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Ontology Generator

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Abstract: The paper proposes a simple method for constructing ontological theories—an 'ontology generator'. It shows that such a generator manages to produce major existing ontological theories, e.g., Realism, Nominalism, Trope theory, Bundle theory, Perdurantism, Endurantism, Possibilism, Actualism and more. It thus turns out, surprisingly, that all these seemingly unrelated different ontological theories that were designed by thinkers hundreds of years apart, can all be generated using the same simple mechanism. Moreover, this same generator manages to produce entirely novel ontological theories, that fare no worse than existing ones in meeting the same common metaphysical challenges.

Keywords: ontology, metaphysics, history of metaphysics, properties, meta-ontology

1 Introduction

Over millennia, philosophers have constructed a wide variety of ontological theories, all designed to address persistent metaphysical challenges and puzzles, with each such theory proposing a different solution. Many of these ontological theories still compete with one another to this day. The following list of such prominent ontological theories, as well as of some of their notable supporters throughout history, testifies to this wide variety and time-span: Realism (Plato c. 400BC; Armstrong 1978); Trope theory (Aristotle c. 350BC, Husserl 1900; Lowe 2006); Nominalism (Ockham c.1300, Quine 1954); Bundle of Universals theory (Hume 1739; Late Russell 1940); Bundle of Tropes theory (Campbell 1990; Williams 2018); Perdurantism (Heller 1990; Taylor 1955); Endurantism (Geach 1966; van Inwagen 1990; Wasserman 2003); Possibilism (Lewis 1986; Wallace 2019); Actualism (Paul 2002; Plantinga 1976).

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The first aim of this paper is to show that, surprisingly, all of these seemingly unrelated ontological theories—that were designed by thinkers hundreds of years apart—can be generated using the same simple mechanism. In other words, it will be argued that there is one simple unified mechanism underlying all of these apparently very different ontological theories. Such a common mechanism also allows for a very clear comparison between these theories. The second aim of the paper is to show how this same mechanism can also generate entirely new ontological theories, that fare no worse than the ones listed above in meeting the same metaphysical challenges. In short, the paper will propose an 'ontology generator'.

Section 2 briefly introduces the main metaphysical challenges that ontological theories strive to meet, and then proceeds to portray how each of the above theories in fact meets these challenges. Section 3 introduces the proposed 'ontology generator' and illustrates how it generates each of the ontological theories discussed. In Section 4 the same mechanism is used to generate entirely new ontological theories, that fare no worse than their existing competitors. In fact, it will be suggested that theories that were generated in a similar way share similar strengths and weaknesses, i.e., they successfully meet similar challenges and are open to similar objections. Section 5 will conclude the discussion.

Surely, each of the ontological theories discussed in this paper has several versions that differ from one another to varying degrees. However, any such versions of a certain ontological theory share some essential feature, by virtue of which they are considered *versions* of that basic theory. The aim of the mechanism proposed in this paper is to generate just these *basic* ontological theories. Accordingly, these theories will be presented in fairly broad strokes.

Finally, by no means does this paper aim to cover all ontological theories. For example, it does not mention ontological theories that feature propositions or bare substrata or states of affairs. Nonetheless, there are good reasons to believe that the same proposed mechanism can be adapted to generate such ontological theories as well.

2 Metaphysical Challenges and Ontological Theories

In order to introduce the proposed ontology generator, first we need to introduce the ontological theories that are to be generated. A convenient way to do so would be through presenting the motivations that had led to their construction, namely the metaphysical facts that they aim to explain.

Natural science is in the business of formulating theories that explain empirical facts. For instance, the empirical fact that the sun rises and sets every day was explained by the intuitive geocentric theory according to which the sun revolves around the stationary earth, and this theory was later replaced by the heliocentric theory, which explains the same empirical fact by stating that the earth spins around its axis (and also slowly annually around the stationary sun). But what do *ontological* theories aim to explain? It may be said that just like there are empirical facts, so there are also metaphysical facts—the latter being the ones to be explained by ontological theories. For example, one metaphysical fact is that different objects can share the same property; an ontological theory will have to explain how it is possible for two distinct objects to share one and the same property, e.g., how it is possible for both Sanna Marin and Ingrida Šimonytė to have the same property of being a person. Of course, trying to explain a shared property by using science—e.g., to explain the shared personhood of the two women in terms of their DNA—will not get us very far, since any such explanation will still involve different objects (e.g., DNA molecules) that share the same property (e.g., number of chromosomes)—which is exactly the fundamental phenomenon that calls for an explanation here. So sharing a property is a fundamental *metaphysical* fact in need of *metaphysical* explanation. Other fundamental metaphysical facts that call for metaphysical explanations by an ontological theory include: the fact that objects undergo changes, e.g. Marin the child became taller as she grew up; the fact that an object might not have had some properties that it actually has, e.g., Marin might not have been prime minister; and, of course, the fundamental metaphysical fact that objects have properties in the first place. As we shall see, all these metaphysical facts raise serious challenges to potential explanations.

