense here at issue, consists in regularities in a given subject's patterns of interactions with its environment. Objects are interactive loci. Before becoming specifically *epistemic* objects, such patterns must become objects-for the given subject. The voting booth is an object-for-me, but not for a chimpanzee. We may, if we wish, speak of a chimpanzee's ignorance of electoral institutions, but such ignorance would be of a totally different order from my human ignorance, should the voting booth, though object-for-me, fail to become a proper *epistemic* object. Different sorts of organisms come to their environments with different sorts of differentiations. Clearly, these lead to different suites of objects. The subject's engagement with objects-for-it is subject to various modes of normativity, many of which have been discussed elsewhere (Mark Bickhard, "Critical Principles: On the Negative Side of Rationality," *New Ideas in Psychology*, 20, 1, 2002). I take it that it is amongst such critical principles that criteria for *knowledge* of epistemic objects—as distinct from the *construction* of such objects in the first place—are to be found.

On an epistemology constructed in this way, the fact that both epistemic objects and their subject are mutable is no obstacle to knowledge. Far-from-equilibrium systems are forever mutable; at thermodynamic equilibrium, there would be neither subject, nor object. Epistemic objects, on this picture, are meta-stable loci of interactive potential.

If epistemology is forced to conform to an ontology constructed in accordance with the demands of substance metaphysics, knowledge is problematic. But what happens to ontology if, instead, we begin with an interactivist epistemology? Taking such an epistemology as given may allow the process metaphysician to account for boundaries and individuation. These would emerge through the interactions between at least two systems, one of which was an epistemic subject. The best evidence I can have for an entity is the reliability of my knowledge of a corresponding object-for-me.

The Role of the Internal Milieu on the Constitution of Different Levels of Agency

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Traditionally the role played by the internal milieu of a living system has been neglected on behavioral and cognitive research. What have become the main focus of research are the interactions between the external environment and the behavior generating mechanisms. With few exceptions recent awareness of the importance of embodiment and physicality has not modified this view. Only the body (understood as a mechanical constraining structure) has been introduced on the mediation between the environment and cognitive mechanism. However, in this presentation we shall argue in favor of a different (complementary) perspective on embodiment dealing with the complex interplay that even the most simple forms of agency show between the internal metabolic milieu, the behavior generating mechanisms and the environment. We will present our argument through the analysis of two very different case studies corresponding to the two extremes. On one side the case of one of the simplest forms of agency (that of bacterial chemotaxis) and, on the other side, the case of the highly sophisticated agency in vertebrates.

As early as in bacterial chemotaxis the internal metabolic milieu plays an important role on the generation and regulation of behavior. Recent studies have shown that what has traditionally been taken as metabolism-independent chemotaxis (since Adler's seminal work in 1969) is severely constrained by internal metabolic factors. Alexandre and Zhulin (2001) have shown that several signal transduction mechanism link chemotactic signal transduction pathways to the internal milieu of the cell (in particular to electron transport pathways) so that chemotactic behavior becomes modulated by internal metabolic and energy requirements (in much more intricate ways that what could have been imagined before).

On the opposite extreme, the much more complex and elaborated cognitive behaviors of highly evolved vertebrates cannot be understood without taking into account complex interactive processes between the sensori-motor neural system and the internal milieu. To deal with the intricate relationship between internal organismic functions and sensori-motor interactions the, so-called, *nervous system of the interior* (NSI, namely the autonomic nervous system + the limbic system) has evolved. This is due to the fact that as the complexity of the organization of the body increases its metabolism's homeostatic regulation starts to require a fine tuned neural control. The NSI assumes the dynamic control and coordination of internal organs and systems (the circulatory system, digestion, breathing, etc.). Interestingly, this dynamics play a regulatory control over specifically cognitive agency, which is maintained by the sensori-motor nervous system (SMNS). Thus, the NSI inherits some of the, evolutionarily speaking, "older" evaluative functions of the body by regulating the sensori-motor processes when interactions with the environment produce some relevant effect on the organism's survival and maintenance.

