ADDING DELEUZE TO THE MIX

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FINAL DRAFT: 8 JULY 2010
Phenomenology and the Cognitive Sciences 9.3 (September 2010): 417-436.
Please cite only the published version.
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INTRODUCTION

Although there are many significant differences in the 4EA approach to cognitive science ("embodied-embedded-extended-enactive-affective"), there is also a family resemblance in philosophical and scientific resources. Among the most prominent common reference points are: in mathematical modeling, dynamical systems theory; in biology, an enactive stance, often coupled with a positive attitude toward Developmental Systems Theory; in psychology, Gibsonian ecological psychology; and in philosophy, phenomenology.

We can see some core elements of this family resemblance in a programmatic statement early in Michael Wheeler's 2005 work, *Reconstructing the Cognitive World*. Wheeler names his project "embodied-embedded cognitive science," which he opposes to "orthodox cognitive science" on four points: 1) that online intelligence, composed of "a suite of fluid and flexible real-time adaptive responses to incoming sensory stimuli" (12), is primary with regard to offline intelligence, which, as "detached theoretical reflection" (142), is "representation-hungry" (213-14), as in Wheeler's examples: "wondering what the weather's like in Paris now or weighing the pros and cons of a move to another city" (12); 2) that online intelligence is "generated through complex causal interactions in an extended brain-body-environment system" (12); 3) that embodied-embedded cognitive science displays an "increased level of biological sensitivity" (13); 4) that embodied-embedded cognitive science requires a dynamical systems perspective (13-14).

However, insofar as it is a family resemblance, each work in the 4EA field need not have all elements. Anthony Chemero's *Radical Embodied Cognitive Science* (2009), for example, brings dynamical systems theory and Gibsonian ecological psychology closely together (28, 83), but has barely a word on phenomenology, while Hubert Dreyfus's works were marked for many years by explicit and sustained reference to Heidegger and Merleau-Ponty, yet have only very recently included a discussion of Walter Freeman's dynamical system neuroscience (Dreyfus 2007). Nonetheless, in quite a few key works dynamical systems theory, biology, and phenomenology are all present, albeit with different emphases in the latter field: Andy Clark's *Being There* (1997) and Alva Noë's *Action in Perception* (2004) refer favorably, although mostly in passing, to Merleau-Ponty, whereas Wheeler 2005 and Evan Thompson's *Mind in Life* (2007) are heavily based on Heidegger and Husserl respectively.

In this article I will suggest ways in which adding the French philosopher Gilles Deleuze to the mix can complement and extend the 4EA use of these core resources. But *why* add Deleuze to the mix? Is it worth the trouble? There's no gainsaying the complexity of Deleuze's thought or the strangeness of his terminology. But I hope to show that the benefits of adding

Deleuze to the mix outweigh the costs. In the first part of the paper, I will show how the Deleuzean tri-partite ontological difference (virtual / intensive / actual) can provide an explicit ontology for dynamical systems theory. The second part will take these ontological notions and apply them to three areas of concern to the 4EA approaches: (a) the Deleuzean concept of the virtual will clarify the ontological status of perceptual capacity as sensorimotor skill; (b) the Deleuzean concept of "intensive individuation" will clarify the ontological status of the genesis of perceptually guided behavior; (c) the Deleuzean critique of the confusion of the actual and the virtual will enable us to intervene in the realism / idealism debate.[1] These three aspects will not be addressed sequentially, but will be interwoven into an unfolding argument.

The prime focus for us will be the ontological difference between a capacity and the exercise of that capacity. Briefly stated, Deleuze enables us to move beyond two standard concepts of capacity: that of a self-identical or fully individuated possible awaiting realization, and that of a self-identical or fully individuated potential teleologically oriented to its actualization. In place of these concepts, Deleuze proposes that a fully differentiated virtual field does not resemble that which is creatively actualized from it via an intensive process of morphogenesis. Thus an individuated perception does not resemble the distributed and differential brain-body-world system, when that is conceived at the level of a virtual web of linked rates of change of neural, somatic, and environmental processes. Keeping this in mind, we will show how confusing the virtual structure of an intensive process (perception) with the actual properties of products (the represented world and the representing subject) will maroon us in the sterile realism / idealism debate.

The structure of the paper will thus involve a move to the abstract in order to reach the proper level of concretion. That is to say, we will have to move to the abstract ontology of dynamical systems in order to reach the concrete being of perceptual process as the exercise of sensorimotor skill, which in turn enables us to criticize the abstractions of the realism / idealism debate. Thus Deleuze's focus on intensive individuation as concrete perceptual process will be shown to be consonant with a deep principle of the 4EA approach – a drive to concretion enabling a concomitant critique of the abstract. The standard 4EA critique of orthodox cognitive science is that the latter falsely takes representational thought as basic rather than derived: "the historical mistake of orthodox cognitive science has been its enthusiasm for extending its distinctive models and principles beyond the borders of offline intelligence, and into the biologically prior realms of online intelligence" (Wheeler 2005, 247). Andy Clark echoes the critique of theoretical intelligence as derived but illegitimately seeing itself as primary: "a new vision of the nature of biological cognition: a vision that puts explicit data storage and logical manipulation in its place as, at most, a secondary adjunct to the kinds of dynamics and complex response loops that couple real brains, bodies, and environments" (Clark 1997; 1-2). These critiques follow the general lines of the classical phenomenological critique of purely rational-representational theorizing as abstracting from its concrete practical ground and breaking free to posit itself as self-sufficient so that it pretends to ground that which in fact grounds it (Heidegger 1996; Merleau-Ponty 1962). Now it is certainly true that many within the classical phenomenology camp would object to Wheeler's use of the term "biologically prior" to characterize the concrete level, but this objection would not bother holders of the "deep continuity" thesis of the "mind in life" position, which builds on Jonas in particular to extend "lived experience" to all organisms (Wheeler 1997; Thompson 2007, 15; 157-162).

With the turn to the standard 4EA definition of cognition as the direction of action of an organism in its environment, we see that the phenomenological drive to concretion finds its home in 4EA cognitive science as a critique of functionalism, which came under fire for proposing a goal of constructing a cognitive architecture so abstract that it could license the treatment of concrete biology as mere "implementation details." The 4EA drive to concretion requires rather than we look for "biologically plausible images of mind and cognition" (Clark 1997, xvii; see also Wheeler 2005, 13 and Thompson 2007, 5).[2] Considered as a response to computationalism, the allegedly more biologically adept connectionist paradigm is also criticized as abstract; for example, Wheeler's insistence on the way neurotransmitters produce modulations of neural firing patterns affecting a "volume" of processing structure, as opposed to the point-to-point binary logic of artificial neural nets, enables him to criticize connectionism as abstracting from the relevant biological details (Wheeler 2005, 13; 262-63).

