The Ontology of Time and Process Part I: Continuants and Occurrents

Antony Galton

Department of Mathematics and Computer Science University of Exeter, UK



ISAO 2016 Bozen-Bolzano, Italy 27 June – 1 July 2016 Ontology = The science of being

But the world comprises not just what is but also what happens.

Ontology = The science of being and becoming

What there is	What happens
People	Lives
Trains	Journeys
Volcanoes	Eruptions
Playscripts	Performances
:	:

How is what exists related to what happens?

Idea 1: There's no difference between existing and happening

The world comprises four-dimensional entities.

What we see at any one time is *cross-sections* (instantaneous temporal parts) of these entities.

An object comprises a continuous sequence of such cross-sections, forming a "worm" extended in time as well as space. The cross-sections are *temporal parts* of the object. The object is not wholly present at any one time.

An object is not different from the event which is the life of the object.

This is Four-dimensionalism or Perdurantism.

N.B., "Worm" vs "Stage" variants.

Idea 2: Things that happen are properties of things that exist

Mary

- ... is 160 cm tall
- ... has red hair
- ... wears glasses
- ... cycles to work every morning
- ... is wearing a blue dress
- ... is painting a picture
- ... bought a new bicycle in June

Properties are not *entities* (first-class citizens of the ontology), and to speak of them as if they were ("Mary's hair colour", "Mary's purchasing a bicycle") is a mere *façon de parler*.

Idea 3: Things that happen are entities that are ontologically dependent on things that exist

Mary's purchasing of a bicycle is an entity (an item in the inventory of all that the world contains) but it can only exist if Mary (and the bicycle) exists.

This is a variant of **specific existential dependence**: "Entity x is specifically existentially dependent on entity y" means that necessarily, y exists at any time at which x exists.

$$\Box \forall t (Exists(x, t) \rightarrow Exists(y, t)).$$

But in this case we might put

$$\Box \forall t (Happens(x, t) \rightarrow Exists(y, t)).$$

(Here t could be an interval rather than an instant.)

Idea 4: Things that exist are ontologically dependent on things that happen

This is a form of **Processism**.

Existence is a process: An object is some kind of ensemble of processes (e.g., a person is a complex of internal bodily processes and interactions with the outside world).

Objects cannot exist without processes; on this view, only things that happen have an independent existence (they are what *primarily* exist).

Idea 5: Things that exist and things that happen are mutually dependent

An object is dependent on its **internal** processes, and its **external** processes (in which it participates) are dependent on it.

The internal processes on which an object depends are themselves external processes of parts of the object, which are in turn dependent on *their* internal processes.

There is a chain of dependencies.

This is the "Waterfall" model of Galton & Mizoguchi (2009).

SNAP and **SPAN**

The creators of BFO distinguished between

- SNAP, the ontology of what exists at a moment of time (a SNAPshot).
- SPAN, the ontology of what happens (SPANning a period of time)

The inhabitants of the SNAP and SPAN components of an ontology are called **continuants** and **occurrents** respectively.

Continuants and Occurrents

A continuant

- "exists wholly at each moment of its existence";
- endures through time, possibly gaining or losing parts and changing with respect to some of its properties;
- has spatial parts but not temporal parts.

An occurrent

- only exists wholly over a span of time (it "perdures");
- cannot itself be said to undergo change, although its occurrence can result in (or consist of) changes in various continuants;
- has temporal (and possibly also spatial) parts.

Example 1: A house

The history of the house:

- 1. At t_1 , the foundations are laid.
- 2. By t_2 , the walls and roof are all in place but the windows, doors, etc, have not yet been installed.
- 3. At t_3 the house is at last ready to live in.
- 4. At t_4 , an extension is built on one side of the house.
- 5. At t_5 , the house is deserted and begins to decay: roof tiles fall off, the windows are broken, the brickwork starts crumbling.
- 6. At t_6 all that is left standing is a ruined shell, with incomplete walls and no roof.
- 7. At t_7 all that remains is a pile of rubble on the ground.

What does it mean to say that the house "exists wholly at each moment of its existence"?

At t_6 it is *not* a whole house — it has lost its roof and parts of its walls.

What exists at t_6 is all of the house that there is at t_6 .

This is "incomplete" by comparison to what it was previously, but at t_6 the whole of this incomplete house exists.

As a house, it is incomplete, but as an incomplete house, it is complete.

What makes it still the whole house is that it is precisely this (incomplete) assemblage of house components, and nothing else, which can be identified as the same house as the assemblage which existed between t_4 and t_5

Example 2: A person (me!)



1952 1956 1960 1963 1965 1972 1975 1976 1979 1981 1987 1988 1990 1999 2012 2016

- Each image in this series shows the same continuant (me) existing in a particular dated SNAP ontology.
- The parts of the entity are spatial parts, e.g., my nose. The whole of my nose exists in each of the SNAP ontologies;

Example 2: A person (me!)



 $1952\ 1956\ 1960\ 1963\ 1965\ 1972\ 1975\ 1976\ 1979\ 1981\ 1987\ 1988\ 1990\ 1999\ 2012\ 2016$

- Each image in this series shows the same continuant (me) existing in a particular dated SNAP ontology.
- The parts of the entity are spatial parts, e.g., my nose. The whole of my nose exists in each of the SNAP ontologies;
- ▶ My life (which is an occurrent), SPANs over these SNAPshots:



- This has temporal parts, some of them shown in the figure; each of these is an occurrent.
- I, the continuant, participate in each of these occurrents, none of which could occur if I did not exist.

The Four-Dimensionalist View

There is no such thing as a continuant.

Each snapshot shows a temporal part of my life.

AG in 1972 is not the same entity as AG in 1975: they are distinct temporal parts of the four-dimensional entity AG which spans a period from 1952 to sometime in the (as yet unknown) future.

On this view, **change** in a continuant reduces to **difference between temporal parts** of an occurrent: the 1972 part of AG is bearded, the 1975 part is not, but strictly speaking nothing changes, since there is no one thing that is now bearded, now not (instead, the 4D AG is partly bearded and partly not).

There is no reason to think the 4D view is not coherent: but it does require a **disruptive reconceptualisation** of many of our everyday ideas.

Is the standard 3+1-dimensional view coherent?

How can the same man be both bearded and not bearded? He was bearded in 1972 but not in 1975.

There are various ways in which we could construe this.

The "stage" view

AG-in-1972 is bearded, but AG-in-1975 is not bearded.

It is not the same entity that is bearded and not bearded.

$Bearded(AG_{1972}) \land \neg Bearded(AG_{1975})$

◆□ > ◆□ > ◆豆 > ◆豆 > ̄豆 → つへぐ

The temporalised property view

AG is bearded-in-1972, but AG is not bearded-in-1975.

It is not the same property that is asserted and not asserted of AG.

$Bearded_{1972}(AG) \land \neg Bearded_{1975}(AG)$

▲日 ▶ ▲圖 ▶ ▲ 画 ▶ ▲ 画 ▼ の < ⊙

Properties as relations between things and times

AG is-bearded-in 1972, but not AG is-bearded-in 1975.

Beardedness is a relation between a person and a time: it is not the same person-time pair of which beardedness is asserted and denied.

 $Bearded(AG, 1972) \land \neg Bearded(AG, 1975)$

The Method of Type-reification

"AG is bearded" is true in 1972 but not true in 1975.

Truth is a relation between property-ascriptions and times: it not the same property-ascription/time pair which is true and not true.

 $True(bearded(AG), 1972) \land \neg True(bearded(AG), 1975)$