Although there are other metaphysical facts,[1] these four facts alone have generated quite a few distinct ontological theories over the centuries, as we shall see shortly. Thus, for our present purposes, we shall focus on these four fundamental metaphysical facts alone.

2.1 Sharing a Property

We begin with ontological theories that aim to explain the metaphysical fact that distinct objects can share the same property. According to *Realism*, objects are *particulars*, i.e., individual concrete entities, whereas properties are *universals*,

1 Standard examples of such facts that call for explanation include numeric distinctness; essential versus accidental properties; creation and destruction; part-whole relations; necessity *de re* and *de dicto*, contingency and impossibility.

i.e., non-particular abstract entities. And for two objects to share the same property is for two particulars to *instantiate* the same universal. Thus, for example, both Marin and Šimonytė instantiate the universal 'personhood'. So the ontology of realism includes both particulars and universals.[2] The obvious problem with such a theory is that universals turn out to be some mysterious entities that are capable of being 'wholly present' in different places at the same time—which is known as 'the problem of universals'.

According to an alternative, *Trope Theory*, a property is not an abstract universal but rather a *trope* (or 'accident', or 'property instance'), which is an abstract *particular*, e.g., *Marin's* personhood, which is distinct from *Šimonytė's* personhood.[3] According to this ontological theory, for two objects to have the same property is for two particulars to have *similar* tropes. So the ontology of trope theory includes only (concrete) particulars and tropes (i.e., abstract particulars), thereby avoiding the mystery of universals. However, this comes at the price of a need for a criterion of similarity, specifically, a criterion that would determine when two tropes—e.g., Marin's personhood and Šimonytė's personhood—are similar enough to justify a claim for a *shared* property. In addition, it is not entirely clear that a trope, i.e., an abstract particular, is indeed less mysterious an entity than an abstract universal.

An ontological theory that avoids both universals and tropes altogether is *Class Nominalism*. According to this theory, a property like being a person is neither a universal nor a trope; rather, it is simply the class of all persons, and in general, a property F is nothing but the class of particulars that F.[4] Thus, for two objects to have the same property is for two particulars to be members of the same class; e.g., Marin and Šimonytė share the property of being a person by virtue of both being members of the relevant class of particulars. By shunning universals and tropes altogether, class nominalism enjoys avoiding their mystery, but this comes with two substantial drawbacks. The obvious one is that taking properties

2 Loux and Crisp (2017: 44) list Plato, early Russell, Donagan and Armstrong as notable proponents of metaphysical realism.

3 Among early supporters of trope-like entities, Mertz (1996) mentions Aquinas, Duns Scotus, Avicenna, and Averroës. Modern philosophers include Spinoza, Descartes, Berkeley and Hume (Mulligan, Simons, and Smith 1984), and in the 20th century, key proponents include Husserl, Ingarden, C. B. Martin, John Heil and Jonathan Lowe (Maurin 2018).

4 Lewis (1983). Other close versions of nominalism are: *mereological nominalism* (having the property F is being part of the aggregate of particulars that F), e.g., Effingham (2020); and, *concept nominalism* or *predicate nominalism* (having the property F is nothing but falling under the predicate 'F'), e.g., Quine (1954) and Rodriguez-Pereyra (2002). The general term 'nominalism' applies to any theory that denies the existence of universals, and hence also commonly applies to trope theory and bundle of tropes theory (to be introduced shortly).

to be classes of particulars is very non-intuitive. But secondly, class nominalism has the unwelcome consequence that any co-extensional properties, e.g., being cordate (i.e., having a heart) and being renate (i.e., having kidneys), turn out to be one and the same property, since such properties correspond to the very same class of particulars.

