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Inter- and En- activism: Some thoughts and comparisons☆

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ABSTRACT

Interactivism and enactivism spring from some similar insights and intuitions. There are, however, some arguably significant divergences, and I will explore a few of the important similarities and differences. Topics addressed include the basic notions of how cognition and mind emerge in living systems; how growth, learning, development, and adaptation can be modeled within the basic frameworks; and how phenomenological investigations can be taken into account and their phenomena modeled.

1. Introduction

Interactivism and enactivism began in roughly the same time period (1970 ± a few years) and with similar, though also significantly different, insights.[1] They have diverged, however, in significant ways. I outline some of the significant aspects of the interactivist model, discuss some important convergences between the two frameworks, and address divergences and criticisms.

2. The interactivist model

2.1. Cognition and living systems

Among the more important initial similarities between the interactivist model and enactivism was that both recognized cognition as an intrinsic realm of properties of living systems. This is embedded in the definition of autopoiesis,[2] and is explicit in, e.g.,: "knowing as explicated above is an intrinsic characteristic of any living system" (Bickhard, 1973, p. 8; also in Bickhard, 1980a, p. 68).[3]

In fact, it is the central insight for both frameworks, though it is not made explicit in the same modeling definitions and it has not always been developed in parallel ways.

2.1.1. Intrinsically open interactive systems

For the interactivist model, cognition and life are intrinsically connected because cognition emerges in intrinsically open interactive systems, and living systems are intrinsically open and interactive. Such systems were originally modeled using the language of abstract machine theory:

> Consider two Moore machines [abstract finite state machines with outputs] arranged so that the outputs of each one serve as the inputs of the other. Consider one of the Moore machines as a system and the other as its environment, and let the system

☆ Thanks to Tom Froese and David Eck for comments on an earlier draft. This paper is a descendent of a talk with the same title given at the 2015 Interactivist Summer Institute (Bickhard, 2015b).

[1] The domain of enactivism has become importantly variegated over the course of its history. In this discussion, I focus primarily on the Maturana-Varela-San Sebastian clade. It should be noted that at times the interactivist model is itself considered to be a variant of enactivism. This is partially justified in terms of similarities in initial beginnings and some later convergences, but it is historically not correct.

[2] See also Froese, Virgo, and Ikegami (2011).

[3] Interactivism is an action-based framework. Any action-based approach to cognition, such as Jean Piaget's, necessarily has strong connections with living systems: it is living systems that act. Autopoiesis is not fundamentally action-based — its focus is internal closure rather than interactions with an environment — but it shares in this insight nevertheless.

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> have the initial and final state selections that make it a recognizer.
>
> The system can thus recognize input strings in the standard sense in automata theory [a recognizer "recognizes" strings of inputs that move it from its initial state to one of its final states]. In this interactive configuration, however, an input string corresponds to — is generated by — a state transition sequence in the environment. The set of recognizable input strings thus corresponds to the particular set of state sequences in the environment that could generate them. The recognition, or knowing, relationship is thus extended from inputs to situations and conditions in the environment.
>
> Furthermore, during an interaction, the environment is receiving outputs from the system — and it is these outputs from the system that induce the environmental state transitions that generate the inputs to the system that the system either recognizes or doesn't. Thus the 'recognition' process is no longer strictly passive — the 'recognized' strings are induced from the environment by the system's own outputs. In fact, the interaction doesn't need to be viewed as a recognition process at all. It is equally as much a construction or transformation process — constructing the situations and conditions corresponding to the last state of a 'recognizable' environmental state sequence — or at least a detection process — detecting an initial state of a 'recognizable' environmental state sequence — and so on.
>
> The system need not be thought of as a single undifferentiated recognizer. It could be, for example, a collection of recognizers connected to each other, say, with the final states of one attached to the initial state of another. Such connections could induce functional relationships among the recognizers, such as one testing for the appropriate conditions for another to begin, or a servomechanism being used to create a subcondition for another process to proceed, etc. (Bickhard, 1973, pp. 21–22; also in Bickhard, 1980a, pp. 75–76).

There have been several important additions to this framework since then. One was the recognition that indications of the potentialities of further interactions could constitute 'anticipations' with truth values, thus could constitute representation (Bickhard, 1980b). Another was moving beyond abstract machine theory into dynamic systems theory because abstract machine theory cannot capture essential properties of timing (Bickhard & Richie, 1983). Yet another was elaborating a model of emergence, and particularly normative emergence, in certain kinds of (dynamic) far-from-equilibrium systems (Bickhard, 1993, 2009a; Campbell, 2011, 2015).

The result has been a framework (Bickhard, 2009b) for modeling multiple and multifarious biological, psychological, developmental, and social phenomena, including language and sociality per se (Bickhard, 2008, 2009a, 2013). What gives it such wide scope is the interactive open system framework with which the programme began.

2.2. Representational normative emergence

Some of the most important differences between the interactivist framework and the enactivist framework concern representational normative emergence, and experience. Here is a more systematic overview of the interactivist models of such phenomena. I will first address representational normative emergence, and do so in reverse order:

> First, an account of metaphysical emergence.
>
> Second, an account of normative emergence.
>
> And third, an account of the emergence of representational normativity.

I will not develop the arguments in full — they are presented in greater detail elsewhere (e.g., Bickhard, 2009a, 2015a,b,c,d; Campbell, 2011, 2015) — but will show the basic architecture of the arguments and models, and give a fundamental sense of their content.

2.2.1. Emergence

The intuition of emergence is that differing organization (especially, new organization) can yield differing (causal) influences on the world. If causal influence is assumed to be a property only of particles, or other entities or substances, this is a difficult intuition to accommodate — organization is neither a particle, nor an entity, nor a substance, thus, just does not seem to be a candidate for having *any* kind of causal power of its own.[4]

But, if the world is constituted as processes, perhaps as quantum field processes, then organization cannot be precluded from having "causal" influence on the world[5]: Processes are inherently organized, and whatever influences they have on the world necessarily depend on those organizations. To delegitimate organization as a locus of influence on the world is to empty the world of any kind of causal power.