However, as we will see, it is precisely the move to the abstract ontology of dynamical systems that enables us to see the biological details that matter. What we will see is that individuated perceptually guided sensorimotor behavior is the actualization of a virtual, differential potential. This move across the ontological difference of virtual and actual has the structure of an integration of differential relations (that is, linked rates of change) among coordinated neuro-somatic-environmental networks.

AN ONTOLOGY FOR DYNAMICAL SYSTEMS THEORY

Since the early 1990s there have been a number of works (among others, Massumi 1992; DeLanda 2002; Bell 2006) that claim that Deleuze's philosophy can help us thematize the abstract ontological structures underlying the vast array of phenomena modeled by dynamic systems methods. Although this link of Deleuze and dynamical systems theory runs contrary to a widely held belief that identifies the mainstream of twentieth-century French thought with an anti-realist suspicion of science and a commitment to the "end of metaphysics" or "end of philosophy,"[3] Deleuze in fact sees himself as providing a metaphysics of contemporary science. In a very clear self-description, Deleuze says "I feel myself to be a pure metaphysician. . . . Bergson says that modern science hasn't found its metaphysics, the metaphysics it would need. It is this metaphysics that interests me" (Villani 1999: 130).

The central claim here is that Deleuze offers a wide-ranging naturalist ontology that maps well onto current research projects that use nonlinear dynamic systems modeling.[4] The scientific fields using these techniques are now wide-spread, from geomorphology and meteorology in the earth sciences to ecology and genomics in the life sciences, economics and sociology in the social sciences, and neurodynamics and developmental biomechanics in the cognitive sciences. In areas relevant to the 4EA approach, Deleuze's ontology can help us think the mode of being of the distributed and differential brain-body-world system of 4EA cognition; it also helps us think individuation in such systems, such as the genesis of an organismic behavior guided by sensori-motor perception, as the integration or resolution of that distributed and differential system.[5] I will give extended examples in a bit. But before then, we should recall that dynamical systems theory shows the topological features of manifolds (the distribution of singularities) affecting a series of trajectories in a phase space. It thereby reveals the patterns (shown by attractors in the models), thresholds (bifurcators in the models), and the necessary intensity of triggers (events that move systems to a threshold activating a pattern) of material systems at

many different spatial-organizational and temporal-processual scales. Insofar as it can also model the transformation of behavior patterns (not just a switch between pre-existing patterns) by tracking changes in the attractor / bifurcator layout, dynamical systems theory enables us to think material systems in terms of their powers of immanent self-organization and creative transformation.

I will reconstruct Deleuze's ontology using the terms of *Difference and Repetition* (hereafter DR).[6] In DR, Deleuze seeks a poststructuralist reformulation of Kant: an account of the transcendental conditions of experience while still respecting the strictures of a "philosophy of difference" that insists that individuated entities (a person, a hurricane, a perception) are produced by the actualization of a virtual field (or integration of a differential field, or resolution of a problematic field -- the three expressions are synonymous for Deleuze [1994, 211]).[7] The philosophy of difference counters many forms of what we might call "identitarian" philosophy, from Plato and Aristotle to Kant and Hegel and others, in which identities are metaphysically primary and differences are seen within a horizon of identity. With regard to Kantian transcendental philosophy, Deleuze attempts to replace the Kantian project of providing the universal and necessary conditions for any rational experience with an account of the genesis of "real experience" (170), the "lived reality [*réalité vécue*] of a sub-representative domain" (1968, 95; 1994, 69).

Since Deleuze criticizes Kant's "tracing" operation whereby the latter grounded empirical identities in transcendental ones (e.g., the Transcendental Unity of Apperception provides the ground for the unity of empirical psychological life), he demands a purely differential transcendental field. Taking his clue from Bergson, Deleuze names the ontological register of such a purely differential transcendental field "virtual" (Deleuze 1991, 95; 1994, 207). In DR, then, we find a tripartite ontological scheme, positing three interdependent registers: the virtual, the intensive, and the actual.[8] Deleuze's basic notion is thus a tri-partite "ontological difference": in all realms of being (1) intensive morphogenetic processes follow the structures inherent in (2) differential virtual multiplicities to produce (3) localized and individuated actual substances with extensive properties and differenciated qualities.[9] Simply put, the actualization of the virtual, that is, the production of the actual things of the world, proceeds by way of intensive processes. In a fuller picture of Deleuze's ontology, we see that the virtual field is composed of "Ideas" or "multiplicities," which are constituted by the progressive determination of differential elements, differential relations, and singularities; what are related are precisely intensive processes, thought as linked rates of change (Deleuze 1994, 182-191).[10] Beneath the actual (any one state of a system), we find "impersonal individuations" or intensive morphogenetic processes that produce system states and beneath these we find "pre-individual singularities" (that is, the key elements in virtual fields, marking system thresholds that structure the intensive morphogenetic processes). We thus have to distinguish the intense "impersonal" field of individuation and its processes from the virtual "pre-individual" field of differential relations and singularities that make up an Idea or multiplicity.

The term "Idea" should not be seen in a Platonic sense. So let's pause to clarify that the Deleuzean virtual is non-Platonic, in two senses. First, it is not wholly separated from the actual. Rather, intensive processes "counter-effectuate" the virtual: there is a two-way traffic between virtual and intensive, such that the interaction of intensive processes changes the virtual conditions for future processes.[11] An example here would be a Deleuzean understanding of niche-construction: the actual activities of organisms change the selection pressures for future

generations. The ecological web of relations that we describe as "selection pressures" is not ghostly, it is perfectly real, but for Deleuze, it does not have the same ontological status as that of a single individuated act (a predator devouring a prey animal, for instance). Rather, the web is virtual, that is, composed of differential elements, relations, and singularities that are progressively determined so that at critical points in the relation of population changes we can find an event such as a population explosion, or in the opposite direction, an extinction. Second, the Deleuzean virtual realm is not composed of self-identical essences. Ideas are not sets of necessary and sufficient conditions for membership in a group and they are not then instantiated by particulars. Rather, Ideas are "differentiated" as zones of intensity in a "space" of continuous variation. As such, they are "perplicated" or interwoven, and they blend into each other at their edges in what Deleuze calls "zones of shadow" (1994, 187; see DeLanda 2002, 22).

