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Philosophical Studies

An International Journal for Philosophy
in the Analytic Tradition

ISSN 0031-8116

Volume 161

Number 2

Philos Stud (2012) 161:309-325

DOI 10.1007/s11098-011-9740-3

Volume 161 · Number 2 · November 2012

PHILOSOPHICAL STUDIES

AN INTERNATIONAL JOURNAL FOR PHILOSOPHY
IN THE ANALYTIC TRADITION

EDITOR-IN-CHIEF: STEWART COHEN

 Springer

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Published online: 21 May 2011
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Abstract This paper presents and defends an account of the coincidence of biological organisms with mereological sums of their material components. That is, an organism and the sum of its material components are distinct material objects existing in the same place at the same time. Instead of relying on historical or modal differences to show how such coincident entities are distinct, this paper argues that there is a class of physiological properties of biological organisms that their coincident mereological sums do not have. The account answers some of the most pressing objections to coincidence, for example the so-called “grounding problem”, that material coincidence seems to require that coinciding objects have modal differences that do not supervene on any other properties.

Keywords Material coincidence · Leibniz’s Law · Grounding problem · Biological organisms · Mereological sums · Supervenience

1 Introduction

This paper defends a particular kind of material coincidence, involving biological organisms and mereological sums of their material components. This type of coincidence is illustrated by the case of Descartes and D-minus, where Descartes is a biological organism and D-minus is all of Descartes except the left leg.¹ Descartes is larger than D-minus, so they are distinct. But suppose Descartes’ left leg is

¹ The example is from van Inwagen (1981). Other widely discussed examples that are essentially similar include Peter Geach’s case of Tibbles and Tib (see Wiggins 1968), and Chrysippus’ puzzle about Dion and Theon (see Burke 1994).

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amputated. Descartes survives the loss of a limb, and D-minus survives being distanced from an adjacent entity. As neither is destroyed, both still exist. At the moment immediately following amputation, Descartes and D-minus occupy exactly the same region of space and are composed of the same parts, so they are coincident. But such coincidence is widely thought to be implausible. It seems to violate commonsense intuitions about ordinary material objects, as well as Leibniz's Law, or the Identity of Indiscernibles, according to which distinct things must differ in properties. Post-amputation, Descartes and D-minus have all the same parts, and they cannot be distinguished by their shape, size, location, mass or volume. If they are distinct, there must be some difference between them. Identifying differences that can plausibly explain their distinctness has proved not an easy task.

That Descartes and D-minus are coincident post amputation seems to follow from just the assumptions that Descartes and D-minus exist, and that they continue to exist under circumstances where they are no longer spatially distinct. It is a common strategy to address the coincidence problem by rejecting one or more of the assumptions that lead to coincident entities. In Sect. 2, I discuss these assumptions, and the motivations for retaining them. I propose to accept them, and to show why the kind of coincidence exemplified by Descartes and D-minus is not implausible. Rather than trying to explain *away* coincidence, I hope to explain it. Section 3 discusses the historical and modal differences that are often cited as distinguishing purportedly coincident objects in a way that does not violate Leibniz's Law. The appeal to historical differences between Descartes and D-minus is unsatisfying, as it leaves the central puzzle of coincidence untouched. The appeal to their modal differences invites a difficulty known as "the grounding problem".² What the defender of coincidence needs to respond to the challenge from Leibniz's Law is an account of the nonmodal, occurrent differences between entities like Descartes and D-minus. In Sect. 4, I argue that there is a class of physiological properties possessed by biological organisms but not by their coincident mereological sums. This difference in properties provides a defense of a limited kind of coincidence, exemplified by the case of Descartes, a biological organism, and D-minus, a mereological sum of the material components of Descartes at a particular time. My defense of biological-mereological coincidence will not apply straightforwardly to other standard coincidence claims, such as those involving artifacts, e.g., statues and lumps, or to the alleged coincidence of persons and bodies. Whether similar accounts, modeled on this one, can explain satisfactorily these other coincidence claims is left open, though I raise worries about their prospects. In Sect. 5, I return to the grounding problem and address the related issue that coincidence is thought to violate certain supervenience principles. I show how one supervenience principle is not violated by biological-mereological coincidence and that the differences between coincident entities discussed in Sect. 4 provide a satisfactory solution to the grounding problem. There remains a stronger supervenience principle that biological-mereological coincidence does violate, but I show how this principle may be plausibly rejected.