If the motivation for endorsing class nominalism was to avoid mysterious abstract entities like universals or tropes, some philosophers find the concept of concrete particulars to be the really mysterious one. For what is an object over and above its properties? Remove all of an object's properties, and you are left with nothing. Following this line of reasoning, according to the *Bundle of Universals* theory, a property is a universal and an object is nothing but a bundle of such universals.[5] Thus for two objects to share the same property is for two bundles of universals to share a universal. So the ontology of the bundle theory includes only universals. Of course, by endorsing universals, this theory endorses, like realism, entities that are somehow supposed to be wholly present in different places at the same time. However, it also generates a new crucial problem. For if a bundle is defined by the universals that compose it, then by losing (or gaining) a universal we ultimately get a new bundle, and hence whenever an object undergoes a change, i.e., whenever it changes one of its properties, what in fact happens according to this view is 'corruption' of that object and 'generation' of a new one. Which amounts, in effect, to the denial of the very possibility of change.[6]

There is also a trope version of the bundle theory, motivated by the aversion to both concrete particulars *and* abstract universals. According to this theory, an object is but a bundle of tropes.[7] Two objects share the same property whenever two bundles of tropes have a similar trope. So the ontology of the *Bundle of Tropes* theory includes only tropes, i.e., it avoids both universals *and* particulars. As expected, this theory inherits problems from both trope theory and the bundle of universals theory. Firstly, its sole ontological components—tropes—remains rather mysterious. And secondly, just like in the other bundle theory, any change in a trope means a new bundle, i.e., a new object, and hence what seems to

5 The origin of this view is commonly ascribed to Hume, but the philosopher mostly associated with it is probably late Russell (1940: Ch. 6). For a recent version, called 'essential bundle theory' see Jago (2021).

6 For another version of this problem see Bergmann (1967: 22–4).

7 The modern articulation of this view is due to D. C. Williams (conveniently presented in the 2018 collection of his work), later adopted with some variations by Keith Campbell (1990). In fact, D. C. Williams was the first one to use the term 'trope' to refer to abstract particulars. Maurin (2018) also lists Peter Simons, Douglas Ehring, Jonathan Schaffer and herself as supporters of the view.

be a change in an object's property turns out to be a case of corruption and generation.[8]

Thus far, in trying to explain the simple metaphysical fact of sharing a property, we have already encountered five different ontological theories, each proposing a different ontology. Table 1 below summarises these ontological theories.

Table 1: Ontological theories that explain the metaphysical fact of sharing a property.

		What is a property?	What is an object?
1.	Realism	Universal	Particular
2.	Trope theory	Trope (i.e., abstract particular)	Particular
3.	Class nominalism	Class of particulars	Particular
4.	Bundle of universals	Universal	Bundle of universals
5.	Bundle of tropes	Trope (i.e., abstract particular)	Bundle of tropes

It should be noted that, just like different scientific theories agree on the facts (e.g., that the sun rises in the east and sets in the west), yet provide different explanations for these facts (e.g., geocentrism vs. heliocentrism), so in the case of ontological theories, they agree on the metaphysical facts but offer different ontological explanations for these facts. Specifically, all five ontological theories above agree that there are objects and that there are properties; that objects have properties; and, that different objects can share the same property. Yet each offers different *accounts* for what an object is and for what a property is and hence for what it is for an object to have a property and for two objects to share the same property. For example, although the ontology of class nominalism includes only particulars, it does not deny the existence of properties; it simply claims that a property is a class of particulars.

2.2 Undergoing Change

Another fundamental metaphysical fact that ontological theories aim to explain is change, e.g., the fact that Marin the child became taller as she grew up. The main challenge in explaining this fact is that it seems to conflict with a fundamental logical principle, namely, the indiscernibility of identicals, also known as 'Leibnitz's law'. According to this logical principle, if $x = y$, then x and y share the exact same properties. And this is logically equivalent to the following

8 Wolterstorff (1973: 176–81).

statement: if x and y *differ* in properties, then $\sim(x = y)$. But this statement seems to conflict with the claim that an object can undergo a change while retaining its identity. For according to Leibniz's law, if Marin the child and Marin the grown-up have different properties (e.g., different height) then they are *not* one and the same individual. We have two very strong intuitions—that objects can undergo change on the one hand, and Leibniz's law on the other—which seem to conflict with one another. Yet foregoing either of them seems too high a price to pay.[9]

There are two prominent ontological theories that propose a way out of this apparent conflict. According to Perdurantism,[10] just like an object has spatial parts, it also has *temporal* parts. An object is thus a four-dimensional 'worm' that is composed of all of its temporal parts. When we encounter Marin at some moment t, what we really encounter is just one of her temporal-parts, namely, the one at time t. Hence, for Marin-the-child to grow taller is for the temporal part Marin-at-t_1 (say, 1990) to instantiate the universal 'being 100 cm tall' and for *another* temporal part, Marin-at-t_2 (say, 2022) to instantiate the universal 'being 168 cm tall'. And generally, for an object to undergo a change over time is for one temporal part x-at-t_1 to instantiate a universal F-ness and for *another* temporal part, x-at-t_2, to lack that universal. In this way, there is no violation of Leibniz's law, as the difference in property indeed applies to *distinct* entities, namely distinct temporal parts, and not to the same entity.