A simple example of the distinction between essential difference and virtual differentiation would be that of tropical cyclones: the nominal definition distinguishing a hurricane from a tropical storm is sustained wind speeds of more than 74 miles per hour. But this is not reflective of any real distinction; it does not map onto physical turning points in storm formation, but has only to do with the properties of already formed storms. For Deleuze, there is instead the Idea of tropical cyclones, but this is a continuous variation in which the "sub-Idea" of "thunderstorm cells" blends into that of "tropical depression" and that in turn into "tropical storm" and "hurricane." Continuous variation and perplication of Ideas does not deny that there are singularities or turning points in intensive processes leading to actual products. There are indeed singularities involved in the morphogenesis of tropical cyclones, but they have to do with temperature and pressure differences among wind and water currents triggering updrafts, eyewall formation, and so on, none of which refer to the sustained wind speed. The latter is a matter of classification by property of an already formed system. Deleuze, by contrast, is interested in the structure of the morphogenetic process leading to tropical cyclones. The question, "which singular points formed this eyewall?" is a morphogenetic question posed in the virtual register, whereas "what wind speed distinguishes a hurricane from a tropical storm?" is a merely classificatory question posed in the actual register.[12]

A more complex example of perplication comes from biology. Deleuze indicates three dimensions of continuous variation among Ideas; along one of those dimensions he will offer the example of "the varieties of animal ordered from the point of view of unity of composition" (1994, 187). That is, all animals share a unity of composition in the sense of being all composed of elements of nucleic acids and amino acids which enter into differential relations determining gene formation and expression and protein synthesis. There is thus an Idea of "animal" which is expressed in different actualizations of those relations and their singular points. Furthermore, the Idea of "animal" is distinguished from that of "plant" not by sharp essential distinctions but by changes in these differential relations, just as the Idea of one species is distinguished from another by changes in differential relations rather than essential definitions. (I suspect Deleuze would have been delighted by the discovery of the conserved homeobox genes studied in evo-devo, whose function is precisely to regulate the differential relations of gene expression and protein synthesis, slowing some down [at the limit, preventing them together] and speeding others up.) For Deleuze, it is not that essential definitions are impossible; it is just that they occur in a different ontological register from that which interests him. Essential definitions belong to the actual register, or the level of properties of formed substances, while Deleuze wants to reach

the virtual register, that is, the level of the structures of the intensive processes productive of such actual substances.[13]

Some concrete examples will help us see how this ontology enables us to understand natural processes in multiple registers: physical, meteorological, and social. Deleuze himself often used Gilbert Simondon's (1995) theory of individuation as a very simple model for "actualization." For Simondon, crystallization is a paradigm of individuation: a supersaturated solution is "metastable" and from that pre-individuated field – which is "differential" in the sense of being replete with gradients of density that do not contain small crystals, but only "implicit forms" or "potential functions" – crystals are individuated via a process of precipitation. The reason crystallization is only a crude image of other individuation processes is that crystals form in homogenous, albeit differential, solutions, while the Deleuzean virtual is composed of Ideas, that is, it involves differential relations among heterogeneous components whose rates of change are connected with each other (Toscano 2006). For an example of such heterogeneity, let us return to hurricane formation, where it is intuitively clear that there is no central command, but a self-organization of multiple processes of air and water movement propelled by temperature and pressure differences. All hurricanes form when intensive processes of wind and ocean currents reach singular points. These singular points, however, are not unique to any one hurricane, but are virtual for each actual hurricane, just as the boiling point of water is virtual for each actual pot of tea on the stove. In other words, all hurricanes share the same structure, and that structure (the Carnot cycle) also underlies any heat engine (DeLanda 1997). Finally, in a still more complex social example, Deleuze will interpret Foucault's notion of "discipline" as an "abstract machine" (another name for Idea or multiplicity) which allows for the control of any human population. The differential relations here are linkages among rates of change of spatial position, coded movements, complex individual training exercises, and teamwork exercises (Foucault 1977, 167-169). But this abstract machine (which Foucault and Deleuze will call a "diagram") is incarnated in many different concrete social "assemblages," such as schools, barracks, hospitals, factories, prisons and so on (Deleuze and Guattari 1987, 530-31 n. 39).

Translated into standard terminology, then, Deleuze will say that Ideas or multiplicities or abstract machines are multiply realizable, but he insists that the underlying structure is virtual or fully differential, that it does not "resemble" the many different concrete systems that actualize it. Using the terminology of Putnam's classic "The Nature of Mental States," we can say that functionalism falls prey to Deleuze's resemblance objection since the "Total State" of a system "resembles" its realizations by being fully individuated. Putnam writes: "A Description of S where S is a system, is any true statement to the effect that S possesses distinct states S1, S2, . . . Sn, which are related to one another and to the motor outputs and sensory inputs by the transition probabilities given in such-and-such a Machine Table. The Machine Table mentioned in the Description will then be called the Functional Organization of S relative to that Description, and the Si such that S is in state Si, at a given time will be called the Total State of S (at the time) relative to that Description" (Putnam 1975, 434).[14] Thus the mental state that can be multiply realized is fully specified or individuated as the "Total State" of the system. It is an individuated pain state (to use Putnam's example), whether it is realized in wetware or hardware, in terrestrial carbon-based life or in some other material. But for Deleuze, an Idea or multiplicity or abstract machine is not individuated, but is fully differential. In this way, the disciplinary Idea, for example, as fully differential or virtual, contains only the relations and singularities into which a human population to be controlled is put. There is nothing prison-like in the disciplinary Idea:

what is put into relation are unspecified populations and unspecified tasks. Thus the elements of the disciplinary Idea are just members of an unspecified population, not prisoners or workers or soldiers or students (these are the components of concrete assemblages), and the relations are merely those of corporeal distance, succession of exercises, precision of movement, degree of obedience to command, and so on, not those of, say, a close-order rifle drill (an example drawn from the concrete military assemblage). The disciplinary Idea can just as well be actualized in a school as in a prison, though (most likely, one hopes) at a different degree of intensity of control.

