The event: a process ontological concept to understand emergent phenomena*

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Discussions about emergence have traditionally been structured around the dichotomy between strong (ontological) and weak (epistemological) emergence. Those focusing on emergence as an epistemological problem, understand it as metaphysically innocent, indicating an insufficient (perhaps temporarily so) knowledge of the world. Ontological emergence, on the other hand, admits new levels of reality and causal powers. It emphasizes that emergence is incompatible with reductionism. This position has faced the problem of dealing with explanatory gaps, and accusations of having recourse to esoteric forces to overcome such gaps. This paper explores the possibilities offered by process philosophy - where the nature of reality is one in which becoming has priority over being - to redefine emergence. From a process perspective, emergence has an ontological dimension in which that it may entail new causal powers, but this does not mean that emergent phenomena cannot be explained or understood. By focusing on the key process concept of the Event, we investigate emergence as an onto-epistemological experience. Building on the Deleuzian work on the assemblage and on the Jamesian concept of experience, we show that organization needs to be understood as the locus of causality in emergent phenomena. We present abduction, which gives

room for intuition, imagination and speculation, as the ground to develop knowledge coherent with this perspective.

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Introduction

Discussions around emergence abound in philosophy of science. At the heart of these discussions lies the question as to whether or not anything can be said to emerge, i.e. whether anything truly novel and endowed with causal potency can appear or whether all phenomena are attributable to the properties of fundamental entities. The appearance of such causally potent phenomena has also been referred to as "strong emergence", as opposed to the so-called "weak emergence" in which what emerges might be epistemologically novel (for instance unpredictable or surprising) but not ontologically novel nor causally potent. Following Chalmers (2006) we make the distinction between weak and strong emergence as follows: «A high-level phenomenon is strongly emergent with respect to a low-level domain when the high-level phenomenon arises from the low-level domain, but truths concerning that phenomenon are not deducible even in principle from truths in the low-level domain. [...] We can say that a high-level phenomenon is weakly emergent with respect to a low-level domain when the high-level phenomenon arises from the low-level domain, but truths concerning that phenomenon are unexpected given the principles governing the low-level domain» (2006, 244-245). In this paper we will disentangle the implications such an understanding of emergence has for causality, especially with respect to notions such as "upward" and "downward" causation.

In particular, we will argue that the distinction between weak and strong emergence is made on the basis of a fundamental assumption, notably that there is a distinction between ontology and epistemology. This distinction has been considered by process philosophers such as Whitehead (2006), Latour (2005), and Stengers (2000) as a bifurcation, i.e. a non-necessary separation the utility of which process philosophers question. This bifurcation, between how reality is and how it is apprehended, paves the way for a type of thinking that allows for reference to fundamental elements, or ultimate building blocks of reality (Latour 2011), such as substances. We will argue below that such a bifurcation invites/imposes an explanatory scheme where an emergent phenomenon is (or rather needs to be, in principle) explained in terms of the properties of those building blocks or substances (or interaction of thereof). A key tenet to this view, according to Santos (2015), is that "no elementary entity or compound system can qualitatively change its identity, that is, to acquire and lose properties, through their extrinsic relations". This means that it is "in" those fundamental elements where one needs to look for the locus of causal power that is necessary to achieve a thorough knowledge of emergent phenomena. Hence, this leaves two possibilities for explaining emergence as already sketched out by Chalmers (2006) above: Either reducing/explaining it in terms of those fundamental elements [1] or facing an explanatory gap in that causal capacities of emergent phenomena might not be able to be reduced to, or explained in terms of such elements.

However, in this paper we side with Bunge in arguing that the «possibility of analysis does not entail reduction, and explanation of the mechanisms of emergence does not explain emergence away» (1979, 156). We propose to go beyond the distinction between epistemology and ontology towards an onto-epistemology. We do this through the concept of experience as understood by William James, which has both an ontological and an epistemological dimension. This allows us to propose an alternative account of emergence and with it a different way of conceptualizing

1 We follow Epstein (1999) who notes that unpredictability does not mean non-deductibility. In other words, just because something might be unexpected as a result of it being unpredictable does not mean that it cannot be explained a posteriori and hence, in the widest sense deducible.

novelty and causal potency. Emergence, we argue, could be understood as the property of an arrangement, inspired in the Deleuzian definition of the assemblage [2] (Deleuze & Guattari, 1975), where the act of experiencing actualizes an emergent property. This means that emergence is real because experience is real. This does not entail embracing a subjectivist account of reality nor an idealist one. Instead, we position ourselves as realists, offering a redefinition of what is traditionally meant by objectivity. The question "emergence for whom" becomes a central one. Objectivity is thus a property of the assemblage, not a mind (and experience) independent property in the framework of a bifurcated reality.