However, the NSI does something more: it evaluates not only the effect of behavior on the maintenance of the body but acts regulating neural activity *for the self-maintenance of neural organization itself* (Barandiaran & Moreno 2006). Thus, behavioral interactive processes appear highly intertwined with bio-regulatory organization. In fact, one of the major roles of emotional dynamics is precisely the modulation of SMNS dynamics for global reinforcement and coherency: attention (amplification of sensory stimuli in order to satisfy a certain goal), stress (generation of global microinstabilities for dynamic rearrangement), satisfaction (reinforcement of the dynamic structure whose produced behavior satisfies a global stability condition) and, in general, shaping the neural dynamics in the direction of the global organization that has been created through the history of the organism. The interaction between the NSI and the SMNS becomes, thus, of fundamental importance for neural and behavioral organization to the extent that the adaptive regulatory capacity of the NSI over the SMNS will be recruited by the later for a high level self-regulation. This way the body and the NSI act as a source of values for the global organization of the SMNS: this relation is exemplified by the role played by the so-called "somatic markers" in higher-level cognition (Damasio 1994, Bechara 2004). This is what Damasio calls *feelings based on secondary emotions* (Damasio 1994) or *core consciousness* (Damasio 1999).

As we have argued, at the specifically cognitive level, neural agency is achieved through the interactive control of the "internal milieu", namely, the body's homeostatic regulatory dynamics. Thus the body (which includes now the INS as an essential bio-regulatory mechanism) becomes an integrated part of the interactive organization. Any approach to the study of behavioral agents needs to take into account not only the embodied interactive processes that lead to cognition but also the intricate interplay that such embodied interactions establish with the internal landscape of metabolic functions that cognition is embedded on; from simple bacteria to complex vertebrates.

References

Alexandre, G. & Zhulin, I. B. (2001) More Than One Way To Sense Chemicals *Journal of Bacteriology* 183(16): 4681–4686.

Adler J. (1969) Chemoreceptors in bacteria. *Science* 166:1588–1597

Barandiaran, X. and Moreno, A. (2006) On what makes certain dynamical systems cognitive. *Adaptive Behavior* 14(2),171—185.

Bechara, (2004) The role of emotion in decision-making: Evidence from neurological patients with orbitofrontal damage. *Brain and Cognition*, 55:30–40.

Damasio, A. (1994) *Descartes' Error. Emotion, Reason and the Human Brain*. Putnam's Sons, New York.

Damasio, A. (1999) *The Feeling of What Happens: Body, Emotion and the Making of Consciousness.* Heinemann, London.

Why Distinguish Action from Motion in Defining Perceptual Invariants?

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Ecological and sensorimotor theories of perception build on the notion of *action-dependent invariants* as the basic structures that underlie perceptual capacities. In this paper we contrast the assumptions these theories make on the nature of perceptual information modulated by action. By focusing on the question, *how motion specifies perceptual invariants*, we show that ecological and sensorimotor theories endorse substantially different views about the role of action in perception. In particular we argue that ecological invariants are characterized with reference to transformations produced in the sensory array by motion: such invariants are transformation-specific but do not imply motor-specificity. In contrast, sensorimotor theories assume that perceptual invariants are intrinsically tied to specific motor schemes and we suggest how this difference leads to different empirical predictions. We submit that the distinction between *motor-equivalence* and *motor-specificity* is an issue that needs to be clarified both conceptually and empirically in order to provide a thorough understanding of the links between action and perception.

Interactivism within a Learning Situation

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The aim is to introduce various level of interactivism within teaching/learning processes and organizations. Each level of interactivism influences the relationship between the learner and the final "object" to be acquired (the future activity the person will be able to do).

We hypothesize that this final "object", as a didactic objective, does not exist "per se" and depends on the specificity of every individual. We will try to show that the relationship S/O will be differently influenced depending on the particularity of the various level of interactivism.

Interactivism defines a permanent search for equilibrium during the S/O exchanges. This implies regulations during and through which the subjects changes his representations of the environment. The S/O exchanges are more complicate to analyse than using the only pair of elements composed by the "S" and the "O", and the context plays an active role in this. In this paper, we will consider a specific context: a teaching/learning organization.