Let us take up the use of dynamical systems methods in neurodynamics as an area relevant to 4EA concerns, one in which Deleuze's concepts can help us with the ontology involved. Neurodynamics shows the brain as generating coherent wave patterns out of a chaotic background. During any one living act (perception, imagination, memory, action) the brain functions via the "collapse of chaos," that is, the formation of a "resonant cell assembly" or coherent wave pattern (Varela et al. 2001). Walter Freeman offers a dynamic systems account of the neurological basis of intentional behavior (Freeman 2000a and 2000b), while Alicia Juarrero uses dynamic systems to intervene in philosophical debates about decisions and intentional action (Juarrero 1999). The basic notion in their accounts is that nervous system activity is a dynamic system with massive internal feedback phenomena, thus constituting an "autonomous" and hence "sense-making" system in Varela's terminology, when it is seen as embodied and embedded. That is, sense-making is the direction of action of an organism in its world; in organisms with brains, then the object of study when it comes to sense-making is the brain-body-environment system (Thompson and Varela 2001; Chemero 2009). Sense-making proceeds along three lines: sensibility as openness to the environment, signification as valuing, and direction as orientation of action. The neurological correlates of sense-making show neural firing patterns, blending sensory input with internal system messages, as emerging from a chaotic background in which subliminal patterns "compete" with each other for dominance.[15] Once it has emerged victorious from this chaotic competition and established itself, what Varela 1995 calls a "resonant cell assembly" (RCA) forms a determinate pattern of brain activity that can be modeled as a basin of attraction.

Following the Freeman line of neurodynamical thought, supplemented by the embodied-embedded perspective, in navigating the world, a person continually forms intentions, that is, leans towards things in outreaching behavior, as the brain-body-world system settles into patterns. Once in a pattern, the system constrains the path of future behaviors, as long as the behavior guided by the resonant cell assembly lasts. (Some intentions entail long strings of firing patterns, yielding coherent complex behavior, as in the intention to play a game of basketball.) Sensory input (changes in body correlated with changes in the world) continually feeds into the system along the way, either reinforcing the settling into a pattern, or shocking the brain out of a pattern into a chaotic zone in which other patterns strive to determine the behavior of the organism. The neurological correlate of a decision is precisely the brain's falling into one pattern or another, a falling that is modeled as the settling into a basin of attraction that will constrain neural firing in a pattern. There is no linear causal chain of input, processing, and output. Instead there is continually looping as sensory information feeds into an ongoing dynamic system, altering or reinforcing pattern formation; in model terms, the trajectory of the system weaves its way in and out of a continually changing attractor landscape whose layout depends upon the recent and remote past of the nervous system.

Continuing with the perspective of somatically and environmentally supplemented neurodynamics, we make the link with Deleuze by seeing the neuro-somatic-environmental system as an Idea, multiplicity or pre-individual virtual field: 1) a set of differential elements (reciprocally determined functions – in other words, neural functions are networked: i.e., they emerge from global brain activity and hence cannot be understood in isolation – and neither can global brain activity be understood in isolation from its somatic and environmental relations); 2) with differential relations (linked rates of change of neural firing patterns as they mesh with rates of change in body, world, and body-world interaction); 3) marked by singularities (as critical points determining turning points between patterns of relations among brain, body, and world).[16] The dynamics of the system as it unrolls in time are intensive processes or impersonal individuations. That is to say, behavior patterns emerge at a singularity or threshold in the differential relations; this coalescing of a behavior pattern is modeled by the fall into a particular basin of attraction from the attractor layout "proposed" by system dynamics. Over time, the repetition of a number of such actualizations provides a temporary structure to the Idea, a virtually available response repertoire, a set of capacities, for the person. With regard to any one actualized behavior pattern, the repertoire is virtual, and any one decision is an actualization, a selection from the repertoire. But "virtually available" cannot mean that the behavior patterns are individuated before their triggering. To respect Deleuze's ontological difference, we must say that before their triggering, behavior patterns are nothing, that is, the Idea or virtual field from which they emerge does not have the same ontological status as an actual pattern. Furthermore, due to counter-effectuation, we cannot say that the repertoire is fixed: the temporary structure of the Idea, the attractor layout, changes as the result of the intensive individuation processes we call "experience."[17]

THE IDEA OF PERCEPTUAL POWER, THE INTENSIVE INDIVIDUATION OF PERCEPTIONS, AND THE REALISM / IDEALISM DEBATE

The notion of perceptual capacity as a response repertoire or set of capacities is a key point at which the addition of Deleuze's philosophy to the core 4EA resources pays off, for the ontological status of "virtual" is needed to understand the mode of being of capacities that are not actually at work. That is, we need to see perceptual ability as an Idea in Deleuze's sense. In this way, there are two classical concepts that relate a capacity to its exercise that Deleuze enables us to overcome, that of possibility awaiting realization and that of teleologically oriented potentiality.

First, then, for our Deleuzean view, capacities for action do not pre-exist their actualization as a self-identical possibility merely awaiting the addition of existence: there is no "grandmother cell" or single neuron – or even single pre-existing network of cells – fully formed and merely awaiting activation. The Deleuzean ontological difference is not that of a possible awaiting realization, but that of a virtual awaiting actualization; the virtual is composed of potentials, not possibles.[18] Second, however, the virtual helps us understand potentiality, not as self-present and simply awaiting actualization, but as a fully differentiated neuro-somatic-environmental web whose actualization proceeds by an individuation or integration of that differential field. The Deleuzean notion of a virtual potential is thus non-Aristotelian. For Aristotle, potentials are always oriented toward their telos in actuality. They are understood simply as non-actual, as that which can become actual, as in the canonical definition of capacity

[*hexis*] at *De Anima* 2.1.412a22-26: "the soul is an actuality like knowledge … possessed but not employed." So in the famous triad, we have the ability to learn; the state of having learned; and the exercise of that which has been learned. Potentiality is oriented to form or self-presence; as Aristotle puts it elsewhere: "matter exists in a potential state, just because it may attain to its form; and when it exists *actually*, then it is in its form" (*Metaphysics* 8.8.1050a15; emphasis in the Princeton edition [Barnes 1984]). The virtual, however, Deleuze never tires of reminding us, does not resemble its actualization; there is nothing identical in its being; it is fully differential.