2 An assemblage, as inspired by the works of Deleuze and Guattari (1975), is a collection of elements that come together for a capacity to affect that could not be realized without the assemblage. Nail (2017) elaborates «In contrast to organic unities, for Deleuze and Guattari, assemblages are more like machines, defined solely by their external relations of composition mixture, and aggregation. In other words, an assemblage is a multiplicity, neither a part nor a whole. If the elements of an assemblage are defined only by their external relations, then it is possible that they can be added, subtracted, and recombined with one another ad infinitum without ever creating or destroying an organic unity»The elements of an assemblage can be radically different and encompass material and immaterial dimensions alike. It is that capacity to affect, as the property of an assemblage that we take to be an emergent property.

Strong and weak emergence: main controversies

inherent in Chalmer's (2006) characterization of emergence are assumptions about the "locus" of causality, i.e. about the appropriate level to be focused on in the analysis of the emergence of such phenomena (Campbell & Bickhard 2011). Weakly emergent phenomena are defined as arising from the low-level domain and, albeit unexpected, are deducible from and reducible to this lower level. Strongly emergent phenomena are those that arise from the lower level but are not deducible (not even in principle) from that level, and are ontologically novel.

In the first case, the locus of causality is "in" what constitutes the lower level, which is said to be foundational. What constitutes the lower level is often atomistic in nature, e.g. entities/things like particles, substances, states of affairs which are endowed with a set of qualitatively immutable properties (Santos 2015). If they are the most fundamental elements, then they need to be qualitatively immutable. In other words, these atomistic elements have sharp (conceptual) boundaries (Santos 2015). What is more, from the point of view of weak emergence, "organization" cannot be considered a locus of causality. We follow Bickhard and Campbell when they say that if one assumes the existence of fundamental entities, organization is necessarily secondary, «a boundary condition, with no causal power of its own» (2011, 47). By contrast, with respect to strong emergence, the locus of causality is to be found in the emergent phenomena itself, without it being explainable in terms of (and reducible to) what gave rise to it. This is what has led many authors and scholars to qualify this account as mysterious and unscientific (see Epstein, 1999). Protevi summarizes the discussion well when he notes:

> The focus on the part / whole relation of synchronic emergence has caused a lot of mischief in social science with the structure / agency dilemma, and in philosophy of mind with the entire range of problems surrounding the issues of physicalism, eliminative materialism, reductionism, supervenience, and so forth. We see a curious chiasmatic relation here. In consciousness issues, researchers operating without a notion of complex systems struggle to relate the global level of freedom (the mental whole) to the local determinism of physical parts, while in social science they struggle to relate the local freedom of individual agents (parts) to the global determinism of social structure (the whole). The relation of methodological individualism

> in social science to genetic reductionism in biology is not chiasmatic however, but analogic. Genetic reductionism is analogous to methodological individualism in that all living or social phenomena are considered mere epi-phenomena of fundamental units (genes or agents); in other words, these stances accept only 'upward causality'. (Protevi 2006, 24-25)

We argue that approaching the issue of emergence in such way assumes that there is a reality (ontology) that pre-exists experience of it and awaits discovery in the framework of epistemological activity. In this context, Bruno Latour, in the tradition of A.N. Whitehead (2006), refers to the bifurcation of nature which he defines as:

> what happens whenever we think the world is divided into two sets of things: one which is composed of the fundamental constituents of the universe— invisible to the eyes, known to science, yet real and valueless—and the other which is constituted of what the mind has to add to the basic building blocks of the world in order to make sense of them (2011).