Supporting Attention with Dynamic User Models

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As networked technologies provide users with increasing access to information and people anywhere, anytime, the need for systems that are capable of supporting users in their choices of cognitive resources allocation has been increasingly recognized (McCrickard, Czerwinski, & Bartram, 2003; Roda & Thomas, 2006b; Vertegaal, 2003). The design of systems capable of adapting to the needs of individual users, that are operating in specific context, and under certain constraints is attracting significant interest both in industry and academy. In particular, research work in *attention aware systems*, i.e. systems that support users in their attentional choices (Roda & Thomas, 2006a), promises to address many of the problems related to information overload, cyber collaboration, and mobility, by providing features helping users in coping with attentional limitations. Such features may include intelligent notification and management of interruptions, support to task resumption and multitasking, and awareness mechanisms for collaborative attention allocation. In general attention aware systems may require a complete rethinking of the metaphors underlying interfaces conceptualization (Roda, Stojanov, & Clauzel, 2006) and of the way we design systems as a whole (see for example the ubiquitous computing (Weiser & Brown, 1996) or ambient intelligence (Kunz, October 2001) literature). At the conceptualization level, attention aware systems will require a much better understanding of how human attentional processes work, and how they might be supported.

Towards a Computational Model for Aesthetics: A Multi-Agent-Based Approach to Modeling Balance

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Aesthetics is a complex human perceptual and cognitive phenomenon that has eluded a proper scientific explanation to date. Over the years, various philosophers, neurobiologists, cognitive scientists, artists and computer scientists have attempted to understand aesthetics and proposed their own theories. Immanuel Kant in his Critique of Judgment claimed that we take pleasure in something because we judge it beautiful, rather than judging it beautiful because we find it pleasurable. He further argued that beauty is not an objective property, but a product of the mind's interaction with the object [8]. David Hume equated beauty with sentiment that exists merely in the mind [9]. David Birkhoff's measure of Order versus Complexity [15], Max Bense's Information Aesthetics[8] and Leewenberg's theory based on patterns and repetitions [16] are some of the very early mathematical theories. Recent theories by V S Ramachandran [10] and Semir Zeki [14] attempt to find a neurobiological explanation based on the structure of our brain. With the advancement in technology, people like Harold Cohen are also working on creating artificial art robots like AARON [3]. At the same time, computers are entering the field of aesthetics creating much debate and discussion [4, 5]. However, none of these theories provide a fully satisfactory account of aesthetics.

Aesthetics of visual art involves various parameters like color schemas, warm/cool colors, gestalt principles of closure, similarity, proximity, alignment and continuance, borders etc. that influence our perception and effect the degree of pleasure obtained[7]. It has been argued that certain principles like peak shift, balance, symmetry, metaphor, contrast extraction and rule of generic views have an universal appeal[10]. To be able come up with a mathematical model of aesthetics it is necessary to understand each of the above principles. With this broader goal in mind, we focus on the principle of Balance in this paper.

On the Plausibility of Encodingist Representations

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In this paper I survey the prospects of the language of thought program to supply a theory of the internal vehicle of thought. According to the LOT picture, thinking is a matter of the manipulation of mental symbols, according to rules. After briefly exploring the nature of the rules, and their relationship to cognitive science, I call attention to the fact that very little constructive work has been done on the nature of a symbol. I then explore the different theories of symbol natures, and show that the only theory of symbol natures that is available to the proponent of LOT (and the related Classical Computational Theory of Mind) is one in which symbols are not shared, from person to person. This is a view which the proponent of LOT, and CTM, would find appalling. I then argue that the result does not ruin the prospects for LOT, although it calls for important refinements to LOT and CTM.

Interactivism and Cartesian Subjectivity

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Subjectivity is a veritable puzzle for naturalism. It seems hopelessly out of place in a world of objective facts, which, allegedly, is the only domain of inquiry open for legitimate investigation by empirical science. In this paper, I contend that the difficulty is, in no small part, a function of an overly Cartesian view regarding subjective phenomena and their relations to the rest of nature. On the Cartesian approach, subjectivity is understood as necessitating phenomenal consciousness, whereas all non-conscious phenomena are considered strictly objective. I argue that by alienating subjectivity from the rest of nature the Cartesian view leads to insurmountable difficulties. Interactivism proposes a radical alternative to the Cartesian view, an alternative that may be described as neo-Aristotelian in that, like Aristotle, it associates selfhood not with consciousness per se, but rather, with the broader and more basic organic capacity for autonomous conduct. By contrast with the dichotomous view presupposed by the Cartesian approach, the interactive alternative is inherently gradualist and, as such, it offers a much more promising prospect for integrating subjectivity within the realm of nature.