An example from a thinker close to the 4EA approach, Jesse Prinz, will help us see what is at stake here.[19] The ontological status of a repertoire as virtual potential can be brought to bear on Prinz's treatment of the wide-spread notion of "disposition":

> In saying that sentiments are dispositions, I don't mean to imply that they are not real, physically implemented states of the mind. As I will use the term, a psychological disposition is a standing state of the organism that can manifest itself as an occurrent state. The standing / occurrent distinction is commonly used in philosophy. In psychological jargon, psychological dispositions can usually be identified with encodings in long-term memory that can be retrieved by working memory and maintained there during explicit mental processing. In neurocomputational terms, dispositions are usually identified with weighted connections between neurons that can activate the assemblies of neurons that they connect. All these ways of talking capture the basic idea that dispositions are internal states that do not always participate in information-processing, but can become active contributors under the right circumstances. A sentiment is a disposition whose occurrent manifestations (or working memory encodings, or neural activation patterns) are emotions. (Prinz 2007, 84)

With our Deleuzean lens, we can see that the standing versus occurrent scheme echoes the potential versus actual scheme, but we need not see the "standing state" or "disposition" as a self-identical state, that is, as a possible awaiting realization, or as a teleologically oriented potential awaiting actualization. Rather, we can follow Deleuze in seeing the move from disposition to occurrent manifestation as happening "under the right circumstances," that is, as an emergence from a dynamic differential field at a threshold, or a singular point in linked rates of change of neural firing patterns as they intersect changes in the body-world components of the entire neuro-somatic-environmental system. The singular point is set by the history of the system. The key is to think dispositions as virtual and the move to their occurrence as actualization / integration / resolution of a differential field. The "encoding" referenced by Prinz thus cannot be seen as a localized and present neural "trace" but as the construction of a singularity in a differential relation (linked rates of change of firing patterns) serving as the threshold for individuation and hence actualization.

A practical example complements the above passage and also provides us a contrast with the Aristotelian notion of a self-identical potential to attain a capacity: learning to swim for Deleuze is "conjugating" the distinctive points of our bodies with singularities of the Idea of the sea in order to form a problematic field, a distributed and differential system of brain, body, and environment. And any one exercise of swimming is then a resolution of that problematic field, an individuation that does not resemble the virtual field, but is a creative actualization of it: "this conjugation determines for us a threshold of consciousness at which our real acts are adjusted to our perceptions of the real relations, thereby providing a solution to the problem" (Deleuze 1994, 165).[20] Note that "consciousness" here should be thought as "sentience" rather than full-blown

reflective self-consciousness. Deleuze agrees to a form of the "mind in life" thesis when he says that "larval subjects" are co-extensive with cellular life, but the adjective "larval" here shows that he does not mean such subjects are a fully reflective self-conscious subject (1994, 70-79).

Let us now turn to perception, or more precisely, the relation of acts of perception to perceptual capacity. For Deleuze, that relation is an "intensive individuation," which can be modeled as the integration of a (virtual) differential field. To see this, note that in DR Deleuze interprets the Leibnizian Idea of the sea as a system of differential relations and singularities, showing how Leibniz helps us think conscious perception as emergent from a differential field of tiny unconscious perceptions: the micro-sounds of the waves coalescing into the murmur of the ocean (Deleuze 1994, 253; see also Deleuze 1993, 85-100). This coalescence of microperceptions at the threshold of consciousness is explicitly linked by Deleuze to the notion of integration. The important thing for us is that the threshold that determines conscious perception is not a persistent identity, a stable property of a substantial organism, but a capacity grounded in a differential field of sensori-motor processes. To see this, we can follow another of Deleuze's main references on perception, Bergson, who writes in *Matter and Memory*: "the truth is that perception is no more in the sensory centers than in the motor centers; it measures the complexity of their relations" (Bergson 1991, 46). So we see Bergson defining perception as the measurement of the complexity of the relations of sensation and movement.

This is precisely the formula given by Alva Noë in his *Action in Perception* (2004). Noë writes, "The basis of perception, on our enactive, sensori-motor approach, is implicit practical knowledge of the ways movement gives rise to changes in stimulation" (8). Thus, failures of perception are due to a "breakdown in our mastery or control over the ways sensory stimulation changes as a function of movement" (10). Noë goes on to contrast his equation of "implicit practical knowledge" with "mastery or control" with Kant's famous line, "intuitions without concepts are blind" (11). As we know, Kant's theory of perceptual experience is a hylomorphic process in which formless intuitions are the material input to a production process; they are given form from transcendent sources, first by space and time as forms of outer and inner intuition, then by schematized concepts of the understanding. By contrast, Noë's formulation is that what completes intuition is "knowledge of the sensorimotor significance of those intuitions." This "knowledge" is not linguaform or conceptual, but is "sensorimotor bodily skill" (11). Deleuze would agree here, and the latter's notion of virtual can help us understand the ontological status of perceptual capacity as sensorimotor skill. Our perceptual capacity or sensorimotor skill is the ability to modulate the relation of the two processes of movement and sensation. As we recall, Deleuze suggests the term "virtual" for these sorts of purely differential structures. Perceptual capacity is a skill that enables us to navigate the differential elements, relations, and singularities involved in the linkage of movement and sensation. Perceptual capacity is an Idea in the Deleuzean sense.

In Deleuze's terms, then, perceptual capacity is "virtual," which is precisely the term Noë uses. So a comparison of the uses of this term in Deleuze and Noë is now in order. Discussing the thesis that our "impression" of the "presence and richness of the visual world is an illusion," Noë writes "all the detail is present, but it is only present virtually, for example, in the way that a web site's content is present on your desktop" (Noë 2004, 49-50). He continues: "To experience detail virtually, you don't *need* to have all the detail in your head. All you need is quick and easy access to the relevant detail when you need it" (50; emphasis in original). So here "virtual" means "accessible." Now if to be "present virtually" means that the detail is already formed, but

just not in the field of vision, then this doesn't fit with Deleuze. But I don't think that is what Noë means, despite his use of the example of "a website's content [that] is present on your desktop" (50). Rather, to be virtually present *to* an organism means the perceptual detail is not yet formed, but *could be* formed, by the proper manipulation of the relation between movement and sensation. The detail is potential, not possible. But it is not a pre-formed (Aristotelian) potential teleologically oriented to its actualization. The dative is the important clue here to our interpretation of a virtual differential potential. Perceptual detail is that which is virtually available to an organism, as that which could be formed in the concrete perceptual process, versus that which is formed "in itself" and just waiting there to enter the field of vision.

With the notion of virtual perceptual detail, a Deleuzean and phenomenologically informed enactive cognitive science faces the classical questions of realism and idealism. On our Deleuzean-inflected 4EA approach, the worldly component of virtually available perceptual detail is not realist (the world is outside us, pre-formed, and we capture a picture of it and hold that picture in our heads) or idealist (the world in itself is chaotic or unknowable, so the world we experience is formed in our heads). And the visual component is neither realist (vision is a camera that will capture the pre-existent information once it swings into view), nor idealist (vision creates the detail by hylomorphically informing a chaotic manifold). With Deleuze's conceptual resources added to the mix, we can say that the realism / idealism debate is based on a confusion of virtual and actual. It assumes that either the world is actual and merely awaiting capture, or that our subjectivity is actual and merely awaiting raw material on which to operate with either empirical or transcendental faculties – Humean associationist regularities of human nature or the Kantian transcendental machinery. For Deleuze, the finished products, the actual world and the actual subject, are both abstractions from the concrete intensive process of experience as it integrates the virtual / differential neuro-somatic-environmental web; as we will see in a few paragraphs when we discuss the concept of affordances, the actual world and actual subject are abstractions in the sense of being limit cases of completion for always ongoing processes.