² This problem has been widely discussed, but the name "grounding problem" appears to have been coined by Bennett (2004).

2 The generation of the problem

The coincidence of Descartes and D-minus follows from the assumptions that both Descartes and D-minus exist, and that they continue to exist under circumstances in which they are not spatially distinct. There are three families of assumptions here. (1) Those concerning Descartes: what Descartes is, what sort of persistence conditions Descartes has, and why we should think things like Descartes exist; (2) those concerning D-minus: what D-minus is, what sort of persistence conditions D-minus has, and why we should think things like D-minus exist; and (3) those concerning the nature of persistence: in particular, the problem is generated in part by assuming an endurantist account of persistence. I will address each of these in turn.

I understand Descartes to be a human biological organism. I set aside the question whether this organism is identical to a person, or whether it bears any other relation to a person. I will also refrain from speaking of Descartes as a “body”, or as “having a body”, since the term “body” can refer to either the organism or the matter composing it. I am supposing we have excellent reason for thinking such biological organisms exist. Biological organisms are the primary subjects of study in several areas of biology and they have a variety of distinctive features, including the ability to reproduce, to respond to stimuli, and to metabolize energy sources from the environment. A biological organism has a life span that includes a beginning, a middle, and an end. Thus it is part of the ordinary and scientific concept of organisms that they are persisting things. While even the scientific concept is not very precise as to what constitutes the beginning and the end of an organism, it is not terribly imprecise either. For these reasons, any satisfactory account of Descartes and D-minus ought to accommodate the existence of Descartes as a persisting biological organism.

I understand D-minus to be the matter that constitutes Descartes at a particular time. D-minus is introduced into the story as all of Descartes except his left leg. This is a description of a quantity of matter picked out by the spatiotemporal region that it occupies. We can circumscribe a spatiotemporal region by talking about Descartes at a particular time before amputation, leaving out that region of space occupied by Descartes' left leg at that time. The matter occupying this spatiotemporal region is referred to using this description, and given the name *D-minus*. D-minus is a part of the matter that composes Descartes at a certain time, and thus is a material part of Descartes at that time. van Inwagen (1981) calls such things as D-minus “arbitrary undetached parts”, and suggests a solution to the coincidence problem that denies that arbitrary undetached parts exist. What exists are just whatever simples occupy the spatiotemporal region we referred to in describing D-minus, but these simples do not compose anything—at least not until after the amputation, when they compose Descartes. van Inwagen solves the coincidence problem by denying that there are two coincident entities. Descartes exists, the simples that compose him exist, but there is no D-minus. I want to resist this move. In describing D-minus, it seems obvious that we succeed in referring to something. Surely there are spatiotemporal regions, and where there is matter occupying a certain spatiotemporal region, it is extremely plausible that that quantity of matter is something,

which we can refer to and name as we like. Not only do we have no trouble talking about D-minus in the somewhat artificial context of philosophical discourse, but we can easily imagine non-philosophical circumstances in which it matters that we can refer to D-minus. Descartes might visit a tattoo parlor and request that the artist tattoo all of him except his left leg.