Epistemological activity is thus reduced to the activity of discovering that which pre-exists the apprehension of the "real" - which might take the form of matter (as in eliminative materialism) or individuals (as in methodological individualism) as illustrated in Protevi's (2006) quote above. May (2005) notes that the legacy of substance ontologies is still strong in western science. There is thus a tendency to consider substances as real, and this tendency underpins significant areas of scientific practice. Consequently, substance ontologies have significantly shaped discussions around emergence. More generally, the important point to take away is that explanations of emergent phenomena are tied to whatever is defined as the "real", and subsequently needs to be explained in terms of whatever one deems to be real, disregarding how it is apprehended. This limits our possibilities of explaining and understanding emergent phenomena, especially when what is real are substances with defined conceptual boundaries and properties.

I. Being as events of experience

as it has been extensively argued, modernity, and in particular the work of Descartes, laid the seeds for the dominance of substance-biased ontologies (see for example Debaise, 2017 for a discussion and references). Substance-biased conceptualizations - be it physicalism, idealism, etc. - build on the fundamental bifurcations that Descartes introduced: the mind is separate from the body and nature is separate from culture. Process philosophers have extensively denounced the flaws in such bifurcated view of reality and have embraced a conceptualization of the world as made of ever evolving relations, or processes that are captured in events. We argue in this paper that conceptualizing emergence from a process perspective allows to overcome both the threats of reductionism and of explanatory gaps when accounting for emergent phenomena.

I.1. Being understood as Events

Process ontologies base all conceptual developments from the concept of becoming: Becoming precedes being. From a process ontological perspective, reality does not consist of immutable and unchanging beings. Beings are just temporal manifestations of stabilized processes and only secondarily, a derivative of a reality in constant flux. We can think of temporal manifestations of stabilized processes as spatio-temporal

events. Therefore, saying that reality is made of processes equals saying that reality consists of events which are, according to Whitehead (1978), «the final real things of which the world is made up» (18).

Whitehead defines events as «chunks in the life of nature» which simply refer to the «experience of activity (or passage)» (2006, 218). Hynes (2016) considers an event to be an "actualization of forces" and as such, it can be taken as an ontological unit. In order to better understand what comes to constitute an event, we turn to the concept of "immanence" that Deleuze and his co-author Félix Guattari put forward (2002). The plane of immanence supposes that forces exist as possibilities, as potentials of which some are actualized through mechanisms that are not transcendent to what gave rise to them in the first place – in other words, what will actualize will not depend on essences and principles but is immanent to the event itself, simply because the event carries all possibilities of its future unfolding within itself.

It is when going from an indeterminacy of the possible, which refers to the space of possibilities open at any given moment, to a determinacy in the actualization of an event that the notion of "process" applies. The event is one singular actualization of forces, which can be determined in multiple ways. In other words, the actualization of forces does not happen according to any predefined necessary pattern but is defined by the event. Indeed, process ontologies are characterized by rhizomatic dynamics (Deleuze & Guattari 2014) which can be referred to as the principles according to which the becoming of the event unfolds. Rhizomatic dynamics evoke a metaphor in contrast with arborescent and hierarchical images, including multiple entry points and influences following which a being may unfold. Every actualization reconfigures/restructures the possible, because the possibilities of unfolding via actualization change continuously.

I.2. Events are experiences

How do we access events? How do we determine them? What "are" they? The short answer is that events are experiences (Whitehead 1978). An event is a unit of experience that is grasped by what we will call a center of experience (a term coined by Debaise 2017). Therefore, we follow James (1904) and readers such as Debaise (2017) arguing that being is experience. Being is to be understood in terms of events which are concrete experiences in space and time. From this perspective, the *manner* of experience – i.e. conscious or unconscious, mental or sensory – is irrelevant, nor is it relevant who or what experiences (Mesle 2008). As such the activity of experiencing goes far beyond the human, or animate realm (see table 1). Debaise notes that feeling (as experience) is the most fundamental or «primary activity [operation] of all existence» (Debaise 2017, 53). "Experience" is defined, following Whitehead, as a form of apprehending being. A process (or processes) that is (are) realized as an event simply is an experience actualized in a center of experience. According to this scheme, the center of experience is thus an integral part of the event to realize.