Besides the obvious counterintuitive notion of objects as four-dimensional worms, perdurantism has another important shortcoming. Once we allow temporal parts into our ontology, they can, in principle, be assembled into four-dimensional worms in many *new* ways, thus allowing a plethora of new, highly counterintuitive, 'objects.'[11] Perdurantism seems to force us to accept them all into our ontology.[12]

By contrast to perdurantism, endurantism retains our intuitive grasp of objects as three-dimensional particulars, and sets to resolve the said conflict by offering a new account of properties.[13] According to (a common version of)

9 Lewis famously called this problem 'the problem of temporary intrinsics' (1986: 202–205).

10 The terminology of perdurantism versus endurantism is due to Lewis (1986: 202). Hawley (2020) lists the following friends of perdurantism: Quine, Taylor, Lewis, Armstrong, Noonan, Robinson, Heller, Le Poidevin, Jubien, and Hudson.

11 E.g., Heller (1990: 49–51).

12 Unless, of course, one has some criterion of special composition in their mereology. However, so far there is no such widely accepted criterion.

13 According to Hawley (2020), all of the following endorse endurantism: Thomson, Geach, Chisholm, Mellor, Lowe, Simons, Forbes, Haslanger, van Inwagen, Oderberg, Merricks, Fine, Wasserman and Shoemaker.

endurantism, objects are indeed three-dimensional particulars, yet a property is a *dyadic relation* between a universal and a time.[14] Thus, for Marin to grow taller is for Marin to instantiate the dyadic relation 'is 100 cm tall *at 1990*' as well as the dyadic relation 'is 168 cm *at 2022*'. These two dyadic relations are not contradictory, and hence there is no problem for one and the same particular to instantiate both, just like there is no problem for one and the same person to be both intelligent and happy. So, here too, there is no violation of Leibniz's law. The cost of such a solution is, of course, the highly counterintuitive notion of a property as a dyadic relation of a universal to a time.[15] Perdurantism and endurantism add two more ontologies to our previous list (Table 2).

Table 2: Ontological theories that explain the metaphysical fact of change over time.

	What is a property?	What is an object?
6. Perdurantism	Universal	Four-dimensional worm of temporal parts
7. Endurantism	Relation of a universal to a time	Particular

2.3 Modalities

The last metaphysical fact that we shall consider here is that things could have been otherwise, and in particular, that an object that has a property F, *might not have had* that property, e.g., Marin might not have been 168 cm tall, but rather 178 cm tall. Or, put in modal terms, although the object Fs in *the actual world*, it fails to do so in some other *counterfactual world*. Like in the case of change over time, here too, this intuitive fact seems to violate Leibniz's law, because it implies that *x* (the actual object) and *y* (the counterfactual object) are identical and yet have incompatible properties, namely F and not-F, respectively.

And here too, there are two major ontological theories that propose to resolve this apparent conflict. According to Actualism, an object is a particular, but a property is a *world-indexed universal*, e.g., Marin instantiates the world-indexed universal 'being 168 cm tall *in the actual world* $W_@$' and she also instantiates *another* world-indexed universal 'being 178 cm tall *in counterfactual world* W_1'. Now, these world-indexed universals are *not* incompatible, and hence the fact that Marin instantiates both does not violate Leibniz's law. And in general, for an

14 I here focus on versions of endurantism like those held by van Inwagen (1990), Wasserman (2003), and Mellor (1981).

15 Lewis (1986: 203–4).

object to be actually F and possibly not-F is for that object to have the two perfectly compatible world-indexed universals, 'being F-in-$W_@$' and 'not-being-F-in-W_n'.[16]

A different type of solution has been put forward by Possibilism. According to this ontological theory, a property is just a good old universal, but an object is a *world-bound particular*, e.g., Marin-at-$W_@$.[17] So, for Marin to be actually 168 cm but possibly 178 cm is for the world-bound particular Marin-at-$W_@$ to be 168 cm, and for *another* world-bound particular, Marin-at-W_1, to be 178 cm. And since these two objects are distinct, there is no violation of Leibniz's law; one world-bound particular instantiates F, whereas *another* instantiates not-F. Actualism and possibilism add yet two more ontological theories to our list (Table 3).

Table 3: Ontological theories.

