Are Objects Ontologically Dependent on Processes?

(Extended Abstract)

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1 Substance Ontology *vs* Process Ontology

The dominant ontological paradigm throughout Western philosophy has been the Aristotelian *substance ontology*, according to which substances — including what we would nowadays more generally refer to as *objects* or *things* — are independent entities ("first-class citizens" of the ontology), whereas processes and events are "accidents", that is, "second-class" entities that are dependent for their existence on the objects that enact or participate in them.

Despite its dominance, the substance ontology has not gone unquestioned. Repeatedly in the history of philosophy there have been thinkers who have sought to elevate *processes* to the rank of first-class independently existing ontological elements, sometimes even reversing the dependence to make objects ontologically dependent on processes. Indeed, this line of thinking had already appeared before Aristotle, being traceable at least as far as Heraclitus, more than a century earlier.

In more modern times, some form of process ontology has been advocated by thinkers such as Whitehead [17], Heidegger [8], Rescher [13], and Dupré [2], amongst others, and has particularly found favour amongst philosophers for whom the primary focus of interest is living organisms, as opposed to, for example, human artefacts. Outside Western philosophy, Buddhist philosophy in particular has had a long history of treating processes as more fundamental than substances [12].

My purpose in this talk is to examine a number of considerations that I consider to be of key relevance to the debate between substance ontologists and process ontologists. My general orientation will be towards the latter, but before presenting a positive case I begin by drawing attention to what I believe is a serious problem with substance ontology.

2 The Cinematographic Model of Reality

If the fundamental elements of reality are substances, how are processes and change to be accounted for? In mainstream thinking, the standard account of change is somewhat as follows. At each instant of its existence, an object has certain properties; but it need not have the same properties at every instant. Change is what happens when an object x has some property P at some time t_1, but lacks that property at some distinct time t_2:

$$\exists t_1 \exists t_2 \; P(x, t_1) \wedge \neg P(x, t_2).$$

Suppose at a given instant t we take together all the properties of all the objects existing at that instant, and call that ensemble the state of the world, or *world-state* that holds at t: call this $ws(t)$. On this view, the history of the world essentially consists of the mapping ws from instants to world-states. Each world-state is itself unchanging, and the existence of change in the world reduces to differences between successive world-states.

I call this the *cinematographic model of reality*. In the cinema we think we see moving images on the screen. But we know that in fact nothing moves: what we are seeing is a succession of still images in each of which there is no change or movement. The view of change described above, which is naturally associated with the substance ontology, works in the same way. Motion and change are reduced to some kind of "illusion" produced by stringing together world-states from which motion and change are absent.

This a problem for us if we believe that changes in the world are continuous, as expressed by Leibniz in the catchphrase *natura non facit saltus* ("nature does not make jumps"). Continuity is important for substance ontology because it provides one of the major underpinnings of the concept of *identity*. If asked what it means to say that the person you see in front of you now is the *same* person as the one you saw entering the room at the beginning of the talk, you may reply in various ways, but most probably you will invoke some form of continuity, be it spatio-temporal, material, or psychological.

On the cinematographic view, we require the functions ascribing quantitative property values such as position to substances to be continuous. What this means is that by focussing on sufficiently small time periods, we can make the changes that we see as small as we like. This is what is expressed in the standard mathematical definition of continuity for a numerical function:

$$\forall t \, \forall \epsilon > 0 \, \exists \delta > 0 \, \forall t' \, (|t - t'| < \delta \rightarrow |f(t) - f(t')| < \epsilon).$$

Now the problem is that this formula — which expresses a *mathematical* notion of continuity — only comes close to capturing something that resembles the physical continuity we believe we see in the world if the set T of times over which the variables t and t' range satisfies the Dedekind completeness condition: any set of numbers with an upper bound has a least upper bound. This in turn means that T must be modelled by something like the set of real numbers $\mathbb{R}$.[2] You can easily see what goes wrong with, say, the rational numbers ($\mathbb{Q}$) by constructing a function which maps x to 1 if $x^2 < 2$ and to 0 otherwise; this function is continuous on $\mathbb{Q}$ but gives a very bad model of any physically continuous variation.

There are two reasons why we should feel uncomfortable about having to use the real numbers to model space and time. The first is

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[2] Perhaps it does not have to be the full non-denumeratble set of real numbers: maybe a denumerable set such as the computable numbers, or the real algebraic numbers, which satisfy the first-order form of Dedekind completeness (quantifying over first-order expressible sets only) but not the full second-order form, would do.

that they require us to admit the existence of *actual infinities*. Within any time interval, however short, there must be infinitely many instants, one for each real number falling between the numbers assigned to the endpoints of the interval — and likewise with spatial regions. The second problem is how we are to account for the facts of *duration* (in time) and *extent* (in space). If a time interval is nothing but an agglomeration of durationless instants, where does its duration come from? However many zeros you add together, you will never get anything other than zero; and yet we are invited to suppose that the positive duration of a time interval somehow emerges from the combination of all the instants it contains.