It is through experiencing events that one creates abstractions, i.e. concepts that allow to refer to particular experiences. If epistemological practice refers to the practice of making useful abstractions on the basis of our experience, and if reality itself is constituted out of experience, then "experience" has both an epistemological and an ontological dimension. From a process ontological perspective, epistemology and ontology are thus inextricably linked. We follow Karen Barad on her challenge of the separation between epistemology and ontology:

> We do not obtain knowledge by standing outside of the world; we know because "we" are part of the world. [...] The separation of epistemology from ontology is a reverberation of a metaphysics that assumes an inherent difference between human and nonhuman, subject and object, mind and body, matter and discourse (2007, 185).

According to process thinkers, there is no pre-existing "entity" like the human subject as the vehicle of knowing. Joan Scott argues, for example, that the human subject should not be taken as given, but thought of as constituted through experience (1992). A human subject is not a fixed substance that experiences an exterior world. Hence, what a human subject, or rather, a subjectivity, refers to is the activity of experiencing. This, according to Whitehead, applies to micro-organisms as much as it does to humans, the two differing only in how they can experience, not that they experience (i.e. different manners of experience). Debaise notes that:

> It is as if the universe ceaselessly contracts into a multiplicity of points that are so many centers of experience [subjects], perspectives of all that exists. It is important to note that these perspectives are not perspectives on the universe but perspectives of the universe, immanent to it (2017, 51).

These different perspectives of the universe derive from the fact that every experiencer experiences from a particular standpoint, out of a particular history, from a particular embeddedness in space and time. In other words, different centers of experience have different conditions of experience. However, the onto-epistemological account does not commit us to any form of subjective relativism. Deleuze's definition of perspectivism allows us to bridge this apparent tension between particularity and realism: «perspectivism amounts to a relativism, but not the relativism we take for granted. It is not a variation of truth according to the subject, but the condition in which the truth of a variation appears to the subject» (1993, 20).

To sum up the previous two sections, existence (as events) is dependent on being experienced. What an event is can only be explained in terms of what it consists of, that is, in terms of other events it has incorporated, a process which, metaphorically speaking, occurs via rhizomatic and not arborescent dynamics. This means that nothing is more fundamental than anything else and can only be explained through mutual reference; in a certain sense, every event mirrors the world from its own unique perspective (see Hooper 1947). This is because an event simply *is* all the other events it has appropriated or incorporated in its ongoing actualization or unfolding. This carries two consequences: firstly, events have fuzzy boundaries, i.e. they cannot be captured by a definite set of properties alike substances because they are fully composed of other events in a process of continuous unfolding where new events enter continuously; secondly, from a process ontological perspective, we need to abolish the distinction between epistemology and ontology because the act of experiencing, an epistemological activity, is at the same time an ontological activity (see table 1).

Event	The most basic ontological category. It can be abstracted because it is experienced as a unit that can be distinguished as such - by a center of experience - from a world in constant process. Yet, it has fuzzy conceptual boundaries since it is made of other events.

Process	Processes are that which bring about events. A single event can be realized by many different processes coming from a variety of different realms, such as the biological, the ecological, the social, the cultural, the aesthetic, etc.
Experience	In experience the processes that bring about events are disclosed and abstracted. Not all possible processes that could enter an event are always experienced. Which processes are experienced depend on the conditions of experience.
Conditions of experience	Conditions which allow a center of experience to have an affecting experience. Examples are: the presence or absence of a nervous system (conscious or unconscious experience) or a particular context (i.e. a position in space and time), or having or not a language at one's disposal (for example, having a conceptual language allows for transmission of events via a conversation or a book) etc.
Center of Experience	That which experiences. Centers of experience can be very different, given that experience is not limited to a human faculty. Human, conscious experience is just one way of experiencing, next to other, unconscious ones.
Possibility space	The set of processes and their interactions that are possible. The possibility space changes as processes actualize and change in interaction with other processes. It records events and contains them and is modified by random events. The possibility of those events occurring is one of the characteristics of the possibility space.