So, a process metaphysics makes emergence a natural kind of phenomenon, because processes necessarily involve the organizational properties that underlie emergence.

Are there reasons to accept a process metaphysics, other than this nice rescue of emergence?

Here are some: 1) A world composed only of point particles would be a world in which nothing ever happens, because point particles have zero probability of ever encountering each other. 2) A world composed of point particles that interact via fields (such as electromagnetic or gravitational fields) already requires the fields, thus requires that their organization have genuine causal influence. 3) According to our best physics, *there are no particles* — what are called particles in contemporary parlance are quantized excitations in quantum fields (Cao, 1999; Halvorson & Clifton, 2002; Hobson, 2013; Huggett, 2000; Weinberg, 1977, 1995; Zee, 2003). Such excitations are quantized in the same sense in which the number of wavelengths in a vibrating guitar string is quantized — and there are no guitar sound particles any more than there are quantum field particles (Bickhard, 2009a; Campbell, 2015).

So, there are good reasons to accept a process metaphysics, and in a process metaphysics emergence is no longer mysterious and no

[4] Kim (1993) argues, for example, that new configurations can manifest new causal *regularities*, but that the causal power resides only with the basic particles (see also Bickhard, 2015a). I argue that this and Kim's better known arguments against emergence (e.g., pre-emption) beg the question. They beg the question precisely in assuming that, most fundamentally, everything consists of particles. Such a metaphysics intrinsically excludes organization from being even a candidate for having causal influence (Bickhard, 2009a).

[5] I put "causal" in scare quotes because ultimately there isn't any unitary kind of relation in the world that answers to the notion of cause (Bickhard, 2011). There are multiple sorts of influence ranging from quantum field couplings to billiard ball collisions to orders from an army commander, and so on. And quantum field couplings cannot themselves model cause because such couplings are forms of influence among quantum processes that are continuous with space and time: they are not relations between events or objects.

longer looks impossible. Emergence becomes almost commonplace (Bickhard, 2015a,b,c,d).[6]

2.2.2. Normative emergence

If there is metaphysical emergence, what about *normative* emergence?[7] A fundamental problem here is to account for the asymmetry between the normatively positive and the normatively negative. Physics offers many kinds of distinctions, but few that are asymmetric and could ground this normative asymmetry. I argue that thermodynamics does offer such grounds.

In particular, some, perhaps most, processes are not stable: they go to some completion and end, such as a rock falling. Some process organizations, however, do have stability: the processes remain in some organization over time. Of these, a major class are stable because they are in some kind of energy well: they remain in their organization unless and until some above-threshold energy strikes them, and then their organization is disrupted. An atom is a canonical example.

A crucial property of energy well stabilities is that they are still stable if they are isolated and allowed to go to thermodynamic equilibrium. This is not the case for another class of stable processes: those that are intrinsically *far* from thermodynamic equilibrium. These cannot be isolated, else they go to equilibrium. And if they go to equilibrium, they cease to exist. A candle flame is a canonical example.

Some processes, like the candle flame, make contributions to their own stability in the sense that they contribute to the maintenance of the far from equilibrium conditions upon which their existence depends — in this case, maintaining a temperature above the combustion threshold.

The crucial point here is that far from equilibrium systems are stable only if they are *maintained* in their far from equilibrium conditions. Contributions to the maintenance, whether from external sources or internal processes, are contributions to the stability, and, thus, are *functional* relative to such stability. It is this asymmetry between not having to maintain energy well stabilities and having to maintain far from equilibrium stabilities that is offered as the basic framework for normative emergence, in particular, for normative functional emergence.[8]

2.2.3. Representational emergence

Among the functions that must be served in any complex agent is that of some sort of functional indications of what that agent might do in the current situation (Bickhard, 2009a, 2009c). Agents must functionally select what to do next, and it is dysfunctional to attempt an interaction that is not currently available — you can't open the fridge for a beer if you're in the middle of a forest (unless you've carted a fridge with you). Indications of potentialities for interaction, thus, are essential to any complex agent, and they are (functionally) normative.

In particular, they can be correct or incorrect; the indications can be true or false. Truth and falsity are the fundamental normative properties of representing, and in this account they emerge in a natural way in the functional organization of agents. This is the basic emergence of representing in the functional processes of agents.

Much more needs to be discussed, because indications of potentialities for interaction do not "look much like" standard kinds of representing, such as representing physical objects. How this basic model can address the representation of physical objects, as well as of abstractions, such as numbers, is addressed elsewhere (e.g., Bickhard, 2009a).

The important point for current purposes is that this is a model of representational emergence. It is a model of representation drastically different from standard frameworks that rely on computation or semantic information or structural homomorphisms. And it is a model that is not subject to the problems that afflict the standard models. The enactivist literature is replete with criticisms of standard models of representation; I not only agree with these, I have made the same critical points myself and added to them over the decades (e.g., Bickhard, 1980b, 1993, 2009a). But, so I argue, the interactivist model is not vulnerable to these critiques, and, therefore, can account for internal representing and cognitive processing,[9] as well as external representations.[10]

In particular, it is not a model of representing as encodings, nor a correspondence model, nor an information semantics model, nor a structural homomorphism model, nor a stand-in model, nor a spectator model (Bickhard, 2009a, 2014). I argue that all these and more share a common underlying error: assuming that representation is constituted most fundamentally as encodings. Instead, representing is a normatively functional, future-oriented, indicative or anticipatory process.[11]

2.2.3.1. Interactivism and autonomy.

Autonomy is a graded property: there are very simple versions, and increasingly more complex forms. It begins with systems that are far from thermodynamic equilibrium; thus, the initial, simplest forms have already been outlined. I will revisit some of these points from the perspective of autonomy.