None of this means that we should give up using real number mathematics for the purposes of science. The use of $\mathbb{R}$ to model physical continua may be a metaphysical fiction — indeed a metaphysical absurdity — but it is the only way we know of providing a formal underpinning for the kinds of calculations needed to obtain quantitatively meaningful results about the real world. It supports the "unreasonable effectiveness of mathematics in the natural sciences" [18]. Despite that, I believe the foregoing considerations render the traditional substance ontology untenable.

3 Taking Time and Change Seriously

In the argument presented above, the notion of *duration* played a key role; this is as it should be, for surely duration is the very essence of time. That is why it is so absurd to try to build time out of durationless instants. Furthermore, the essence of duration is surely *change*: any duration has parts, and without change, how can one part of a duration be distinguished from another?

Although I do not postulate any such thing as a minimum duration in actuality, subjectively the present moment seems to be a kind of minimum duration, reflecting the limit of the temporal resolution of our immediate experience. By technological means, we are able to measure temporal separations much shorter than we can discriminate ourselves, but no technology can identify for us an absolute minimal duration. What is crucial here is that time always comes endowed with duration; durationless time seems utterly contradictory. And therefore time depends on change: a temporal duration completely lacking in change also seems contradictory.

It follows from this that the present, which is part of time given in experience, encompasses change. This is radically opposed to the standard picture of real-number time, in which the present is portrayed as a durationless instant and therefore completely lacking in change. I propose therefore that we should embrace the notion of the *dynamic present*. A 'snapshot' of the world, if such can be conceived, so far from being the static 'time slice' postulated by conventional ontologies, itself contains motion and change: the processes of the world are active at all times of their existence. Elsewhere I have advocated a view of processes as being, if not actual continuants, at least in important respects *continuant-like* [5, 6, 7]. Processes are wholly present at each time of their existence, and have attributes which themselves can undergo change, resulting in *metaprocesses*, such as the fluctuation in loudness of a noise, or the acceleration of a motion. This is fully in accord with the picture I am painting here.

In order to allay possible misunderstanding, I must clarify that I am here using the word 'process' to denote something that is ongoing, open-ended, a pattern of activity rather than a completed episode with a beginning and an ending. It is the sense of process that is aligned with *activity* in Vendler's well-known classification of verb meanings into achievements, accomplishments, states and activities [16]; in [11], these are called processes. It also corresponds to the category 'process' in the DOLCE ontology. This is *not* the same as the 'processes' of BFO [1]. A BFO process is a four-dimensional entity, similar to the completed episodes of the kind I mentioned earlier; in more standard terminology this could be described as an *event* rather than a process.

It cannot be stressed too strongly that most of what I say about processes in this talk would be false or unintelligible if 'process' were to be understood as meaning a BFO process. A process ontology, BFO-style, would be *perdurantism*: like the substance ontology (or *endurantism*), it too is unable really to come to terms with the notion of real change. Whereas endurantism must simulate change cinematographically by compounding together infinitely many changeless instants, perdurantism reduces change to difference amongst the temporal parts of a four-dimensional whole which represents a substance by means of its entire life-history. In the kind of process ontology I am advocating, change is fundamental: it is a primitive given, not to be explained away in terms of changelessness.[3]

4 Object, Process and Event as Ontological Aspects

In [6] I defined two contrasting, and complementary, perspectives we use in describing the world. On the one hand, we may describe reality in terms of how it presents itself to us in experience, taking, in other words, a present-tense point of view. I call this the *experiential perspective*; forms of description appropriate to this perspective may be said to present elements of reality under an experiential *aspect*. In this aspect we see objects and ongoing processes. On the other hand, we can as it were stand back from the immediately experienced world and present a synoptic view, integrating over a period of time to form temporally extended episodes that we call events. This is called the *historical aspect*. The use of the term 'aspect' here reflects its use in linguistics to denote distinctions such as that between perfective and imperfective forms of the verb, which typically correlate with the historical and experiential aspects respectively.