Emergence of Higher Order Motivational Systems in Artificial Agents

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With the advent of developmental (epigenetic) robotics we are witnessing an increased interest in motivational subsystems for autonomous agents and especially in the notion of curiosity.

This is not surprising as this community is particularly interested in agents that, during their development, exhibit ever more complex behavior via the much sought after *autonomous* and *open-ended learning*. Sometimes this type of learning is also referred to as *task-independent* or *task non-specific*.

In Stojanov and Kulakov (2006) we have given an overview of the approaches to building systems capable of (various degrees of) open-ended learning via introduction of some sort of *curiosity*. The overall impression is that the prevailing understanding of curiosity is rather one dimensional and reductionist in spirit: when the curiosity drive

(usually a parameter with a value between 0 and 1) is high, the agent would do some action just to learn its consequences. In the same paper, we argued that this was a result of rather simple agent's representations of the environment that were usually adopted.

In this paper, we want to argue that curiosity cannot be treated as a simple driving force which only pushes the agent to do something (rather than nothing), but rather as an elaborated mechanism which is inseparable from the internal knowledge representation. Curiosity and other higher level emotions are closely related to the agent's *value system*. Furthermore, higher order value systems need socially embedded agents and cannot emerge in isolated, one of a kind agent. Higher-order value systems require shareable, language-like knowledge representation.

In Stojanov et al (2006) we give an overview of research in AI and intelligent robotics adopting implicitly or explicitly the interactivist framework. Most (if not all) of these examples deal with rather simple, interaction based, representations and typically the autonomous agent tries to solve a variation of the navigational problem. We argue that there is a good reason for this situation as this type of *procedural knowledge* is easier to model within the process-based framework.

Of Robots and Functions

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Interactivism holds that representation and cognition are emergent properties of far-from-equilibrium systems. This has the surprising implication that robots such as are being constructed by Rodney Brooks and others are, in fact, the wrong way to go about in trying to work towards artificial intelligence for the reason that they are not far-from-equilibrium systems. The unintuitive nature of this claim – an artificial thinking being made of wires and steel seems if anything more readily imaginable than one made from something approaching flesh – suggests that investigating the issue will lead to valuable insights. However, roboticists would like to side-step the seemingly conceptual issue by claiming that in their work they only aim to create models – the question of whether the robots do engage in something like cognition or only look like they do being beyond the scope of their work.

If this distinction were defensible three basic possibilities would seem to exist:

1) Robots can not satisfactorily model the cognitive behaviour of certain far-from-equilibrium systems
2) Robots can satisfactorily model cognitive behaviour but without function and representation
3) Robots can have (non-derivative) function and representation

Clearly, if **3** is correct then interactivism is false – luckily for it, though, at the current level of development in robotics there seems precious little evidence for **3**. On the other hand, were **1** shown to be correct, interactivism would be provided with a certain amount of empirical support – the question in that case being what it might be that robots are actually incapable of. The situation with **2** is not as clear cut as with the other two options. The basic problem is that which led Turing to suggest a purely behaviourist basis for determining whether one is dealing with an intelligent being. If one was faced with the existence of a stainless steel being capable of hosting a successful cocktail party, suggesting novel scientific experiments and writing the weekly sports column, as well as of the full range of other human activities – to give an extreme example – it would seem to be mean-spirited to deny that its utterances mean anything, when we are happy to accept the utterances of far less adept humans. And, if the view were indeed correct then one would be forced to the conclusion that function and representation are not actually all that important.

In effect, it seems reasonable to conclude that the distinction suggested by roboticists, while obviously justified in limited contexts, fails to properly side-step the big issue – to the degree that robots turn out to be able to model significant elements of cognitive behaviour the interactivist model becomes less attractive regardless of whether they are *just* modelling or not.

One of the strengths of the interactivist account is that on it functions are causally efficacious. However, the discussion at hand suggests two possible ways in which they might be causally efficacious:

- **A**) Functions play a causal role in maintaining far-from-equilibrium systems
- **B**) Functions are actually necessary for cognition (or something that looks like it)

A is not in question in the current context. Regardless of what robots turn out to be capable of, functions (in the sense given by interactivism) will be significant to the maintenance of far-from-equilibrium stability. However, that is not where the interest in functions really comes in – it is only because functions are seen as a requisite for cognition (i.e. **B**) that they as interesting as they are, and this is precisely the issue in question in the current context. It seems that **B** will only be the case if it turns out that **1** is correct while both **2** and **3** would entail **A**.