Some processes are fleeting, such as the fall of a leaf, and others are relatively stable. Among such stable organizations of process are those, like atoms, that are stable because they are in energy wells. Energy well stabilities are forms of process that stay in that organization unless energy above some threshold disrupts them (Bickhard, 2009a; Campbell, 2011, 2015). Another form of relatively stable process organization is that of far from thermodynamic equilibrium stabilities. In general, far from thermodynamic equilibrium processes will go to equilibrium, and whatever properties had been instantiated in their organization will cease to exist. Some far from equilibrium processes,

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[6] In Western thought, the background assumptions that render emergence impossible go back at least to Parmenides, and have been dominant ever since (Bickhard, 2009a; Campbell, 2015).

[7] This should be *especially* impossible, given Hume's argument against deriving "ought" from "is", but I argue that Hume's "argument" is itself unsound (Bickhard, 2009a).

[8] This model differs from standard etiological models in several ways. Among others, it makes "*serving* a function" primary, not "*having* a function." Although history is pertinent to how a system comes into being, it has no relevance in this account to the presence or absence of normative functional emergence (Bickhard, 2009a).

[9] Including language (Bickhard, 2009a).

[10] There is a strong theme in the enactivist literature of rejecting any notions of internal-to-the-organism cognitive dynamics, in favor of external, observer-dependent identifications of various patterns of activity. But, such rejections of organism-level cognition are based on invalid arguments, usually arguments by elimination that only eliminate one range of conceivable models. What's more, the labels that enactivists apply to various activities, such as participatory sense making, require dependencies on the past on the part of the persons (or other organisms) involved. But such dependencies on the past could be in error. They have truth value, and, thus, are representational and cognitive. In order for the definitions of such phenomena as participatory sense making to be satisfied, important kinds of dynamic processes must exist, but these processes are not modeled in the enactivist framework and are often incapable of being modeled.

[11] I would submit that this model of representing is fully consistent with the basic intuitions of the enactivist framework, though *not* with its formal definitions of autopoiesis or autonomy.

however, are *maintained* in their far from equilibrium condition, and remain relatively stable, along with whatever properties might be realized in those processes.

Far from equilibrium processes, thus, must be maintained in their far from equilibrium conditions if they are to persist. They might be maintained, for example, by external processes, such as chemical reservoirs and pumps maintaining a vat in far from equilibrium conditions, perhaps for the sake of exploring the self-organizing processes that might ensue.

Some far from equilibrium processes, however, contribute to their own maintenance of their far from equilibrium conditions, and, thus, to their own persistence. A canonical example is a candle flame (Bickhard, 2009a; Campbell, 2015). A candle flame maintains above combustion threshold temperature, vaporizes wax, induces convection which brings in fresh oxygen and gets rid of waste products, and so on. A candle flame *makes use* of its environment in order to maintain itself within that environment. A candle flame is an example of a process that is *self-maintaining*.

If a candle is running out of wax, there is no alternative form of process available to the candle. A bacterium, however, has alternative processes that it can engage in, depending on its current situation. So, a bacterium might swim, and tend to continue swimming if it is going up a sugar gradient, but, if it finds itself going down a sugar gradient, it will stop and tumble before resuming swimming (D. T. Campbell, 1974). Swimming contributes to self-maintenance if going toward higher sugar concentrations, but detracts from self-maintenance if going toward more dilute sugar concentrations. Tumbling is the self-maintenant process that is available to the bacterium if it is going down a sugar gradient.

In these ways, a bacterium can switch among alternative processes so that it remains self-maintaining through changes in its conditions and relations to the environment. It is in these senses *recursively self-maintenant*: it self-maintains its property of being self-maintenant. It can make use of its environment in appropriate ways even in the face of relevant changes in its situation with respect to that environment.

Self maintenance and recursive self-maintenance are two of the lower level forms of autonomy. There are myriad further and more complex forms of autonomy that emerge from these. Autonomy in this sense is autonomy *within* an environment or range of environments. It is the ability to make use of environments in order to maintain persistence of far from equilibrium conditions. Autonomy has to do with how (well) the system manages its interactions for its own persistence.

2.3. Experience

Experience is not a unitary realm. Kinds and aspects of experiencing are multiform, and they did not all emerge in evolution at the same time. The different kinds are at least partially independent, though, so I argue, there is a central hierarchy to those emergences that are involved in human experiencing (Bickhard, 1973, 2000, 2003, in preparation).[12]

In particular, there are primary kinds of processes that include being a contentful flow of experiencing,[13] learning, pain and pleasure, emotions, and simple motivation. In the basic model of interacting agents, all of these arise intrinsically; they might be called basic awareness or primary consciousness (Bickhard, 2005).

But this is not all there is to consciousness. In particular, there is, purportedly, a “hard” problem of accounting for qualia. Atomizing experience into *qualia* is an error that I will not address here. But without qualia we still have to model the experiencing of experiencing. If primary consciousness — basic experiencing — is constituted in primary kinds of interactive processes, then what is *reflective* consciousness constituted in?

Exactly that: Reflective consciousness is consciousness *of* (primary) conscious processes. Just as the body interacts with the world in ways that yield emergent primary experience, higher-level processes interact with those primary levels of process. The experiencing of experiencing is precisely what it sounds like.

What makes the problem “hard”—in fact, impossible—is taking qualia not merely as *results* from the experiencing of experiencing, but also as *elements* of experiencing itself.[14] Qualia become the (experiential) qualities of themselves — a tight ontological circle that is impossible to break into.

This has been a highly skeletal presentation of some parts of the interactive model. It should not persuade the reader on its own, though I hope it might stimulate some interest in interactivism as a candidate model for the progressive emergence of experiencing within the world. And it should suffice for some comparisons.

3. Autopoiesis and enactivism

3.1. Autonomy

A direct descendant, if not a corollary, of recognizing the intrinsic relationships between life and cognition is the notion of autonomy.