D-minus is divisible into smaller pieces of matter—its material parts. We can think of D-minus as the mereological sum of these material parts. If there are material simples, D-minus is the mereological sum of those simples. If there are no simples, but indefinitely divisible material “gunk”, we can still usefully think of D-minus in mereological terms. Classical mereology is noncommittal as to whether there are simples.³ Even if all the material parts of D-minus themselves have parts, D-minus is a sum composed of those parts, and has the persistence conditions of a mereological sum. That is, since D-minus is identified simply as a certain quantity of matter, any entity consisting of distinct matter—either more or less than that composing D-minus—is a distinct entity. Given the way D-minus is picked out, it is an extensional object that has its parts essentially. In maintaining that we are able to pick out mereological sums like D-minus by circumscribing any region of space–time and referring to the matter occupying that region, I am also supposing that mereological universalism is true. There is no reason we cannot circumscribe and refer to a “scattered” region of space–time, which would allow us to refer to all manner of mereological sums. Given the apparent ease with which we can refer to spatiotemporal regions and the matter that occupies them, mereological universalism is on the face of it more plausible than either nihilism (the view that there are no composite objects) or restricted composition principles.⁴ Thus we have good reason to think that D-minus exists and that it is an extensional mereological sum. One of the most troubling consequences of mereological universalism is the rampant coincidence to which universalists find themselves committed. If the world is filled with mereological sums such as D-minus, as well as things like Descartes with very different sorts of persistence conditions, we will be left with distinct material objects occupying the same place at the same time and consisting of the same parts at that time. Rather than rejecting mereological universalism, I propose to accept it, and to show how coincidence cases such as that of Descartes and D-minus can be accepted plausibly.

The story about Descartes and D-minus assumes an ordinary, endurantist picture of how objects persist through time. Descartes endures through the amputation in the sense that Descartes-before-amputation and Descartes-after-amputation are numerically identical. Alternatively, perdurantism can solve the coincidence problem by denying that Descartes-before-amputation and Descartes-after-amputation are numerically identical. They are distinct temporal parts of Descartes, who persists through time in the sense that he consists of a series of momentary temporal parts, and is in this way “spread out in time”. D-minus also consists of momentary temporal parts, but the series of temporal parts that makes up D-minus is distinct

³ See Simons (1987, p. 41).

⁴ There may be plausible restrictions, for example a formal mereological restriction that prohibits the summing of overlapping individuals.

from the one that makes up Descartes. Descartes and D-minus consist of the same material parts at the moment following amputation, since the matter post-amputation is a temporal part of both entities. Yet they are numerically distinct, since Descartes occupies a longer spatiotemporal region than does D-minus. Rather than being coincident entities, they temporally overlap at the moment following amputation when they share a temporal part. Though this is in many respects a neat solution, I will set it aside, and attempt to deal with the coincidence problem within an endurantist framework. I take endurantism to provide a more natural and intuitive picture of how objects persist through time, a picture worth retaining if possible.

3 Historical differences and modal differences

At the moment immediately following amputation (let's call it t_0), it is true of Descartes that he once had a left leg. This is not true of D-minus, who never had a left leg. This difference in historical properties might be employed to answer the challenge from Leibniz's Law to identify a difference in virtue of which Descartes and D-minus are distinct. But the appeal to historical differences alone to show that Descartes and D-minus are distinct is unsatisfying, since it is still mysterious how they could have all the same occurrent properties at t_0 when they coincide. It is true of this case of coincidence, and of all the coincidence cases I defend, that the coincident entities have different temporal properties. I will not be dealing with cases in which two entities occupy the same spatial region during their entire careers, such as Gibbard's (1975) example of Lump1 and Goliath. It is also true that facts about Descartes at times other than t_0 will play a role in my explanation of his distinctness from D-minus. But the appeal to historical differences alone seems to sidestep the central problem of coincidence. Gibbard's example of entities apparently coincident their entire careers helps to focus our attention on that problem. I cannot construct a case in which a biological organism is coincident with a mereological sum over its entire career,⁵ yet the puzzle remains that at t_0 , Descartes and D-minus appear to have all the same occurrent properties, even while we are inclined to say they are two things.