For both Deleuze and phenomenology, then, experience is not based in the outside or the inside. Rather, experience is in the middle, in the concrete process whose limits can be abstracted from the process and reified as actual world or actual subject. Let us first follow the phenomenological path, as it informs Noë's argument that locates experience in the middle, between subject and object. Noë writes:

> If the content of experience is virtual, in this way, then there is *a sense* in which the content of experience is not in the head. Nor is it in the world. Experience isn't something that happens in us. It is something we do; it is a temporally extended process of skillful probing. The world makes itself available to our reach. The experience comprises mind and world. Experience has content only thanks to the established dynamics of interaction between perceiver and world. (215-216; emphasis in original)

Our argument that a Deleuzean interpretation of the virtual status of perceptual capacity helps inform 4EA approaches gains valuable support when Noë argues against splitting experience into "an occurrent and a merely potential or dispositional aspect" (215). The potential or dispositional, as we have argued above in discussing Prinz, is not pre-formed, self-identical and merely awaiting realization. That Aristotelian schema is rejected by Noë, who claims that any candidate for what can become "occurrent" is itself "virtual all the way in," so that "experience is fractal and dense" (216). We might use a Deleuzean distinction at this point: the virtual detail

does not "exist," but "insists," so that it "is" only as that which could be actualized out of its differential condition (Deleuze 1990, 81).

This distinction reminds us that we do not just have perceptual capacity as a (virtual) skill, we also have the concrete perceptual process, which for Deleuze would be an "intensive individuation" which integrates a differential field, that is, a set of linked rates of change of movement and sensation. This notion of intensity as the passage across the virtual / actual ontological difference shows us how Deleuze agrees with the phenomenological critique of realism and idealism. For Deleuze, both realism and idealism are flawed because they take one side of an opposition of finished products, a fully formed world or a fully formed subject. To avoid this, we have to move to "the genesis of real experience" (Deleuze 1994, 69) as integration of a differential field, that is, as individuation leading the actualization of the virtual. Now for Deleuze, individuation in perception is just as much morphogenesis, that is, bringing into form, as is hurricane formation, But perceptual morphogenesis is not hylomorphic: we are not imposing form on formless sensory matter. Rather, we are guiding the implicit forms of "sensorimotor contingencies," as Noë puts it in his enactive take on Gibsonian "affordance," (Noë 2004, 105). An affordance is in the middle, a relation of organism and environment; it is not freestanding, but needs to be completed by an organism (Thompson 2007, 247).

Turning to the more complete discussion of affordances in Chemero 2009 will help us understand what is at stake here for a Deleuzean contribution to the 4EA approach. Chemero offers us a recap of what he calls "Affordances 1.1" (Chemero 2009, 200) in three claims: 1) "affordances are what we perceive; they are the content of experience"; 2) "affordances are relations between what animals can do and features of the environment"; 3) "the perception of affordances is also a relation; it is a relation between an animal and an affordance."[21] Chemero continues with Affordances 2.0, a dynamical theory of affordances (150-154). In developing Affordance 2.0, we are directed to start with Affordances 1.1, "then consider the interaction over time between an animal's sensorimotor abilities, and its niche, that is, the set of affordances available to it." Chemero specifies two time scales here. First, we have the developmental time scale, in which an "animal's sensorimotor abilities select its niche – the animal will become selectively sensitive to information relevant to the things it is able to do." Secondly, we have the behavioral time scale, in which "the animal's sensorimotor abilities manifest themselves in embodied action that causes changes in the layout of available affordances, and these affordances will change the way abilities are exercised in action…. Affordances and abilities causally interact in real time and are causally dependent on one another" (151).

We can give a Deleuzean reading to Chemero's notion of affordances by identifying the differential relation here. Start with the elements: affordance (Af) is the relation of animal ability (AA) to feature of environment (FE), while perception (P) is the relation of animal ability (AA) to affordance (Af). Thus the perception of an affordance (P of Af) is a relation (perception relates animal to affordance) to a relation (affordance relates animal ability to feature of environment). So, P of Af = P of AA / FE. Dynamically speaking, however, perception is constantly changing (we are always faced with a Δ P, and our sensory apparatus is that which finds the instantaneous rate of change of that change, the acceleration or deceleration). Similarly, an affordance is the link of the rate of change of what an animal can do (Δ AA) and the rate of change of features of the environment (Δ FE). So, dynamically speaking, the perception of affordance (P of Af) is the relation between the rate of change of what an animal perceives (Δ P) to the linked rates of change of animal ability and features of the environment (Δ AA / Δ FE). In

a formula, P of Af = Δ P / (Δ AA / Δ FE). In Deleuzean terms, perception is composed of differential relations and singularities; perception is an Idea. If dynamic processes are the concrete level of sensorimotor perceptually guided behavior, then the terms of Affordances 1.1 (perception, affordance, animal ability, and feature of the environment) are abstractions, limit cases of freezing and reifying ongoing processes. This is why Chemero's dynamic Affordances 2.0 account is so helpful. And following this line of thought, "feature of the environment" has to be something that changes at the appropriate rate for an interaction (DeLanda 2002, 90-91). For affordances to take place, there has to be a match between time scales of animal and environment.[22] For example, sports daring and imagination can be seen as the meshing of time scales: is this rapidly closing opening between two defenders an affordance for a shot given the acceleration I might attain? You don't calculate this; you feel it as a potential you might actualize. You feel your potentials based on your history of trying similar attempts. So differentiation and integration are here practical exercises that give their results as feelings; they are not calculations that give their results as consciously accessible numerically formed probabilities. We will see how this notion of affective and practical handling of linked rates of change pays off in our final paragraphs.