	Ontological theory	What is a property?	What is an object?
1.	Realism	Universal	Particular
2.	Trope theory	Trope	Particular
3.	Class nominalism	Class of particulars	Particular
4.	Bundle of universals	Universal	Bundle of universals
5.	Bundle of tropes	Trope	Bundle of tropes
6.	Perdurantism	Universal	Four-dimensional worm of temporal parts
7.	Endurantism	Relation of a universal to a time	Particular
8.	**Actualism**	**World-indexed universal**	**Particular**
9.	**Possibilism**	**Universal**	**World-bound particular**

3 A Generator of Ontological Theories

The above nine ontological theories were invented by different philosophers, at different centuries, and are apparently very different in nature. However, I shall argue that all these ontologies can be generated by applying the same simple mechanism, composed of just two 'devices.' Applying either device starts with the same step—*mapping* one ontological realm onto another. For example, one can map universals onto particulars in the following way (Table 4).

16 Plantinga (1976). For a more recent version of such an ontological theory, see L.A. Paul (2002).
17 I mainly refer here of course to Lewis's modal realism (1986). However, a recent interesting version of this view has been developed by Meg Wallace (2019). According to her 'Lump Sum' theory, a world-bound particular is a modal *part*, and an object is the sum of its modal parts. Wallace credits David Kaplan for discussing this view already as early as 1979.

Table 4: Mapping universals onto particulars.

Particulars Universals	Sanna Marin	Ingrida Šimonytė	Tsai Ing-wen	. . .
Being blue-eyed	+	+		
Being brunette	+		+	
Being over 40		+	+	
. . .				

3.1 First Device: Replacing

Having mapped two realms one onto the other, we can apply the first device of the ontology generator, which is the device of *replacing*. Thus, we can replace each universal with its matching particulars, e.g., we can replace the universal 'being blue-eyed' with the particulars [Marin, Šimonytė, . . .] and the universal 'being brunette' with the particulars [Marin, Ing-wen, . . .] etc. What we arrive at is the ontology of class nominalism. Alternatively, we can use the very same mapping to replace each particular with its matching universals, e.g., we can replace the particular Šimonytė with the universals ['being blue-eyed', 'being over 40', . . .]. What we arrive at in this case is the ontology of the bundle of universals theory.

This makes it evident that the bundle of universals theory is a mirror view of class nominalism. Since the two views result from using the same device, namely 'replacing', it is only to be expected that they will also share some similar pros and cons that are related to this device. For example, replacing an entity (from one realm) with a group of entities (from another realm) results in a counterintuitive ontology, like an ontology according to which a property is nothing but a class of particulars, or, similarly, an ontology according to which an object is nothing but a bundle of universals (see objection number 1 to both these views in Table 5 below). In fact, by juxtaposing two such positions, we can spot new pros or cons, should we have failed to notice some of them in the first place. For example, recall that one of the problems facing the bundle of universals theory was that merely losing or gaining a universal in the bundle entails a new object. This problem highlights a similar problem facing class nominalism: when a property is no longer instantiated by an object, the respective class of particulars loses that particular as a member, which ultimately results in a new class, and hence in a new property. This clearly violates our common intuition, according to which properties remain the same regardless of the objects that instantiate them (see objection number 3 to class nominalism in Table 5 below, which mirrors objection number 3 to bundle of universals).

Table 5: Comparing class nominalism and bundle of universals.

	Class nominalism	**Bundle of universals**
Mapping	Map universals onto particulars	
Device: replacing	Replace each universal with its matching particulars	Replace each particular with its matching universals
Pros	No mysterious universals	No mysterious particulars
Cons	1. Counterintuitive properties	1. Counterintuitive objects
	2. Co-extensive properties turn out to be the same property	2. Objects with the same properties turn out to be the same object
	3. Losing or gaining a particular in the class entails a new property	3. Losing or gaining a universal in the bundle entails a new object

3.2 Second Device: Slicing

In order to generate the other ontological theories, we will need to introduce the second device of the generator, namely, *slicing*. Using this device also begins by mapping. However, unlike in the case of replacing, we now 'slice' each entity from one realm according to its matching entities in the other—a slice for each matching entity. For example, if we start by mapping particulars onto universals and slice the latter according to the former, we get the being-blue-eyed-of-Marin, the-being-blue-eyed-of-Šimonytė, etc. This would be the ontology of trope theory.

Alternatively, we can also map particulars onto times (Table 6).

Table 6: Mapping particulars onto times.

Particulars / **Times**	**Sanna Marin**	**Ingrida Šimonytė**	**Tsai Ing-wen**	**. . .**
1960			+	
1980		+	+	
1990	+	+	+	
. . .				

We can then slice each particular according to its matching *times*. This will result in time-indexed particulars, which is in fact the perdurantist ontology of temporal parts. Alternatively, we can map universals onto times, and then slice each universal according to its matching times. This will result in time-indexed universals, which corresponds to the endurantist ontology of dyadic relations of universals to times (Table 7).