To the extent that we think Descartes and D-minus are two distinct things, it is because we are thinking of Descartes and D-minus as different *kinds* of things. That Descartes is an organism and D-minus a hunk of matter motivates the intuition that they are numerically distinct while coincident. Different kinds are associated with different essential properties and persistence conditions, which constitute their modal profiles. Organisms like Descartes can survive changes in parts (e.g., through growth) while mereological sums cannot. Mereological sums like D-minus can survive radical re-arrangement of parts (e.g., being run through a blender) while organisms cannot. The difficulty is that appealing to these modal differences

⁵ This highlights an important difference between my case and Gibbard's case of Lump1 and Goliath. Lump1 is a lump of clay, not a mass or a sum. It is the sort of thing that can come into being when two smaller lumps are stuck together, and can persist through small changes in parts. This is why Lump1 can have the same career as Goliath. In the cases I am considering, one of the entities is a mereological sum, so it cannot have the same career as an organism, because it doesn't survive any change in parts.

between Descartes and D-minus as an answer to the challenge from Leibniz's Law does not solve the problem, but only refocuses it. Could a difference in modal profile be the sole difference between two otherwise indiscernible objects? The difficulty of locating other features that could explain the different modal profiles of allegedly coincident objects is the "grounding problem," as discussed in Bennett (2004), Burke (1992), Heller (1990), Olson (2001), Sosa (1987) and Zimmerman (1995). The coincidentalists might accept that there is no other difference, and that the different modal profiles are just brute differences.⁶ Or the coincidentalists could accept that something grounds the modal differences but claim ignorance about what that is. Another option is that coincident entities each have a unique "thisness" or haecceity, which individuates them and determines their distinct modal profiles. These responses are problematic in that they all leave the coincidentalists committed to objects that are apparently empirically indistinguishable but still modally and (hence) numerically distinct. This invites the suspicion that the distinction between allegedly coincident objects, along with their different modal profiles and the kinds with which they are associated, is a matter of convention. We are simply conceiving the same object in different ways, referring to it under different sortal concepts, rather than discerning any ontological distinction between coincident entities. Coincidence is not plausible without convincing grounds for an ontological distinction between coincidents.

In order to make plausible the appeal to different modal profiles of purportedly coincident objects, some nonmodal, empirically discernible difference ought to explain the different modal profiles. Modal profiles should supervene on nonmodal properties in the sense that two entities perfectly alike in every other discernible respect are also perfectly alike in their modal profiles. The ways an object *can be* should depend in some way on how it *is*. According to this supervenience claim, a difference between Descartes and D-minus in their modal profiles requires some other difference between them. But they appear to be perfectly alike in every other respect, at least at t_0 when they coincide, which is why we were led to distinguish them by their persistence conditions in the first place. This is a serious problem for the coincidentalists. A satisfactory account of coincidence should identify differences between coincident objects that are nonmodal and occurrent properties.⁷ Such

⁶ Zimmerman (1995) finds the appeal to ungrounded persistence conditions "absurd" (p. 87). Bennett (2004) provides an interesting exploration of the unfortunate consequences of accepting primitive "sortalish" properties in defense of coincidence. To be clear: the "primitivism" at issue here is the view that there is really nothing in virtue of which an object has its modal profile—it is just a brute fact. This is distinct from the "modal primitivism" according to which modal concepts cannot be completely analyzed in nonmodal terms—as Lewis (1986) attempted to do by postulating real but non-actual possible worlds. One could be a modal primitivist in this second sense and still maintain (plausibly I think) that essential properties and persistence conditions are not brute, but supervene on the nonmodal.

⁷ One type of nonmodal occurrent property sometimes appealed to in distinguishing purportedly coincident objects is a certain kind of relational property. Fine (2003) for example, claims that the statue but not the alloy of which it is made may be "*defective, substandard, well or badly made, valuable, ugly, Romanesque, exchanged, insured, or admired*" (p. 206). I won't address this suggestion in detail here, but I do wish to raise a worry about the appeal to these sorts of properties. These have to do with the way the statue but not the alloy is perceived or related to by a community that recognizes the statue as a work of art. While there is nothing objectionable about distinct objects differing only in their relational properties (as in qualitative duplicates differing only in their spatial relations to other objects), in order for an art

an account would be even more satisfying if these differences can explain the differences in persistence conditions. I offer such an account below.