Within the experiential perspective we find both objects and processes, but contrary to the impression given by the substance ontology, it is not always easy to distinguish between these two categories. In previous work [3, 4] I drew attention to what I called *dual-aspect* or *multi-aspect* phenomena, such as rivers, waterfalls, ocean currents, waterspouts, hurricanes, and tornadoes; depending on how one views these, they may equally well be described as objects, processes, or events. A hurricane, for example, as captured in a series of satellite images, has size, shape, position, and motion along a trajectory, all features typically associated with objects; but to the unfortunate villager in the path of the hurricane, it is not an object but a process, a ferocious rushing of the wind, wreaking destruction as it passes by; or else, taking the duration of its passing as a whole, it is an event.

There are, indeed, complex interdependencies between the objects and processes we see in the world. In the spirit of [7], we can readily recognise that a human being, for example, is dependent on its metabolic processes by which the living fabric of the body is maintained in working order; but these processes are themselves dependent on the molecules which participate in them. They in turn are dependent on the atomic and subatomic processes which hold them together. For a process philosopher the nature of the dependence of an object on processes might best be described in terms of constitution: the processes are *constitutive* of the object. This does not mean that the object 'does not exist' but rather tells us something important

[3] I am indebted to Anne Sophie Meincke for helping me to clarify my understanding of the deficiencies of both endurantism and perdurantism.

about what it means *for* an object to exist: in effect, it suggests that existence is a process rather than a state.

5 An object image schema

If 'object' and 'process' are to be understood as aspects of the same experiential reality then an appropriate approach to explaining their relationship might be to examine the cognitive apparatus through which we apprehend and experience them. Here I explore the potential of the *image schema* as a tool to aid us in this examination. An image schema [9, 10] is a recurring "semi-abstract" pattern by which we can mould our raw experiences into a structured understanding of the world. As Johnson [9] puts it, "image schemata operate at a level of mental organization that falls between abstract propositional structures, on the one side, and particular concrete images, on the other". Typical examples of image schemas include PATH, CONTAINER, FORCE, LINK and COLLECTION.

Johnson's list of image-schemas includes both PROCESS and OBJECT, but he says frustratingly little about these. Subsequent authors have elaborated on them somewhat, but I have the impression that these schemas have not been subject to the same scrutiny as many others. Santibáñez [14] attempts to characterise the main features of an OBJECT image-schema, but seems to be limited to rather a narrow conception of 'object' as prototypically middle-sized, solid, inert, and manipulable: cars, books, keys, tables, and apples rather than hurricanes, animals and trees. Szwedek [15] distinguishes static and dynamic object schemas, but the dynamic schemas exclusively relate to the external processes of objects and in no way support any notion that objects may be inherently processual in nature. Can we do better than this in support of the process-ontological theory?

What features do we expect to find in an object in the most general sense? Most fundamentally there is *persistence*: an object manifests a certain stability, either of matter or form. This is achieved through a balance of internal processes (a living organism undergoes a constant exchange of matter with its environment, rebuilding itself throughout its life; an inert chunk of matter maintains a balance between attractive and repulsive forces at atomic and subatomic scales). An object owes its identity to this stability. But objects also enact changes, manifested as their external processes or *activities*. Changes can be intrinsic, affecting the matter and form of the object itself, or extrinsic, affecting its relation to its environment — the most obvious extrinsic change is change of location, or motion. These changes or motions can come about either autonomously, as a result of the object's inner processes, or in response to *impingements* by environmental processes: thus an object's external processes comprise both *action* and *reaction*. But because of stability, an object is able also to resist impingements, giving us *resilience*. Finally, if the balance of the internal processes cannot be maintained, perhaps as a result of external forces too strong to respond to while maintaining stability, the object may undergo *destruction*, involving the separation or dissolution of its parts. All these features are illustrated schematically in Figure 1, where the arrows represent various kinds of causal relation.

The key point to observe here is that the object schema is specified in terms of processes. If this schema comes anywhere close to capturing what it is to be an object, then objects must be dependent on processes. For a thoroughgoing process ontology one must go further than this and maintain that objects are dependent on *nothing but* processes; only thus could we claim that objects are constituted by processes, that the nature of objects is essentially processual. All the considerations I have put forward in this talk tend in this direction, but I readily admit that the case is not proven.

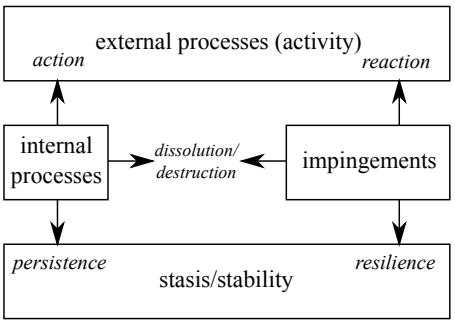

Figure 1. A sketch for a process-oriented OBJECT schema.

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