Given the embryonic stage of development of robotics, the question becomes – What sorts of behaviour would robots not be capable of if the interactivist approach is correct? This question is as relevant to the theoretical pursuit of interactivism as to the practical pursuit of robotics, despite roboticist claims to the contrary.

Bickhard has suggested that the difference will ultimately lie in how robots explore their domains of interaction in that a far-from-equilibrium system's explorations are directed by its normative stake in the success of those interactions. While this response seems intuitively correct, it obviously doesn't constitute more than a suggestion for empirical research given that it relies upon interactivist assumptions.

Understanding Mental State Lexemes: An Interactivist Alternative to Theory of Mind

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My own academic background is, in part, in the field of linguistics, with a particular interest in functional theories of language and its ontogenesis that focus on language as a form of social action and interaction (e.g. Halliday 1993). I am interested in the development of a theory of language and related analytical practice that assumes an interactivist perspective as foundational to the study of language and which rejects the encoding view of representation (see Bickhard and Campbell 1992: 401-407). I am also interested in the cognitive and cultural dynamics of language as a distributed phenomenon that connects body, brain and world (Thibault 2005a, 2005b). In the proposed paper, I would like to develop an interactivist and distributed alternative to the prevalent view that mental state verbs such as *know*, *think*, *believe*, *want*, *intend*, and so on explicitly label and encode inner mental states and contents and that the use of these terms helps to scaffold the child's emerging Theory of Mind (ToM). One could easily object to the crude and inadequate pre-Saussurean view of language as a nomenclature for labeling objects of various kinds that this kind of thinking about language represents.

However, my main concern will be with the ways in which the encoding view of the mental state verbs presumes that the way we get to know others' minds is through a process of analogical simulation whereby first persons project their own 'inner' mental contents onto others. On that basis, they are then able to infer inner mental experience in others through observation of the external (public) behaviour of others and the concomitant semantic extension of the mental state vocabulary to the inner life of the other through a process of inferential deduction.

Mental process verbs are accordingly construed in terms of the familiar philosophical problem of access to one's own and others' minds. The problem is an age-old one: if we lack direct access to the inner mental life of others, how can we know what they are thinking, feeling, desiring and so on? The issue is very often polarized around a choice between extensions of the mental process verbs to be 'inner' mental states or the 'outer' behaviour of others as the basis of learning the vocabulary of mental life. This has the consequence that our understandings of these linguistic terms are ambivalent when applied to first person and third person instances. These appear to have different meanings in the two cases – direct access to one's own inner mental states versus interpretative inference based on the outwardly observable behavioural signs of others – even though we tend to think that such mental concepts apply to and mean the same for everyone.

A number of psychologist and linguists accordingly treat mental process verbs or mental state lexemes as the encoding of inner mental states (e.g. Gopnik and Meltzoff 1997; Olson 1988; Plaut and Karmiloff Smith 1993 and De Villiers and De Villiers 2000). This way of considering mental process verbs and their extensions considers the encoded mental contents of these linguistic items to be "objects" in some sense. This view in turn leads psychologists and linguists of this persuasion to postulate further that these verbs refer to real experience that reside inside the individual's mind and have independent causal effects. In such a view, mental process verbs pick out mental objects with determinable characteristics. Moreover, mental process verbs like *know*, *think*, *believe*, *remember*, *want*, *desire*, and many others have the property of encoding or representing referring an inner experience that we are conscious *of*. Mental concepts and predicates are therefore framed in terms of ostensive definitions that refer to objects of some kind. This way of thinking quickly leads to the idea that such objects must be located somewhere. Such views give rise to familiar dichotomies such as 'inner' versus 'outer' experience.