4 The solution: physiological processes and P-properties

Physiological processes include processes such as respiration, digestion, circulation, ovulation, and photosynthesis, that are commonly observed in biological organisms. Physiological processes typically involve interactions between cells, tissues, and organs, and the exchange of matter between an organism and its environment. Like all processes they take time, so that anything undergoing such a process persists through that process. There is a class of physiological properties of biological organisms that depend in some way on an organism's undergoing one or more physiological processes. For example, a female mammal's being *fertile* depends on her undergoing certain physiological processes, including ovulation. Certain medical conditions also constitute properties of this kind. Descartes' being, for example, *hypertensive*, depends among other things on the circulation of blood. If he is *diabetic*, this depends on how efficiently he metabolizes glucose. Perhaps the most general property of this kind is simply *being alive*. An organism's being alive depends on its undergoing a family of metabolic processes involving the production of energy, the breaking down and synthesizing of complex molecules, and so forth. These properties, being fertile, being hypertensive or diabetic, and being alive, are properties that depend on physiological processes in such a way that an organism can have these properties only if it undergoes one or more physiological processes that extend over a period of time. Most female mammals cannot be fertile unless either currently ovulating, or in a phase of a process preceding ovulation. An organism cannot be alive unless it is undergoing metabolic processes that extend over a period of time. Properties that depend on physiological processes in this way I call *P-properties*, and define as follows:

P-properties are physiological properties that are (1) associated with physiological processes in such a way that a biological organism *O*'s having P-property *F* at time *t* depends on *O*'s undergoing certain physiological processes over a period of time that includes times other than *t*; and (2) such that a biological organism *O* that has P-property *F* over a period of time t_1-t_n has that same property *F* at each t_i in t_1-t_n .

The first condition has the consequence that nothing that exists instantaneously at a time *t* could have a P-property at *t*, since P-properties depend on the thing's undergoing processes over a period of time that extends beyond *t*. This presents a certain epistemic limitation that is indicative of P-properties: one can determine that an organism has a P-property only by observing that organism over a period of time.

Footnote 7 continued

community to deem the statue but not the alloy *valuable*, e.g., it seems that it must antecedently be able to distinguish them. In the absence of differences between the statue and the alloy other than the ways we relate to them, the anti-coincidentalist can plausibly claim that this is another case of our thinking of the same thing in two different ways.

A human organism is diabetic at t due to processes occurring over a period of time that includes times before and after t . Merely having a high blood glucose level at t is insufficient to be diabetic at t . Physiological properties that are not P-properties include having a blood glucose level of 140 mg/dL, being female, and having blood type AB. These are properties that an organism could have at a time t that do not depend on anything occurring at times other than t . One could observe an organism at an instant, for example by taking a blood sample, and determine that it has any of these properties. An instantaneous “swamp creature”, created by a random lightning bolt and destroyed the next moment by a second bolt, could have any of these properties.⁸ On the other hand, to determine whether an organism O is alive at t , we need to look beyond O 's properties just at t . We need to see what is going on in the organism for a period of time surrounding t to see if it is undergoing metabolic processes. It is not sufficient for O to be dead at t that O skips a heart beat at t , nor is a momentary period of flat-lining sufficient for O to be dead. To determine whether O is alive or dead we need to see whether O shows signs of life over an extended period of time. Determining that an organism is fertile also requires observations over a period of time. For a human female, it requires observing her menstrual cycle over a period of time in order to determine that she is in an appropriate phase of that process. Our instantaneous “swamp creature”, even if it is an organism, would lack P-properties.