Table 1 Definitions (based on works by Whitehead 1925, Deleuze and Guattari 2002)

II. EMERGENCE FROM A PROCESS ONTOLOGICAL PERSPECTIVE

Two implications for emergence: organization matters and need of an experiencer to exist

II.1. Organization matters

As indicated above, the boundaries of the event are fuzzy. Thus, explaining emergent phenomena - which are events themselves - in terms of other events with fuzzy boundaries puts emphasis on the concrete processes that bring the emergent phenomena about. [3] In other words, the locus of causality lies in the particular organization of processes that generate emergent phenomena at any given moment. Process thinkers such as Deleuze and Guattari talk about assemblages of processes to characterize emergent phenomena.

3 Saying that an emergent phenomenon is an event that can be understood in terms of other events is, in the end, just another way of stating that emergence is the property of an assemblage (see the introduction to this paper)

To illustrate the process conceptualization of emergence, let's turn to the well-studied Balinese water management temples (Lansing 1987 and 2003; Lansing & De Vet 2012). Those temples and the rituals around them are organized into an emergent, highly complex crop-management system. We will define such system as an assemblage of processes in which the rotation of crops not only allows efficient shared irrigation practices but also pest management control. Management is at the same time the result of and shaped by a «process of coadaptation on a rugged fitness landscape» (Lansing & Kremer 1993, 99). This process of coadaptation should be understood as continuously evolving in time and space and involving farmers, ecological systems, cultural practices, and the physical geography of Bali. Put differently, what these individual components are, and why they do what they do, cannot be understood without reference to this very process of co-adaptation that changes these same components along the way. In this sense, the emergent property – the highly complex crop management system – is not something that pre-exists the relation between the individual components. Put differently, it cannot be said to be the result of a simple aggregation or combination of pre-existing components precisely because these components are changed by the very process of co-adaptation. This continuous co-adaptation among individual components can be understood in terms of evolving possibility spaces (defined by the plane of immanence at any moment) in the framework of which novel relations actualize as processes. The properties of emergent phenomena simply lie within those actualized processes that define such assemblages. In other words, it is because the particular relations between the farmers, ecological systems, cultural practices, and the physical geography of Bali are actualized by the processes of continuous co-adaptation that the emergent property (crop-management system) realizes.

Holding that true, we neither have essences that would be the locus of upward causation, nor do we have some kind of whole that would "do" the downward causation. We side with Santos when he notes that:

> Therefore, we can preserve the meaning of both upward (UC) and DC [upward and downward causation] without assuming the existence of causes that "go up" and "go down" between parts and wholes. UC and DC must be conceived as two different aspects of the same ongoing intra-level process of systemic relational causation between different relata that belong to the same relational domain. (2015, 28)

Another way of putting this is to re-emphasize that relations which are actualized as processes modify the possibility spaces of events. It is precisely in terms of this modification of the possibility spaces that upward and downward causation have to be understood. This modification influences what an assemblage, understood as an event, can and cannot do. Thus, we can think of UC and DC without thinking that either wholes or parts do the job but rather think of them in terms of actualized relations that modify the possibility space of events.

II.2. Emergence needs an experiencer

The fact that events are units of experience implies that for emergent phenomena to exist it requires to be experienced. In other words, the fact that emergence requires an experiencer implies that emergence is a property of an event, which, in turn, is inseparable from a center of experience. This contrasts with a layered view of reality, since from a process perspective, emergent phenomena do not exist independent of

an experiencer. We can therefore not answer the question about emergence without asking at the same time the question about emergence for whom. Taking the example of the water temples above, we can say that for the human farmer, or for the scientist who investigates, and in accordance with their respective conditions of experience, the process presents itself as *one* process organizing interactions of components into a functional structure that is a highly complex crop-management system.

This process has two dimensions: how the interaction of the components leads to the functional structure as well as how the functional structure impacts on the components. Highlighting those two dimensions is important because otherwise one could not make a difference between, on the one hand, emergence and, an encounter/interaction on the other hand. An encounter of two assemblages may modify a possibility space but does not necessarily count as what has been defined as emergence - which involves that encounters/interactions lead to new functional structures that themselves impact on the possibility space of the entities involved.