In the enactivist framework, autonomy was initially identified with being autopoietic, but the notion has been modified in important ways. Autonomy is also an important property in the interactivist framework, but the interactivist conception of it is notably different.

3.1.1. Autopoiesis and autonomy

Autopoiesis focuses on the construction of components of a system. This gives a notion of autonomy that focuses on persistence of a system independent of its environment: autonomy *despite* an environment. Such a framework cannot account for change: learning, development, or adaptation (Christensen & Hooker, 2000; Di Paolo, 2005; Moreno, Etxeberria, & Umerez, 2008). It has an all-or-nothing character (Di Paolo, 2005).

Such self-construction cannot take place unless the system is far from thermodynamic equilibrium, but the basic definitional framework for enactivism makes no mention of such conditions, nor of relations to them. In fact, there is no mention of any relations to an environment. Consequently it is an inadequate framework for understanding or modeling relationships *between* an organism and its environment, such as cognition. The emphasis is entirely on autonomy *from* an environment.

3.1.2. Enactivism and autonomy

Enactivism involves, among other changes, revisions to the definition of autonomy. Here is a recent example:

[12] The hierarchy is a macro-evolutionary trajectory of increasing adaptedness to niches of adaptiveness (Bickhard, 1973, 1980a, in preparation).

[13] For content, see, e.g., Bickhard (2005, 2009a) and Campbell (2011). For flow, see Bickhard (2005).

[14] Dewey made a similar point in his critique of Russell's model of sense data: sense data are not constitutive of perceiving, but are *results of our analysis* of perception (Dewey, 1915, 1941; Tiles, 1990).

> An autonomous system is defined as a system composed of several processes that actively generate and sustain an identity under precarious conditions. To generate an identity in this context is to possess the property of *operational closure*. This is the property that among the enabling conditions for any constituent process in the system one will always find one or more other processes in the system (i.e., there are no processes that are not conditioned by other processes in the network — which does not mean, of course, that conditions external to the system cannot be necessary as well for such processes to exist). By precarious we mean the fact that in the absence of the organization of the system as a network of processes, under otherwise equal physical conditions, isolated component processes would tend to run down or extinguish. Similar constitutive and interactive properties have been proposed to emerge at different levels of identity generation, including sensorimotor and neurodynamical forms of autonomy (Di Paolo, Rohde, and De Jaegher 2007; Moreno and Exteberria 2005; Thompson 2007; Varela 1979, 1997).
>
> De Jaegher & Di Paolo, 2007, p.487[15]

This is significantly different from earlier autopoietic definitions. There are five aspects that I wish to comment on here:

- Closure
- Identity
- Precariousness
- Change
- And (an absence of) system-environment inter-relational conditions.

3.1.2.1. Closure. First, though less focused on components, this definition still cannot accommodate a relational identity: it still emphasizes "operational closure". It is clear that neither the autopoietic definition of autonomy nor the more recent enactivist definition could be satisfied except by systems that are not in equilibrium with their environments. But the definitions do not mention that, though more recent discussions begin to. Even the most recent discussions, however, still do not recognize the importance of *far* from equilibrium conditions, nor of essential *inter*-relationships between the organism and those conditions. They do not recognize that the system is itself ontologically an open process flow, *not* a system that "presupposes" or "requires" non-equilibrium conditions in order to reproduce its internal components or enable its constituent process to support one another. It is the *irreversibility* of *far* from equilibrium processes that *constitutes* the "precariousness" of those kinds of processes.

Yes, "conditions external to the system [are] necessary … for such processes to exist", but such a statement is much too weak, it is missing the basic ontological nature of living systems. Living systems do not just *depend* on non-equilibrium conditions: they are *constituted* as interactive processes that (tend to) *maintain* those conditions, and do so recursively.[16]

"Operational closure" is also meant to have an epistemological consequence; roughly, that an organism has no direct epistemic access to its world. Closure rules out such problematic conceptions of cognitive relations to the world, but at the cost of not being able to model *any* dynamic cognitive interactions with the world (leading to the issue of observer idealism, mentioned below).

A final point is that operational closure is supposed to yield unity (or identity) for a system, but (as I will point out in the next paragraph) such unities do not necessarily exist. (See Barandiaran, 2014, concerning the "unclear notion of 'operational closure of the nervous system'.") I would suggest, then, that enactivism has not fully resolved problems that it has inherited from autopoiesis.

3.1.2.2. Identity. Concerning "identity": the definition emphasizes creating a "unity" or "identity", but some processes don't do so,[17] even in the biological realm. What is the unity—or what are the unities?—in a field of crabgrass, spreading via runners, some of which are still "live," some of which are decayed, and some of which are decaying?[18] Is there any fact of the matter about it? Unities, identities, boundaries, etc., are sometimes created by some dynamics, and sometimes not, and this fact holds for living processes as well as non-living (Bickhard, 2011; Bickhard & Campbell, 2003).[19]

3.1.2.3. Precarious. Third, "precarious" is a normative term. For enactivism, precariousness is the ground of all normativity (Froese, submitted) — but there is no account of how such normativity emerges. I will return to this point below, in the discussion of phenomenology.

3.1.2.4. Change. Fourth, there is still no account of change. Without any property like recursive self-maintenance, there is no way to model interactive variability. Furthermore, without an account of change *within* a system, there is no framework for modeling learning, or adaptivity more generally (Di Paolo, 2005; Moreno et al., 2008).

Autopoiesis is "all-or-nothing", which precludes (e.g., adaptive) change within a system. Enactivism tries to escape such impossibility of change-within-a-system mainly by adding "adaptivity" to its basic definition of autonomy (Di Paolo, 2005). Adaptivity is defined as a graded property, so it can handle changes in or degrees of adaptive processes. But adaptivity is defined functionally, stipulatively, and by examples, not dynamically. Grafting it *ad hoc* onto the framework puts it in tension with the all or nothing character of autopoiesis. There are basic conflicts between the non-change definitions and the change definitions.