The second condition in the definition is meant to make explicit that not every predicate we can apply to an organism is a candidate for a P-property. We have a number of linguistic devices that allow us to formulate predicates from terms for processes, where these predicates denote no new property, but merely express the fact that something is undergoing a process. One such device is taking the gerund of a process term. For example, an organism in the process of a sneeze extending from t_1 – t_n can be said to be *sneezing* at a time t between t_1 and t_n . Participles do similar work. A cow is *being milked* if it is undergoing a milking. While it is not obvious that the milking, especially if performed by a dairy farmer, counts as a physiological process, the sneeze surely does. Since an organism's sneezing at t depends on the sneeze that extends from t_1 – t_n , this satisfies the first condition for being a P-property. But the second condition is not met because there is no single property *sneezing* that the organism has at each t_i in t_1 – t_n . At each t_i during which the organism is sneezing it is simply undergoing a segment of a sneeze, and it undergoes a distinct segment at each t_i . In general, gerundive predicates such as *sneezing*, as well as participles like *being milked*, do not pick out any single property that an object has continuously at each moment during which it is undergoing the associated process. The second condition excludes both gerundive and participle “properties” from the class of P-properties. Probably these are not properties at all, but just predicates that flow from convenient grammatical devices. Indeed I suspect the second condition is strictly unnecessary as a condition for P-properties, because it expresses a necessary condition for properties in general. That is, if we can apply

⁸ “Swampman” was originally introduced by Davidson (1987), though in a very different context, to illustrate a claim about mental content. While Davidson's “swampman” is produced in the same way as my “swamp creature”, he is not instantaneous. My instantaneous “swamp creature” is meant to represent an instantaneous replica of a biological organism.

a predicate to an object in virtue of its undergoing certain processes over a period of time, then unless that predicate expresses a single property possessed by the object continuously over that period of time, the predicate expresses nothing more than the process. However, the account provided here does not depend on this general condition on properties. It only requires the specific restriction on P-properties stated in the definition. As spelled out more explicitly below, this restriction is important for the account because features that violate the second condition, such as those associated with gerundives and participles, can be attributed plausibly to each of a pair of purportedly coincident entities.

My proposal is that Descartes but not D-minus has P-properties, and that these are sufficient to distinguish the two entities, even while they are coincident. At the time t_0 immediately following amputation, while Descartes and D-minus share precisely the same parts, Descartes is alive and D-minus is not. Perhaps Descartes is diabetic at t_0 , but D-minus certainly is not. Descartes' being alive or diabetic at t_0 is explained by the fact that Descartes is the subject of a variety of metabolic processes, processes that are temporally extended to include times before and after t_0 , and that involve the gain and loss of parts. Because D-minus is a certain quantity of matter, it is not identical to anything consisting of distinct matter, and so does not undergo any processes involving changes in its material parts. Physiological processes such as respiration and metabolizing glucose involve the exchange of matter between an entity and its environment, so no extensional mereological sum could be the subject of such a process. Descartes' P-properties—being alive and perhaps being hypertensive or diabetic—are nonmodal, occurrent properties he has at t_0 , that D-minus lacks. These properties are sufficient to distinguish Descartes from D-minus.⁹

In order for P-properties to distinguish biological organisms from sums of their material components, it is important that these are properties possessed continuously by an organism over a period of time, as specified by the second condition in the definition. An organism O would need to have the same P-property at distinct times, so that the property is not reducible to those physiological processes on which it depends. If the property is nothing more than being the subject of one or more processes, then since processes consist of distinct stages, O would have distinct properties at different times, each corresponding to a different stage of a process. *Being alive* is a complex property involving a variety of characteristics and dispositions, and is distinct from the metabolic processes on which it depends. A living organism encodes information about proteins in its DNA and RNA, and has dispositions to use such information to assemble proteins for growth, reproduction, healing, etc. Such characteristics are partly what it is to be alive, and Descartes has

⁹ Doepke (1982) also employs a strategy of defending coincidence by attempting to identify nonmodal, occurrent properties possessed by a constituted entity (a person in the case he considers) but not by the collection of parts that constitutes it. His example is having a true memory, which he thinks requires that the person who has the memory persists through a period that includes the time at which the memory is acquired. I find this example unpersuasive. It is an adequate explanation of an entity's having a true memory at a time t that it be causally related in the right way to an entity that received the right sort of sensory input. The collection of parts that is supposed to constitute the person at t can be a relatum in this sort of causal relation.

this same complex property *being alive* continuously, that is, at each t_i in the period t_1 – t_n during which he is alive, even while his being alive at any t_i depends on processes occurring at times other than that t_i . If Descartes is diabetic, then he has all the characteristics and dispositions constitutive of diabetes at each moment of the period of time during which he is diabetic. Being diabetic depends on an organism's metabolizing glucose in a certain way, but Descartes remains diabetic even between meals when he is not metabolizing glucose.