But before then, with this Deleuzean take on Affordances 2.0 we can offer two supplementary comments to Chemero's account. First, when Chemero writes that "the animal's sensorimotor abilities manifest themselves in embodied action" this must be changed to read that actions "actualize the virtual ability." We know that an action has a different ontological status from an ability. But what moves us across that ontological difference between an ability and the exercise of that ability, that is, an action? It cannot just be "manifestation" because that makes abilities into pre-existing individuated entities awaiting discovery, perhaps at most into possibilities awaiting the addition of existence. Rather, the move from ability to action has to be actualization as individuation in the integration of a virtual differential field. Second, the notion that embodied action can change the layout of affordances has to be read as counter-effectuation, as the intensive changing the virtual conditions for future actualization. It cannot be that affordances and abilities causally interact: affordances are relations as are abilities, and relations cannot causally interact. What can causally interact (in sense of efficient causality) are individuated beings and acts: only the act of climbing a tree, not the unactualized ability to climb, can knock some bark off of it or strain a muscle. It is only these individuated actions that can change the web of relations structuring the intensive processes that integrate differential fields and produce action.

To take up the question of realism where we left it in our discussion of Noë, we can say that different organisms connect with different affordances even when they are based on the "same" thing. So for Deleuze, the "thing in itself" is scattered or dispersed across a virtual field of potential affordances, whose multiple actualizations depend on the relation made with a individual organism. But for all that, for all his critique of the standard picture given in the realism / idealism debate, Deleuze is not an anti-realist (a major point of emphasis for DeLanda 2002). It is just that he is a realist about Ideas, not about things in themselves (with all the appropriate caveats we gave above as to Deleuze's non-Platonic notion of Ideas). As he puts it in DR, "problematic Ideas are precisely the ultimate elements of nature" (Deleuze 1994, 165). So the interesting sense of realism for Deleuze is that the world has structure, but that structure is the structure of multiply realizable processes, not the structure of fully individuated things which result from those processes. This Deleuzean take can be connected to Noë's notion of enactive

phenomenology: the world has some structure, but it is not fully pre-formed. The world needs to be met half-way. Phenomenology is the study of the way the world reveals itself in the middle between subject and thing; it is not introspection into the picture-creating activity of an idealist subject, nor is it introspection into the camera-like abilities of a realist representing subject. The Deleuzean notion of concrete perceptual process also operates in the middle: it is the perceiving organism that integrates the differential relations of movement and sensation and thereby individuates its perceptual objects.

To reinforce our claim that Deleuze's ontology of dynamic systems allows us to reach the concrete level of biological perception, let us look at two recent biology works, Howard Berg's *E. Coli in Motion* (2004) and Dennis Bray's Wetware (2009), in particular their account of E. Coli perception as differentiation- integration. Berg and Bray stress the temporality of perception for their objects of study. Bray stresses the retentive aspect of *E. coli*, who "continually reassess their situation" by means of "a sort of *short-term memory*" (Bray 2009: 7; emphasis in original). Such "bacterial memory" can be tested by exposing them to a step change in the concentration of an attractant: "Now it is clear that what the bugs respond to is not the concentration of aspartate per se but its rate of change" (94). Bray interprets these results in terms that cannot fail to draw our attention: "But once aspartate has settled down to a steady concentration, the bug no longer responds. Biologists call this adaptation, but a mathematician examining the time course of response would call it differentiation. By measuring the rate of change in the signal, the receptor cluster has in effect performed calculus!" (94). In other words, the bacterium has repeated its measurement of aspartate and drawn a difference from that repetition: it has performed a differentiation.

Bray deals with retention. But the living present of perception is a synthesis of retention and protention (Deleuze 1994, 70-79). Berg's work on temporal synthesis reveals the protention aspect. Berg first clearly shows retention as one aspect of the passive synthesis of the living present: "to correct its course, the cell must deal with the recent past, not the distant past" (Berg 2004: 57). But then we see that the living present is serial, that it draws a difference from a repetition; Berg writes that "to determine whether the concentration is going up or down, the cell has to make two such measurements and take the difference" (57). Berg shows that this perceptual synthesis is temporal rather than spatial; describing the results of a key experiment, he writes: "the response to the positive temporal gradient was large enough to account for the results obtained in spatial gradients" (36). So the cell repeats its sampling procedure (it analyzes the environment, breaking it down to identify the concentration of molecules of interest) and then synthesizes the two results. What we see here in this perceptual synthesis is differentiation (calculation of the instantaneous rate of change of a gradient) and integration (calculating the trajectory of the change by combining the results of previous differentiations).

Even in E. Coli, then, we have sense-making in the living present: retention (of past differentiations) and protention (the integrated trajectory as indicating the future course of the organism). Commenting on Leibniz, Deleuze confirms our analysis of his theory of perception: "differential calculus is the psychic mechanism of perception" (Deleuze 1993, 90), so that "the tiniest of all animals has glimmers that cause it to recognize its food, its enemies …" (92). But here we must do some interpretive work if we are to make this aspect of Deleuze relevant to 4EA cognition approaches. We must demur from the literal sense of Deleuze's remarks about differential calculus as the mechanism of perception. Differential calculus has indeed been a paradigm for computationalist models of vision (a classic example being Johansson 1976). But

for the 4EA approach, much or even most cognition is not brain-bound information processing. It is instead the direction of action of an organism in world. The important thing then is the practical, embodied and embedded, handling of instantaneous rates of change of changes, accelerations and decelerations. Andy Clark cites studies of baseball players who handle a decelerating fly ball not by computation but by running so that the angle of vision to target does not change (Clark 1999, 346; citing McBeath et al, 1995). The trick is to maintain the coordination of changes in the organism with changes in the environment. This practical coordination of linked rates of change has to be the sense of "integration" for an enactive Deleuzianism. Let us recall the notion of a "conjugation of singularities" between our bodies and the Idea of water from Deleuze's analysis of swimming from DR: "our real acts are adjusted to our perceptions of the real relations, thereby providing a solution to the problem" (Deleuze 1994, 165). It is this practical, embodied and embedded, "conjugation" of singularities that provides the individuation which leads the actualization of the virtual capacity for successful engagement with the environment, the exercise of our sensorimotor perceptual capacities.[23]

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NOTES

[1] The latest 4EA work to tackle the realism / idealism debate is Chemero 2009, which contains a fine overview of the issue (183-205).

[2] Despite the general trend described here, how precisely to define cognition within this general framework, and the exact nature of which biological details are necessary for cognition – or even if they are necessary at all – is hotly contested within the 4EA and orthodox approaches. See Wheeler 2010 for an overview of the issues involved.

[3] Although it is an excellent book, Braver 2007 nonetheless treats only Foucault and Derrida, not Deleuze, in its "History of Continental Anti-Realism."