Nomological Emergence vs. Functional Reductionism in Dynamical Cognitive Science

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It is often claimed that that the dynamical approach to cognitive science, in both its philosophical and empirical manifestations, is importantly related to the doctrine of emergentism about the mind. Tim van Gelder, for example, writes:

> "From a broadly dynamical perspective, cognition is seen as the emergent outcome of the ongoing interaction of sets of coupled quantitative variables rather than as sequential discrete transformations from one data structure to another."1

Jeff Elman makes a slightly stronger claim -- that the dynamical approach will *explain* emergentism -- thus:

> "The dynamical systems approach is also concerned with interaction and emergentism; more generally it can be viewed as a *mathematical framework for understanding* the sort of emergentism and the high-order interactions which are found in both connectionist and artificial life models."2

Such an approach is, I think, an intuitively plausible and laudable contrast with "classical" approaches to cognitive science. However, the precise nature of this claim is problematic -- in particular, it's not clear what conception of emergence is at stake, and so we still face the task of elucidating what kinds of philosophical implications follow from dynamical cognitive science. This paper is an attempt to make some headway on this issue.

Firstly, certain conceptions of emergence are ruled out by the explanatory practices of dynamicists. At the Interactivist Summer Institute in 2003, I argued that the kind of explanation found in, and sought by, dynamical cognitive science is a kind of covering law explanation. This presents a problem since covering law explanations require a deducibility relation between explanans and explanandum, whereas most theories of emergence require the *absence* of such deducibility.

In this paper, I argue that the relation between dynamical cognitive science and emergentism about the mind might be saved by reconstruing the concept of emergence. Following C.D. Broad,3 I suggest that we could develop an understanding of emergence in terms of the relationship between *laws*. Such “nomological emergence” would amount to the claim that the dynamical laws of cognition were not reducible to (i.e., deducible from) the laws of physics or physiology, but that *given* a dynamical law of cognition, we might still be able to deduce (or predict) cognitive behaviours of the system in question. This conception of emergence would, at the very least, be compatible with the explanatory practices of dynamical cognitive science, and would therefore be one way of preserving the intuition that the dynamical approach is related to emergentism.

Is this a kind of emergentism that dynamical cognitive scientists actually *want*? In fact, it seems that some claims made by dynamical cognitive scientists might fit better with the kind of functional reductionism that has recently been discussed extensively.4 Theorists such as Kelso, and Thelen and Smith point out that, if successful, the dynamical approach to cognitive can provide a kind of “unification” of different levels of explanation. Kelso, for example, writes:

> “My aim here was to join together neural processes at one end of the scale and mental or cognitive processes at the other, in a common language. This is the language of dynamic patterns, not the neuron per se. But more than a language, shared principles of self-organisation provide the linkage across levels of neural and cognitive function.”5

This view, ultimately, has more in common with functional *reductionism*, than with any particular conception of *emergence*. Does this mean that, contrary to the widespread intuition I outlined above, dynamical cognitive science is really reductionistic?

Taken together, these different options constitute a dilemma as to which kind of position on the mind-body problem dynamical cognitive scientists ought to prefer; should they adopt an emergentist account that is at least consistent with their explanatory practices, or should they continue to pursue a functional reductionist program? The solution to this dilemma remains an open empirical question pending the development of a more robust or developed dynamical cognitive science, and it's one which I hope that those working within the interactivist framework might help to resolve. To put this in the terms of dynamical systems theory itself, we presently stand at a bifurcation point, but my hope is that (a) this paper will at least show us the shape of the attractors ahead, and (b) interactivist studies could help us determine which of the attractors is stronger.

1 van Gelder, T. (1999) “Revisiting the Dynamical Hypothesis” Preprint No. 2/99, University of Melbourne, Department of Philosophy. p.12. Available at http://www.arts.unimelb.edu.au/~tgelder/papers/Brazil.pdf

2 Elman (1998) "Connectionism, Artificial Life, and Dynamical Systems" in W. Bechtel and G. Graham *A Companion to Cognitive Science* (Oxford: Blackwell), p.504. My emphasis.

3 e.g., Broad, C.D. (1925) *Mind and Its Place in Nature* (London: Kegan Paul)

4 e.g., Kim, J. (1997) "Explanation, Prediction and Reduction in Emergentism" *Intellectica* 25(2):45-57 and Khalidi, M.A. (2005) "Against Functional Reductionism in Cognitive Science" *International Studies in the Philosophy of Science* 19(3):319-333.

5 Kelso, J.A.S. (1995) *Dynamic Patterns: The Self-Organisation of Brain and Behavior* (Cambridge, MA: MIT Press), p.289.