3.1.2.5. Relational conditions. Change, in turn, is problematic because the crucial thermodynamic relations have not been recognized. The post-autopoietic definition of autonomy emphasizes a network of processes that collectively keep themselves going, against the tendency to "run down" or "extinguish." Yet it makes no reference to the thermodynamic properties or *system relations to those properties* that are necessarily involved in this self-maintenance — self-maintenance is most fundamentally *the system itself* maintaining the *thermodynamic conditions* for its own

[15] This is essentially the same definition of autonomy presented by Di Paolo (2009), and in other sources (e.g., Di Paolo & Thompson, 2014).

[16] "Components" of a living system are themselves necessarily open processes, and are ongoingly changing. These are intrinsically open systems just like the overall organism, but at slower time scales (Bickhard, 2015c, 2015d; Bickhard & Campbell, 2003). They are not "constructed" so much as organized and maintained.

[17] Is a candle flame a unity or does it have an identity? A weather pattern? An excitation in a quantum field?.

[18] Or in a grove of aspen— with many trees and one root system? And so on.

[19] This problem presumably derives from the original focus on a single cell. It not only produces problems with regard to living systems, but also regarding social processes, in which non-"unities" are pervasive.

existence. A living system *is* a self-maintaining process[20]: a system in a self-maintaining relationship with its own existence relations to its environment.

In the interactive framework, it is not problematic to model how a system, in order to maintain the *relation* of (recursive) self-maintenance, alters the dynamic manner in which it does this. So adaptivity, and change in general, including learning, emerge naturally within the general framework. Furthermore, self-maintenance is itself an interactive relational process, and is thus well suited as a framework for modeling the emergence of cognitive and representational relationships. Leaving these necessary interactive relationships unacknowleged, enactivism makes it difficult to model not just change, but also any processes that bear a truth value. Enactivism consequently makes it difficult to model representing (though this last point is taken by some to be a strength of the framework).

Self-maintenance, thus, is a system relation to ontologically necessary thermodynamic conditions. It has nothing to do in any direct sense with production of components, nor with interdependence of internal processes. It has to do, instead, with relationships with the thermodynamic relational conditions that are necessary for any such processes to occur. Such relationships with the thermodynamic properties and processes are what *constitute* the system's "precariousness."

3.2. Phenomenology

Interactivism and enactivism also share an origin in phenomenological analysis, though the nature of the influence has differed significantly. I will first outline the role of phenomenology for interactivism.

3.2.1. Phenomenology and interactivism

Science is a process of model building, in which tentative models are subject to a variety of constraints, supports, realms of potential refutations, and so on. Every science has one or more foci of analysis, and both external and internal perspectives on such foci. Part of the task is to relate phenomena in those perspectives.

The study of psychological phenomena involves double internal perspectives: physiological and phenomenological. No other science has such dual internal perspectives; in particular, the phenomenological or experiential perspective is unique in this realm.

These internal and external perspectives are not the only constraints. Another realm of constraints of particular importance is that of origin; in particular, emergent origin. Psychological phenomena did not exist 13 billion years ago, and they do now. They have to have emerged (Bickhard, 2009a; Campbell, 2015). There has been, and continues to be, emergence on multiple time scales: cosmological, evolutionary, phylogenetic, historical and cultural, learning, and developmental.

For an example: Fodor's (1975) argument for a base set of innate representations out of which all other representations are then assembled was that we have no account of how learning could create *emergent* new representations, so the base set of representations must be innate. But, if evolution *could* create emergent new representations, then Fodor offers no argument concerning why learning and development could not also create emergent representation, thus undermining the purported need for an innate base. On the other hand, if the emergence of new representation is *impossible* in principle, then evolution could not yield emergent representation either, and, for lack of any way that it could come into being, representation itself would be impossible. This constitutes a refutation of Fodor's position.[21]

In general, model building faces empirical constraints, experiential constraints, constraints of origin, metaphysical constraints, logical constraints, and mathematical constraints. The more constraints that are taken into account, the better supported the model that can satisfy them (if any such model can be found). Experience is one of the most important among these constraints.

3.2.2. Enactivism and phenomenology

The perspective of an observer was important at the very inception of the autopoiesis framework, and has developed into a central importance of the phenomenology of experiencing.

3.2.2.1. Autopoiesis. The involvement of experiential considerations in autopoiesis traces back at least to second-order cybernetics (Froese, 2010, 2011), which posits the need for an observer in any analysis (e.g., to note coupling between a system and its environment). Unfortunately, the observer has neither been analyzed nor made open for analysis.

Autopoiesis shared with second order cybernetics the slogan that all distinctions are made by an observer. One explicit implication is that the distinctions have no objective reality: they are observer-dependent. Observer dependence, in turn, yields observer

[20] As well as, generally, recursively self-maintaining and self-reproducing.