In contrast, to attribute *sneezing* to an organism is to say nothing more than that it is currently in the process of a sneeze, and that for any time t at which it is sneezing, it is undergoing a segment of that sneeze. To attribute *being milked* to an organism (a cow, say) is to say nothing more than that it is currently undergoing a milking, and that for any time t at which it is being milked, it is undergoing a segment of that milking. Unlike the complex properties I've suggested as examples of P-properties, these involve no characteristics or dispositions other than the processes on which they depend. The processes, consisting of distinct process segments, exhaust the features associated with those processes. At each t_i in t_1 – t_n during which an organism is sneezing, it is undergoing a distinct sneeze segment, and does not have any additional property continuously in virtue of the sneeze. Such properties, if they are properties at all, which are reducible in this way to the processes on which they depend, cannot plausibly distinguish purportedly coincident entities. If an organism O is sneezing at a time t , then at t it is undergoing a particular sneeze segment. Any feature we can attribute to O at t in virtue of its undergoing that sneeze segment is also a feature of the matter that coincides with O . By contrast, P-properties can do the job of distinguishing organisms from their coincident matter because they both require the undergoing of processes and also are real properties distinct from those processes, which an organism can possess continuously over a period of time.

Because of this limitation on the types of properties that can distinguish coincident entities, I am not optimistic that the account provided here can be extended, by finding analogs of P-properties, to explain cases of alleged coincidence involving statues, for example. Certainly it is not difficult to find properties attributed to statues that depend on processes. We might say that a statue is *corroding*, or *being repaired*, and we might think that the bronze cannot survive the sorts of changes required to corrode or to be repaired. But these are just the sorts of gerundive and participle "properties", that, while depending on processes, are really nothing more than those processes on which they depend. If a statue is corroding or being repaired at a time t , this is simply its being in a particular segment of a process of corrosion or reparation. The bronze that is supposed to be coincident with the statue at t has whatever features the statue has at t in virtue of its being in that particular process segment. There is no extra property of the statue in virtue of this process that is not also a property of the bronze. We can insist that the statue just is the bronze, and that for the statue (and the bronze) to be corroding at t is just for it to exemplify a certain process segment at t . Neither the statue nor the bronze need persist through any changes of parts to do that. The entire corrosion process could be exemplified by a series of distinct masses of bronze, each consisting of different parts with different chemical compositions, as parts are added and lost during

oxidation. Thus we still have no grounds for saying the statue and the bronze are distinct coincident entities.

Attempts to extend the account to explain the alleged coincidence of persons and bodies should also be met with caution. One must be clear about what is meant by “body” in such coincidence claims. “Body” can refer to the matter that makes up a person at a given time, or it can refer to the biological organism, as distinguished from the person. Suppose by “body” we mean the constituent matter, understood in mereological terms, so that bodies do not survive changes in parts. In that case, there are certainly properties we attribute to persons that can play the role of P-properties and thereby distinguish persons from bodies. Plausible candidates include all those we used to distinguish organisms from their material components. Persons can be alive, diabetic, hypertensive, etc., while their constituent matter is not. This leads to the more interesting question whether persons are distinct from but coincident with bodies understood as organisms. That is, is there a third entity in addition to D-minus and Descartes (the organism), which is a person? Here the strategy I’ve used to explain the coincidence of biological organisms and their material components is of no use, since both the organism and the person are supposed to be things that persist through changes in parts. Certainly there could be no mereological considerations for denying that a property of the person belongs to the organism as well. Other strategies would be needed to show that persons are distinct from biological organisms.