Table 7: Mapping universals onto times.

Universals Times	Being blue-eyed	Being brunette	Being over 50	. . .
1960	+	+	+	
1980	+	+	+	
1990	+	+	+	
. . .				

Again, given that both perdurantism and endurantism result from using the same device, namely slicing, unsurprisingly they will also exhibit similar pros and cons, as is illustrated in Table 8 below.

Table 8: Comparing perdurantism and endurantism.

	Perdurantism	**Endurantism**
Mapping	Map particulars onto times	Map universals onto times
Device: slicing	Slice each particular—a slice for each of its matching times	Slice each universal—a slice for each of its matching times
Pros	Change = *different* objects with conflicting properties Hence, no violation of Leibniz's law	Change = same object with *non-conflicting* properties Hence, no violation of Leibniz's law
Cons	1. Counterintuitive objects 2. Allows assembling slices into new strange objects	1. Counterintuitive properties 2. Allows assembling slices into new strange properties

In a similar manner, we can also map particulars or universals onto *possible worlds*. Slicing each particular according to its matching possible worlds—a slice for each such possible world—will result in the possibilist ontology of *world-bound particulars*. Similarly, slicing each universal according to its matching possible worlds will result in the actualist ontology of *world-indexed universals*.

Again, using the same device of slicing will give rise to similar pros and cons. For example, (like in the case of perdurantism and endurantism) by 'slicing' a particular (or a universal) into modal parts, we open the gate to endless recombinations of those slices, thus introducing a myriad of counterintuitive beings into our world. In this manner, we will be forced to admit the cross-world individual that is made of the slice 'Marin in $W_{@}$' and 'Šimonytė in W_1' and 'Ing-wen in W_2' etc. Or so the objection goes (Table 9 below summarises all this).

Table 9: Comparing possibilism and actualism.

	Possibilism	**Actualism**
Mapping	Map particulars onto worlds	Map universals onto worlds
Device: slicing	Slice each particular—a slice for each of its matching worlds	Slice each universal—a slice for each of its matching worlds
Pros	Possibility = *different* objects with conflicting properties Hence, no violation of Leibniz's law	Possibility = same object with *non-conflicting* properties Hence, no violation of Leibniz's law
Cons	1. Counterintuitive objects 2. Allows assembling slices into new, strange objects	1. Counterintuitive properties 2. Allows assembling slices into new, strange properties

Generally, in order to highlight the common features of all of the different ontologies that result from applying the device of slicing, we can use the common term 'indexing'. Thus, instead of speaking of 'world-bound particulars' (possibilism), we can speak of 'world-indexed particulars'; similarly, instead of speaking of 'dyadic relations of universals to times' (endurantism), we can speak of 'time-indexed universals'; and, instead of speaking of 'four-dimensional worms composed of temporal parts' (perdurantism) we can simply speak of 'time-indexed particulars'; finally, instead of speaking of 'tropes', we can speak of 'particular-indexed universals'. Such terminology unveils the shared structure that all these different types of entities have in common.

3.3 Moving on to Two-Tier Ontologies

So far, we have managed to generate seven out of the nine ontologies that have featured in our discussion, by using our 'ontology generator.' Specifically, by using the replacing device, we have managed to generate the ontologies of class nominalism and of the bundle of universals theory; by using the 'slicing' device, we have managed to generate the ontologies of trope theory, perdurantism, endurantism, possibilism and actualism. What about the remaining two ontologies, namely realism and bundle of tropes? Could they also be generated using these same two devices?

Realism is, in a way, the default position, whose ontology—particulars and universals—fits our pre-theoretical intuitions, and hence needs no special device to generate it. Realism is, so to speak, the point of departure to generating all other ontologies, by applying our devices to its basic ontology. By contrast, the bundle of tropes theory is an interesting case, since, as we shall now see, it makes

use of *both* our devices—the device of replacing, followed by that of slicing. As always, we begin with mapping.

First, we map universals onto particulars and then *slice* each universal according to its matching particulars, thus generating tropes, viz., universal-indexed particulars. Then, we *map those tropes back* onto particulars, and *replace* each particular with its matching group of tropes, which results in the generation of bundles of tropes. Mission complete.

To recap, nine ontological theories that are unrelated and apparently very different from one another, were all shown to be generated by using merely two very simple devices: 1. (mapping+) replacing; and, 2. (mapping) + slicing, which together compose our 'ontology generator'. Consequently, these apparently unrelated ontologies turn out to be very much related, sometimes to the degree of merely mirroring one another. We have also witnessed that ontologies that result from applying the same device will have similar cons and pros, i.e., they solve similar problems and are open to similar objections.