[21] Fodor was and is quite aware of problems with his position. Consider: "I admit that these conclusions really may seem scandalous. I should be inclined to view them as a reductio ad absurdum of the theory that learning a language is learning the semantic properties of its predicates, except that no serious alternative to that theory has ever been proposed. Consonant with the general methodology of this study, I shall endure what I don't know how to cure." (Fodor, 1975, p. 82). "I am inclined to think that the argument has to be wrong, that *a nativism pushed to that point becomes unsupportable, that something important must have been left aside*. What I think it shows is really not so much an a priori argument for nativism as that *there must be some notion of learning that is so incredibly different from the one we have imagined* that we don't even know what it would be like as things now stand." (In Piattelli-Palmarini, 1980, p. 269, italics in original). "The second, and final, point is that what *none* of us is doing … is providing a semantics for a natural (or any other) language: a theory of language-and-the-world. What we're all doing is really a kind of logical syntax (only psychologized); and we all very much hope that when we've got a reasonable internal language (a formalism for writing down canonical representations), someone very nice and very clever will turn up and show us how to interpret it; how to provide it with a semantics." (Fodor, 1981, p. 223). "On the one hand, the B/P [Barwise and Perry] information contained in the tokening of a mental representation becomes 'available' just insofar as it is explicitly encoded. Being explicitly encoded means being encoded by 'syntactical' (if you prefer, by intrinsic) features of mental representations. This doesn't get us out of the woods of course; in particular, we still have in play an unexplicated (a fortiori, an un-Naturalized) construct. Viz. the notion of *syntactic encoding* (if you prefer, the notion of 'representation by intrinsic features'). B/P semantics tells us what it is for a situation to *contain* information, but it doesn't tell us what it is for a situation to *encode* information, and I hope it's clear by now that not every situation encodes the information that it contains. It goes without saying — anyhow, it *ought to* go without saying — that encoding and attunement are *both* pie in the sky so far. Both are semantical notions, and — as things now stand — we haven't got a ghost of a Naturalistic theory about either. So, attunement is the joker in B & P's deck; encoding is the joker in mine." (Fodor, 1987, pp. 80–81). "But of the semanticity of mental representations we have, as things now stand, no adequate account." (Fodor, 1990b, p. 28). "Deep down, I think I don't believe any of this. But the question what to put in its place is too hard for me." (Fodor, 1990a, p. 190). "The right questions are: "How do mental representations represent?" and "How are we to reconcile atomism about the individuation of concepts with the holism of such key cognitive processes as inductive inference and the fixation of belief?" Pretty much all we know about the first question is that here Hume was, for once, wrong: mental representation doesn't reduce to mental imaging. What we know about the second question is, as far as I can tell, pretty nearly nothing at all. The project of constructing a representational theory of the mind is among the most interesting that empirical science has ever proposed. But I'm afraid we've gone about it all wrong." (Fodor, 1994, p. 113). "Hume hasn't, in short, the slightest idea how 'the world' or 'the object' (or anything else) *could* cause an impression (and neither, of course, do we)." (Fodor, 2003, p. 121, n. 10).

idealism and relativism, which I have heard explicitly endorsed by Maturana,[22] though denied in print (e.g., Maturana & Varela, 1987). Nevertheless, the enactivist framework seems to remain committed to observer idealism and relativism.

Observer *dependence* obstructs being able to *account* for any such observer. One place this surfaces is in *Autopoiesis and Cognition* (Maturana & Varela, 1980). Over the course of pages 38–40, an internal organization of recursive processes is posited, and, over the course of the discussion, those recursive processes become an internal observer — an observer with perspectives on both the system and its environment. There are two non-sequiturs here: The first is that recursive processes do not constitute epistemic observers. The second is that, even if it could somehow come into being, an internal "observer" at best will have a perspective *internal to the system*. It will not attain the perspectives both internal and external to the system that an external observer is thought to have. Observers are not accounted for; nothing is done to block a regress of observers necessarily involved in trying to account for observers. We get a kind of dualism, complete with a metaphysically unsupported realm of "observers."

3.2.2.2. Enactivism. Enactivism has modified both its notion of autonomy — which is no longer equated with being autopoietic — and its approach to the experiential or phenomenological realm. In Varela's "Neurophenomenology" we find:

> Abstract: This paper starts with one of Chalmers' basic points: first-hand experience is an irreducible field of phenomena. I claim there is no "theoretical fix" or "extra ingredient" in nature that can possibly bridge this gap. Instead, the field of conscious phenomena requires *method* and an explicit pragmatics for its exploration and analysis. My proposed approach, inspired by the style of inquiry of phenomenology, I have called neurophenomenology. It seeks articulation by *mutual constraints* between phenomena present in experience and the correlative field of phenomena established by the cognitive sciences. It needs to expand into a widening research community in which the method is cultivated further.
>
> Varela, 1996, p. 330, italics in original

The first point that I note is that the claim is made that there "is no 'theoretical fix' or 'extra ingredient' in nature that can possibly bridge this gap." Varela doesn't actually argue for this, but, in effect, accepts Chalmers' arguments.[23] But Chalmers' arguments have serious problems; here is one: Chalmers' (1996) is, in its overall architecture, an argument by elimination. He argues that causal-functional analysis can handle the "easy" phenomena, but cannot handle the "hard" problem. His focus is on causal functional analysis, not on normative function, and not on emergence.[24]

Causal functional analysis, he contends, cannot model experiential phenomena because causal functions are "just" particular causal consequences, and cause cannot model experience. The argument is flawed in multiple ways. First, causal functional analysis, contrary to Chalmers, cannot solve the "easy" problems either. For instance, no way is offered and none is on the horizon by which causal functional analysis could capture the normative aspects of representation, nor could it capture any other normativities. Second, even if we accept this claim from Chalmers, he has eliminated at best one candidate for accounting for experience. There are others. So his argument by elimination is invalid for failing to eliminate all relevant alternatives.[25] In particular, a normative functional model that acknowledges metaphysical emergence (Bickhard, 2009a; Campbell, 2011, 2015) has not been eliminated.[26]

Second, there is no "gap", bridgeable or not (Bickhard, 1998). The experiential realm is complex and multiform, leaving no one single gap between non-experiential and experiential. Consider, for example, learning, emotions, and reflective consciousness. There are animals that can learn, but do not manifest emotion, and animals that do manifest emotion, but not reflective consciousness. The course of macro-evolution has been through *various kinds* of phenomena that constitute experience. It has not involved some singular jump from non-experience into experience.

This macro-evolutionary trajectory has involved the emergence of multiple kinds of mental and experiential phenomena. Varela's position denies the possibility of such a variegated emergence account.

Still further, Varela's position offers no model, indeed denies there could be one. So there is nothing to be "constrained." Accepting such a divide, as Varela urges, entails that we will at best be able establish *correlations* between the experiential and the non-experiential. There will be no explanations.