[4] Naturalism is a notoriously fecund notion. We can say that Deleuze is a naturalist qua anti-humanist, in the Spinozist sense of denying that humans form a "kingdom within the kingdom" (of nature). In refusing a special status to human beings Deleuze uses the same basic concepts (self-organization and creative novelty in dynamic systems) to handle phenomena in the physical, biological, social (including the social animals), and human registers. However, these same basic concepts have enough differences in their expression in the different registers that we cannot say Deleuze is a reductionist, with purely physical explanations being the only legitimate form of meaningful discourse.

[5] I will use organismic behavior guided by sensorimotor perception as my paradigm case. Among the differences that divide thinkers in the 4EA approach is the status of "representation-hungry problems" and "action-oriented representations," which are approved of by Clark 1997 and Wheeler 2005, but contested by Chemero 2009. They do agree however that a wide range of behaviors that traditional AI or orthodox cognitive science tries to handle by positing computation performed on representation do not in fact require representations, as they can be handled by models of coordination within the organism-environment couple considered as a dynamic system.

[6] Notable discussion of DR include DeLanda 2002; Williams 2003; Bell 2006; Bryant 2008; Hughes 2009.

[7] Differential calculus for Deleuze in DR is only a "technical model" for the structure of progressive determination of the Idea (Deleuze 1994, 220-221). The important thing is the ontological differences among virtual, intensive, and actual, terms which we will discuss shortly in the main body of the text. This tri-partite difference is illustrated by the difference between differentiation as determining the existence and distribution of singularities in a vector field and integration as the full determination of singularities while generating the trajectory modeling system behavior (Deleuze 1994, 176-179; DeLanda 2002, 30-34). But as we will show, the physical model of crystallization, the meteorological model of tropical cyclones, the biological model of gene regulatory networks and protein synthesis, and the social model of disciplinary institutions are also models of individuation leading the actualization of a virtual field.

[8] Deleuze distinguishes intensive processes – those that cannot change beyond a certain threshold without qualitative change of the behavior pattern of the process – from extensive properties, which can so change. In a simple example, a ruler cut in half becomes two rulers (length is thus an extensive property), while a pot of water heated from below produces convection currents at a certain threshold of temperature difference between top and bottom (heating water is thus an intensive process, or, in standard terminology, temperature is a control parameter of the system) (DeLanda 2002, 26-27).

[9] In a terminological wrinkle that need not concern us here, Deleuze distinguishes virtual "differentiation" from "differenciation" as the process of actualization.

[10] Deleuze's discussion of the "progressive determination" of an Idea is expressed in the language of calculus (Deleuze 1994, 171), but this is only for expository reasons. Following DeLanda's discussion (2002, 30-31), we see that considered as pure "elements," rates of change are undetermined, but determinable (dx, dy). As these rates of change are linked, they enter into differential relations, which are reciprocally determined (dx / dy) – this is differentiation as yielding instantaneous rates of change. These differential relations define the "existence and distribution" of the singularities of a vector field, but they are only completely determined as those differential relations and singularities are actualized (values of dy / dx) – this is integration as the generation of trajectories.

[11] It will also change the conditions for the sense of past processes, but exploring this would take us deep into the thickets of *Logic of Sense* (Deleuze 1990). Williams 2008 is an excellent guide here.

[12] Deleuze distinguishes "who?" questions, which pick out individuation processes, from "what?" questions, which classify products. However, our focus on the individuation of a hurricane, such that it deserves a proper name, cannot be so extreme that we lose sight of the shared structure of the morphogenetic process leading to hurricanes. Each hurricane is unique – they really do deserve proper names – yet they are all hurricanes. In other words, Deleuze does not deny the utility of genera, but he does insist that individuation precedes the differenciation of genera; this insistence allows for counter-effectuation and hence allows for dynamic development in the virtual register. These very delicate points are discussed in Chapter 5 of DR (Deleuze 1994, 244-254).

[13] Deleuze rehearses in several works the debate between Geoffroy Saint-Hilaire and Cuvier which follow the same lines of a distinction between the structure of morphogenetic processes and the classification of properties of products (1987, 45-47; 1994, 184-185). It would of course be necessary to treat the difficult questions of teratology and the limits of viability in a full treatment of Deleuze and biology, but I will defer that challenge for another time.

[14] My thanks to Manuel Cabrera Jr. for pointing me to this passage and for clarifying remarks.

[15] "Neurological correlates" is a loaded term in this context and should be approached in terms that Chemero lays out clearly: "Experiences do not happen in brains. Even though it is perfectly obvious that *something* has to be happening in neurons every time an animal has an experience, for the radical embodied cognitive scientist, as for the enactivist, this something is neither identical to, nor necessary and sufficient for, the experience" (2009, 200; emphasis in original).

[16] A more full treatment of this issue would take us to the distributionist vs localist dispute in neuroscience. Deleuze is on the side of the distributionists. Thus he would agree that, for example, while the hippocampus may indeed be necessarily involved in long-term memory, the retrieval of a memory involves the integration of distributed neural systems. In many ways, the dispute between distributionists and localists is a dispute between dynamicists and anatomists, and Deleuze, as a process philosopher, will side with the dynamicists.

[17] In another context, we might develop more fully this notion of the progressive determination of the Idea of the embodied-embedded system, and its counter-effectuation, as the ontological grounding of neural and behavioral plasticity.

[18] Deleuze follows Bergson's critique of the possible as the retrojection of the real minus

existence (Deleuze 1991, 43; 96-97).

[19] Although in his books Prinz does not rely on dynamical systems theory or on phenomenology, he does rely on biologically plausible models of emotion that emphasize the brain-body-world context: "emotions are not merely perceptions of the body but also perceptions of our relations to the world…. This book … is an attempt to bring body, mind, and world together" (Prinz 2004, 20).

[20] Certainly, learning to swim in the ocean is more complex than learning in a pool; but even in a pool, putting on one of the new bodysuits will require that even expert swimmers attempt a new "conjugation."

[21] We should note that in his discussion of Affordances 1.1, Chemero insists that abilities are not dispositions, which on Chemero's understanding are automatically triggered under the right circumstances (145). Thus Chemero will claim that abilities are not inherent in animals (as are dispositions), but in animal-enviroment systems. However, I do not believe that Prinz's notion of disposition, discussed above, is as deterministic as Chemero's.

[22] Think of two trains moving on parallel tracks at the same velocity. You can look from one window to the other and see stable things, but this is only due to the coordination of rates of change.

[23] I would like to acknowledge very helpful comments from Jeff Bell, Manuel Cabrera Jr, Manuel DeLanda, Shaun Gallagher, Joe Hughes, Mike Wheeler, James Williams, and two anonymous reviewers from PCS.