4 Using the Ontology Generator to Generate Novel Ontological Theories

As we have seen in Sections 3.1 and 3.2, perdurantism and endurantism are in fact mirroring views, and so are possibilism and actualism. Both couples of ontological theories result from using the slicing device. However, trope theory, which also results from applying the same device, is yet to have a mirroring view. But such a view is in fact easy to generate, in the following way.

As in the case of trope theory, we start by mapping particulars onto universals. Now, instead of slicing each universal according to its matching particulars—thus generating tropes, (i.e., particular-indexed universals) such as 'the being blue-eyed of Marin' and 'the being blue-eyed of Šimonytė'—we can simply *slice each particular according to its matching universals*. This will result in a new ontological realm, composed of *universal-indexed particulars*, which may be aptly called 'protes'. An example of such a prote would be the 'slice' of Marin that matches her property of being blue-eyed—a blue-eyed-indexed Marin. Now, recall that according to trope theory, for an object to have a property is for a particular to instantiate a trope (i.e., to instantiate a particular-indexed universal). Correspondingly, according to our newly devised *prote theory*, for an object to have a property would be for a prote (i.e., a universal-indexed particular) to instantiate a universal.

What are protes good for? Well, given that this is a mirror ontology of the ontology of tropes, its pros and cons can be drawn directly from those of the

trope ontology. Specifically, if the main advantage of the trope ontology was that it dispensed with mysterious universals (that are supposed to be wholly present in different places at the same time), the respective advantage of the prote theory is that it dispenses with mysterious particulars (that are supposed to somehow be over and above the collection of universals that they instantiate). Similarly, just like the obvious drawback of tropes was that they conflicted with our common notion of properties, so it is an obvious drawback of protes that they conflict with our common notion of objects.

The novel protes theory is a one-tier ontology, i.e., it results from employing just the one device of slicing. However, our ontology generator is also capable of generating novel *two-tier* ontological theories (like the bundle of tropes ontological theory). For example, having generated protes using the slicing device, we can now map those protes back onto universals (Table 10).

Table 10: Mapping protes onto universals.

Universals **Protes**	**Being blue-eyed**	**Being brunette**	**Being over 40**	**. . .**
Brunette-indexed Marin		+		
Blue-eyed indexed Marin	+			
Blue-eyed-indexed Šimonytė	+			
Over-40-indexed Šimonytė			+	
Brunette-indexed Ing-wen		+		
. . .				

Then, by applying our replacing device to this mapping, we can replace each universal with the group of its matching protes. E.g., the universal 'being blue-eyed' is replaced with the group [blue-eyed-indexed Marin, blue-eyed-indexed Šimonytė, . . .]. The view that would endorse such an ontology may be aptly called 'prote nominalism,' for it admits only protes and nothing else into its ontology. According to this view, for an object to have a property is for a prote to be a member of the relevant group of protes. This ontology mirrors the bundle of tropes ontology.

Again, the pros and cons of this ontological theory can be easily gathered from its mirroring view, the bundle of tropes theory, as specified in Table 11 below.

Table 11: Comparing bundle of tropes and prote nominalism.

	Bundle of tropes	**Prote nominalism**
Motivation	Avoid universals *and* particulars Avoid problem of bundle of universals: two objects with same properties turn out to be the same object	Avoid particulars *and* universals Avoid problem of class nominalism: co-extensional properties turn out to be the same property
Pros	Avoids universals *and* particulars The tropes weight-of-drop-A and weight-of-drop-B are *distinct* (despite being the same weight). So A and B are not the same bundle and hence not the same object	Avoids particulars *and* universals The prote chordate-indexed Fido and the prote renate-indexed Fido are *distinct.* So cordate and renate are not the same group of protes and hence not the same property
Cons	1. Tropes are rather mysterious too 2. Any change of trope results in an entirely new object	1. Protes are rather mysterious too 2. Any change of prote results in an entirely new property[a]

[a] This is an unwelcome consequence of the theory, for the following reason. Intuitively, a property remains the same despite changes in the objects that exemplify it. Now, according to prote nominalism, a property is a group of protes, and for an object to exemplify a property (e.g., for Marin to be under 50) is for a prote to be part of a certain group of protes (e.g., for the prote Marin-indexed being-under-50 to be a member of the group that includes also Šimonytė-indexed being-under-50, etc.). Thus, once Marin turns 50, the prote Marin-indexed being-under-50 no longer exists, and hence is no longer a part of that group. Which entails that the group has changed, and hence, according to prote-nominalism, that it is a new property now. Or, in short, once Marin turns 50, the previous property 'is under 50' is replaced by a new property.