In contrast, interactivism offers at least a candidate model for "bridging" the purported "gap" between non-experiential and experiential, via hierarchies and trajectories of emergence.

3.2.2.2.1. Description. Varela's correlational method (apparently enabled by the earlier second order cybernetics) encourages the attachment (correlation) of normative labels to observable phenomena. The labeling is supposed to constitute explanatory modeling, when, in fact, no model of the phenomena nor of their normative aspects has been attempted. Normativities are presumed to reside in the "experience" realm, therefore, in the "experience" domain of labels to be correlated.

For example, the notion of "sense making"[27] is a description from an observer's point of view. It is supposed to be from a phenomenological, consequently a normative, perspective. But there is no model of any of the normative aspects. All such norms seem to be rooted in the notion of "precariousness" (Froese, submitted)—which is itself from an experiential perspective, and offers no model. It is a normative label, applied to certain phenomena; in keeping with the correlational method, it avoids trying to explain them. By contrast, the interactivist account of the of normativity emerging in far from thermodynamic equilibrium conditions may turn out to be incorrect, but it definitely offers a candidate explanation.

Another consequence of this descriptive correlational approach is that the *observer* naturally focuses on *observables*—on behavior. The correlations are with patterns of observable behavior, not with the dynamics underlying the behavior. The notion of

[22] At a conference on cybernetics in the mid-1980s.

[23] Thus accepting a form of dualism.

[24] Does emergence entail "reducibility," making it unacceptable?.

[25] Invalid arguments by elimination seem to be quite common. For example, Hutto and Myin (2013) argue against computational and information semantic models of representation—from which they conclude that there are *no* mental representations. Another example: Chomsky argues that there must be constraints from Universal Grammar to make language acquisition possible: constraints on the space of mathematically possible grammars are necessary in order for the grammar of a particular language to be learned (correct); environmental constraints do not suffice (perhaps, but Chomsky's own arguments here are bad); therefore, the constraints must be innate (invalid, because Chomsky has failed to consider another source of constraint) (Bickhard, 1995, 2007).

[26] Additional errors that are built into the very conception of the "hard" problem actually make it impossible to solve (Bickhard, 2005). But this impossibility is an artifact of background assumptions made while defining the problem. The in-principle impossibility disappears when those background assumptions are corrected.

[27] And, thus, *participatory* sense making.

"embodiment" is commonly used in this literature in a way that further legitimates this focus on "embodied" behavior, and supports an anti-physiological or anti-brain stance.

There are some intimations of awareness that not all is in order here. For example, Beaton (2013) discusses how counterfactual behavioral possibilities are involved in enactivist discussions of sense-making, and related terms. But he neither explains how such counterfactuals are "available" to the organism, nor how they could influence anything that the organism does. Toward the end of the paper, however, he acknowledges that "We still need a satisfactory, naturalistic, but not reductive, account of the origin and nature of normative action itself" (Beaton, 2013, p. 310). This is, in my judgment, an important recognition, but satisfying that "need" requires an account of emergence, including normative emergence, and the enactivist framework, as currently defined, cannot account for either.

3.2.2.2.1.1. Some examples

The reliance on observer-dependent descriptions seems pervasive. Here are a few examples, with some comments and questions:

> For the enactive approach, cognition is embodied action (De Jaegher & Di Paolo, 2007, p. 487).

Can there be *potential* (embodied) action? Does action bear truth values? What are the relevant dynamics within the organism?

> Exchanges with the world are inherently significant for the cogniser and this is a definitional property of a cognitive system: the creation and appreciation of meaning or *sense-making* in short. The distinction between a strictly physical encounter and a cognitive one is to be found in the dimension of significance for the cogniser itself that is characteristic only of the latter class, even though cognitive interactions are themselves also physical processes (De Jaegher & Di Paolo, 2007, p. 488).

There are multiple normative labels here. What justifies them, or models them, or explains them? For example, "significant for the cogniser" seems to be an observer attribution, not based on an explanatory model. In "the creation and appreciation of meaning or sense-making" the appreciation is, presumably, done by the observer. Is "creation" also the work of the observer? If not, how is meaning or sense-making created? In general, this seems to give "sense-making" a normative-descriptive meaning, but does not offer any model of normative significance from the "perspective" of the system itself.

> For our purposes, we take coordination to mean the non-accidental correlation between the behaviors of two or more systems that are in sustained coupling, or have been coupled in the past, or have been coupled to another, common, system. A correlation is a coherence in the behavior of two or more systems over and above what is expected, given what those systems are capable of doing. For instance, when we observe a crowd of people walking on a busy road, the fact that they walk is not surprising, and we do not label this a case of coordination since walking is one of the things people do on a road (as opposed to, say, flying). But if we find that they are all walking in the same direction this could be a correlation, and if we suspect that this is not by accident, we can hypothesise the presence of a coordinating factor (for instance, an anti-war demonstration). (De Jaegher & Di Paolo, 2007, p. 490).

"A correlation is a coherence in the behavior of two or more systems over and above what is expected" — presumably, "expected" by an observer? "We do not label this a case of coordination" is clearly a direct appeal to labeling by an observer. "If we suspect that this is not by accident, we can hypothesise the presence of a coordinating factor" — "accident" is with respect to the expectations of an observer. Hypothesizing a coordinating factor sounds more like an explanatory stance, but, because "coordination" is itself "non-accidental correlation", where accident is observer dependent, this does not ultimately avoid being observer dependent itself.

> To be a sense maker is, in other words, to be actively *sensitive* to dangerous or beneficial *trends* in the ongoing coupling with world. Sense-making thus combines, *in nuce* and for all forms of life, what for complex minds, like those of animals, can be differentiated into action, perception, and emotion. (Cuffari, Di Paolo, & De Jaegher, 2014, p. 26, italics in original)

"Sensitive" and "dangerous" are normative terms, but again their normativity appears to belong strictly to a description made by an observer.