II.3. Organization and Experience mutually determine each other

To fully grasp the scope of an onto-epistemology it is necessary to elaborate on the mutual determination of processes which realize organization on the one hand, and on experience of those very processes on the other hand. These processes, and the organization they realize, only have their given causal powers *because* they are experienced. Experience and processes are two dimensions of the same thing in an ongoing process of unfolding which is defined by the interplay of what is possible and what is actualized. *In other words, experience organizes processes into events, but at the same time those very processes determine the possibilities for subsequent experience.*

III. Abductive methods from complexity sciences to further our understanding of emergent phenomena

process ontologies have been proposed as foundations for complexity science (Weinbaum 2015; Holland 2013; Protevi 2006), which suggests that methods used in complexity science might be appropriate to tackle emergence from a process-relational perspective. As an example, see Preiser et al. (2018), who comprehensively identify appropriate methods for furthering our capacity to analyze complex systems. It is striking to note that to a large extent these methods are abductive in nature.

Abduction, as a form of reasoning, was proposed by the American pragmatism philosopher Charles Sanders Peirce (1994) as a third form of reasoning next to induction and deduction. The latter two have been criticized by process philosophers, such as Whitehead, as not allowing novelty to enter the line/chain of reasoning. Indeed, induction and deduction have been criticized by process thinkers as too rigid since they both begin with reference to something pre-existing. We follow Shaviro (2015, online) in his summary of the issue:

> Deduction starts with conditions that are already given, and traces out a chain of logical consequences for those conditions. Induction, for its part, generalizes on the basis of an already given set of particular observations. According to Peirce, neither deduction nor induction can actually suggest anything new.

Inductive and deductive forms of reasoning have been used to analyze emergent phenomena on the basis of substance ontologies. Instead, Whitehead insists that there needs to be room for «the play of a free imagination, controlled by the requirements of coherence and logic» (1978, 5) in a process perspective because otherwise one is bound to miss the process of the unfolding of the event according to rhizomatic dynamics. This needs speculative activity. Shaviro (2015) is among those authors who see the Whiteheadian call for speculation in scientific activity akin to the Peirceian abduction. What the call for speculation does is to reverse the order of reasoning. It focuses on phenomena and speculates as to what brought them up, thus allowing change, interaction and thus true novelty to enter the process of scientific discovery.

IV. Conclusion

weak emergence entails reductionism where the causal potency of an emergent phenomena can in principle be explained in terms of the elements of the lower level (or interaction thereof). Strong emergence has been condemned as entailing explanatory gaps where the causal capacity of the emergent phenomena cannot be explained in terms of the lower level elements (or interaction thereof). The onto-epistemological point of view, which situates the locus of causality in the relations between components of an assemblage, allows us to side with Bunge in saying that the «possibility of analysis does not entail reduction, and explanation of the mechanisms of emergence does not explain emergence away» (1979, 156).

Saying that emergence is the property of an event equals to saying that something is emergent because it is abstracted as an event. From an onto-epistemological perspective, this does not entail reduction because an event simply IS defined by other events it has integrated in the process of abstraction. This means that it cannot be reduced to something more fundamental because it can only be understood by reference to other events. There is nothing to what a particular being or an entity (or set of beliefs for that matter) can ultimately be reduced to except events of experiences but which are mutually conditioning, presupposing, constituting, explaining etc. each other (see Latour 2005, 72). This is because all experiences are equally important, and none is more “real” than others (James, 1904; Duvernoy 2016).

This also means that the onto-epistemological position does not entail an explanatory gap when accounting for strong emergence. There are two reasons for this: First, because the onto-epistemological position abolishes bifurcations. When it comes to the explanation of an emergent phenomena, one is freed from having to explain it in terms of particular experiences (such as those conveyed by primary qualities). Second and more importantly, entities, understood as events, evolve according to rhizomatic dynamics and acquire new properties and capacities by entering novel relations and laying thus a fundament for a type of novelty that is akin to algorithmic understandings of novelty (Arthur 2011).

Emergence is a property of the event, and of the center of experience that experiences it. This opens up the possibility that emergent phenomena can exist for some, but not for others, but that doesn’t make the phenomena less real - which certainly goes beyond reducing them to mere epistemological differences and further develops the Deleuzian idea of perspectivism. As such, we have argued here that investigating emergence involves dwelling in those differences and to follow them by the use of, for example, abductive methods.

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