For example, recall that the bundle of universals theory faced the problem that two objects with the same properties turn out to be the same object (for they are the same bundle of universals). The bundle of *tropes* theory sidesteps this problem since two such objects correspond to *different* bundles of *tropes*, and hence are different objects. Now similarly, class nominalism faced the problem that two co-extensional properties—e.g., being cordate and being renate—turned out to be the same property, for they are the same class of particulars (Aristotle, Fido, . . .). Our newly generated prote nominalism sidesteps this problem because on this theory, the group 'cordate' includes *cordate*-indexed Aristotle, *cordate*-indexed Fido etc., whereas the group 'renate' includes *renate*-indexed Aristotle, *renate*-indexed Fido etc., so these two groups are distinct, and hence the two properties are indeed distinct.

4.1 Recursiveness

Lastly, the two devices of our ontology generator—(mapping+) replacing and (mapping+) slicing—can be applied *in succession*, thus allowing many more possible combinations and hence possible ontological theories. For example, in the case of the bundle of tropes theory, the slicing device was followed by the replacing device, and the same succession was used in the case of the newly generated prote-nominalism theory.

In fact, it seems that a powerful ontological theory called 'possible world nominalism' can be generated using exactly this method, namely, the succession of slicing followed by replacing. According to possible world nominalism, a property F is a function from possible worlds to sets of particulars, viz., a function that assigns to each possible world the set of particulars that F in that world.[18] Now if we start, like in the case of possibilism, by mapping particulars onto worlds and then *slice* the particulars accordingly, we get world-indexed particulars. We can then map those world-indexed particulars onto universals, and then *replace* each universal with the group of its matching world-indexed particulars. This allows an account of each property as a group of groups of world-indexed particulars. And this seems just another way of saying that a property is a function from worlds to groups of world-bound particulars, which is the ontology of the said possible world nominalism. So possible world nominalism too can be generated using our ontology generator (row 11 in Table 12).

Table 12: More two-tier ontological theories.

	Ontological theory	What is a property?	What is an object?
10	Prote nominalism (*new*)	Bundle of protes	Prote
11	Possible-world nominalism	A function from worlds to sets of particulars	Particular
12	Possible-world bundle of universals theory (*new*)	Universal	A function from worlds to bundles of universals

At any rate, such a fine-grained account is superior to simple class nominalism—according to which a property is simply a group of particulars—for the following reason. Since there are *possible* worlds where some cordates are not renates and vice versa, it turns out that the respective properties—being cordate and being renate—correspond to *different* groups of world-indexed particulars,

18 Loux and Crisp (2017: 179) list Lewis, Cresswell and Hintika as supporters of this approach.

and hence are ultimately distinct, as opposed to the case of class nominalism (which considers only the actual world). So such an ontology can account for differences between co-extensive properties, like being cordate and being renate.

In the spirit of other ontologies, this ontology also invites the generation of a mirroring ontology, according to which an object is but a group of world-indexed universals, or—put somewhat differently—according to which an object is a function from worlds to bundles of universals. (It should be clear by now how this ontology is to be generated.) By comparing this view to possible-world nominalism, one can easily draw (from the discussion in the previous paragraph) how this fine-grained ontology fares better than the normal bundle of universals theory in distinguishing between objects that share all of their actual properties. And this possible-world bundle of universals theory too, to the best of my knowledge, is novel and has not been thus far proposed. Yet it can be easily produced by our ontology generator (row 12 in Table 12).

5 Conclusion

It has been shown that many highly creative ontological theories, apparently unrelated and very different from one another, can all be generated using the same rather simple mechanism—an 'ontology generator.' In more detail, we have listed four ontological realms—particulars, universals, times and possible worlds, and two devices—replacing and slicing; ontological realms can be mapped onto one another and the two devices can be applied to these mappings and thus generate new ontological realms. These two devices can be applied consecutively, which allows, in principle, for a generation of ever finer-grained ontologies.

The fact that this same simple mechanism can generate the various ontological theories facilitates a very convenient way of comparing between them and exposing the similarities and dissimilarities between them. Notably, ontological theories that result from applying the mechanism in the same way will have similar cons and pros, i.e., they will solve similar problems and will be open to similar objections. Moreover, the very same ontology generator can also generate new ontological theories, not previously held by anyone, thereby offering new solutions to metaphysical problems.

Consequently, at least in some cases, the proposed ontology generator can replace much of the creativity that has been thus far paramount to arriving at new ontological theories.[19]

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