> When we combine the intrinsic normativity that emerges in precarious life with the realization that we only live in the present, the conditions for meaning are set. Having a mind, making sense, and transcendent activity are characteristics of life for sensitive, present beings. (Cuffari et al., 2014, p. 26).

"Intrinsic normativity" seems to derive from "precarious," but what is precariousness and how is it explained?

> our eventual internalization of normative social acts or self-control affords us reflective powers (Cuffari et al., 2014, p. 26).

"Internalization" might be a purely descriptive term. But what are the dynamics of internalizing, independently of an observer that is attributing the internalizing? It is not clear what "self-control" is nor how it yields reflection.

> Thus an autopoietic system — the minimal living organization — is one that continuously produces the components that specify it, while at the same time realizing it (the system) as a concrete unity in space and time, which makes the network of production of components possible (Weber & Varela, 2002, p. 115).

This is still about components and unities.

> The key here is to realize that because there is an individuality that finds itself produced by itself it is *ipso facto* a locus of sensation and agency, a living impulse always already in relation with its world. There cannot be an individuality which is isolated and folded into itself. The can only be an individuality that copes, relates and couples with the surroundings, and inescapably provides its own world of sense. In other words by putting at the center the autonomy of even the minimal cellular organism we inescapably find an intrinsic teleology in two complementary modes. First, a *basic* purpose in the maintenance of its own identity, an affirmation of life. Second, directly emerging from the aspect of concern to affirm life, a *sense-creation* purpose whence meaning comes to its surrounding, introducing a difference between environment (the physical impacts it receives), and world (how that environment is evaluated from the point of view established by maintaining an identity). (Weber & Varela, 2002, p. 117)

The "*ipso facto*" relation is not at all clear. An "individuality" that "copes, relates, and couples with the surroundings" moves away from the strictly internal focus on components, but, although it is a move in the right direction, it seems added on top of — added *ad hoc* to —the internal component focus, and it is unclear *how* this "inescapably provides its own world of sense."

Varela (1997) again stresses internal unity and coherence, but also recognizes that this involves interaction — and makes the claim that "this is the source for informational, intentional, or semantic values" (p. 73).

> The fundamental logic of the nervous system is that of coupling movements with a stream of sensory modulations in a circular fashion. The net result are perception–action correlations arising from and modulated by an ensemble of intervening neurons, the interneuron network" (Varela, 1997, p. 81).

This seems to ignore the fact that the body and the brain are not just engaged in circular interactions, but that they are *endogenously* active — and necessarily so — and that endogenous activity requires its own (kinds of) models.

> Autopoietic systems should be interpreted as being far from equilibrium and open to material and energetic exchange — though not implied by the definition, this interpretation is supported by the dynamic connotation of the word "process" (Di Paolo, 2005, p. 435).

Di Paolo's point is correct. But because the definitions do not take into account these far from equilibrium conditions, nor of any relationships to those conditions (e.g., self-maintenance), the general autopoietic and enactive frameworks are not able to account for these conditions or relationships, nor for any of their further consequences.

And the "should be interpreted" reminds us that there must still always be an observer.

> Autopoiesis provides a systemic language for speaking about intrinsic teleology but its original formulation needs to be elaborated further in order to explain sense-making. This is done by introducing adaptivity, a many-layered property that allows organisms to regulate themselves with respect to their conditions of viability. (Di Paolo, 2005, p. 429)

> Autopoietic systems exist far from equilibrium and must tolerate the natural entropic trends by remaining energetically and materially open. (Di Paolo, 2005, p. 437)

Adaptivity must be accounted for and explained, but adding it *ad hoc* to a framework based on components and unities introduces a conflict between what is supposed to be unchanging (the components and unities) and what is supposed to be changing (the adaptations). There are echoes of recursive self-maintenance in these discussions, but no mention of it. Enactivism ultimately fails to capture such properties because there is no acknowledgment of the necessary *relationships* between the system and the thermodynamic conditions of its continued existence.[28]

The enactivist approach seems committed to observer-dependent normative descriptivism by, among other things, its assumption that the experiential realm (thus the normative realm) cannot be modeled naturalistically. The presumed gap between nonexperiential and experiential permits at most a correlational analysis. This sort of dualism cannot be rejected out of hand, but the arguments for it are weak and invalid, and normative emergence constitutes an alternative that is not considered. I see pervasive dependence on description by an observer as a troubling theme in the enactivist tradition.

[28] In that sense, the discussion is not able to capture even self-maintenance. Once again I note that such thermodynamic conditions are necessary for "autopoietic systems" to exist, but to simply point that out still fails to address the necessary *relationships between* the system and those conditions — relationships such as self-maintenance and recursive self-maintenance.

4. Conclusions

Interactivism and enactivism share important basic intuitions and insights. One is the recognition of the deep connection between cognition and life. Another is the recognition of the central importance of the experiential realm. But there are also important differences. Autopoiesis is focused on internal self-production, whereas interactivism is concerned with intrinsically open interactive systems. Enactivism denies that the normative realm of experience can emerge — there is just an unbridgeable gap between nonexperience and experience — whereas interactivism sets out to explain how it emerges.

Recent developments in the enactivist literature have recognized the essential importance of far from thermodynamic equilibrium conditions, but still overlook the necessary *relationships* between the organism and those thermodynamic conditions: the essential relationships of self-maintenance, as well as recursive self-maintenance.

Denying that a gap between mind and world can ever be bridged, on the other hand, seems to have produced a reliance on observer-based normative description in lieu of models and explanations. What is badly needed is an "… account of the origin and nature of normative action itself" (Beaton, 2013, p. 310).

Such an account needs to be able to make sense of metaphysical emergence. It needs a process metaphysics — and a model of normative emergence, including the emergence of representational phenomena — within such a process metaphysics. The interactivist model offers such accounts.

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