5 Supervenience and the grounding problem

One of the most serious problems for coincidence is that it runs afoul of powerful intuitions regarding supervenience. The “grounding problem,” discussed in Sect. 3, is a concern about distinguishing purportedly coincident entities solely by their modal profiles. If the different modal profiles of Descartes and D-minus were the only difference between them, this would violate the supervenience principle that there cannot be a modal difference between two entities without some other difference. The intuition behind this is that modal properties cannot come from nowhere; they must somehow be grounded in how things actually are. It was this worry about the grounding of modal properties that motivated our search for a nonmodal difference between Descartes and D-minus. Since we’ve now determined that Descartes has P-properties that D-minus lacks, the two entities can be coincident without any violation of modal supervenience. That is, while they have different modal profiles, this is not the only difference between them. Their different essential properties and persistence conditions are accompanied by differences in P-properties.

But this just shows that the supervenience principle is not violated, since biological organisms and mereological sums of matter will not differ just in their modal profiles. What about the intuition behind the supervenience principle, that modal differences *depend on*, or are *grounded in* the nonmodal? Can P-properties explain the modal properties in a way that offers a satisfactory solution to the grounding problem? I believe they can. Consider the property of being alive. If an

organism *O* is alive at *t*, then it is undergoing a family of metabolic processes over a period of time surrounding *t*, processes that involve its changing parts during that period. Given the dependence of this P-property on metabolic processes, a necessary condition for an organism *O*'s being alive is that it actually persists through changes in parts. *O*'s *actually* persisting through certain kinds of changes entails that it *can* persist through these changes. Other P-properties will yield the same results, since the physiological processes on which they depend involve the exchange of matter between an organism and its environment. Hence if an organism has P-properties we can explain why it has the persistence conditions that it has. The different modal profiles that indicate a distinction between biological organisms and coincident mereological sums are explained by their differences in P-properties. P-properties are empirically discoverable, occurrent, nonmodal properties of biological organisms, which entail persistence conditions distinct from those of mereological sums.

But are the P-properties I've mentioned really nonmodal properties? In arguing that P-properties like *being alive* and *being diabetic* are properties of biological organisms that could not be possessed by mereological sums, I maintained that these are complex properties involving various characteristics and dispositions. That they are dispositional helped to establish that P-properties were real properties not reducible to the processes on which they depend. One might worry at this point that dispositions are after all modal, involving what would happen in various actual and counterfactual situations. If P-properties are ultimately modal, then it appears I have smuggled in modal properties to explain differences in modal profiles. It is not obvious that dispositions ultimately must be understood modally. Certainly they are importantly different from the modal properties that raise the worries expressed in the grounding problem. Unlike essential properties and persistence conditions, which I take to constitute a modal profile, dispositions seem to be a matter of how a thing *is*, not just of how it *could be*. Dispositions certainly have modal consequences, but properties with modal consequences are exactly what one would expect to ground an entity's essential properties. If, less plausibly I think, dispositions are modal in the same sense that essential properties are, and if dispositions are, as I've suggested, indications of real properties, then it is not clear what could count as a nonmodal property. The grounding problem would lose its force if properties are modal in the same sense all the way down, for then modal properties are never grounded in the nonmodal. What gives the grounding problem its urgency is the worry that the only differences between coincident entities are differences in essential properties and persistence conditions. These modal properties could not come from nowhere, and any claim that they do invites the worry that such free-floating differences in modal profile are a matter of mere convention, of our conceiving the same object in different ways, and imposing different modal profiles and sortal concepts on the same object. Even if we grant that dispositions are in some sense modal (since they have modal consequences), these are not the sort of properties that motivate the grounding problem. It is the prospect of free-floating essential properties and persistence conditions that must be avoided.

In discussing the grounding problem, Sosa (1987) speaks of the sort of property “whose essential possession can be explained by its actual possession” (p. 80). He offers as examples *being even* and *being a person*. These might help as a way of grounding certain modal properties, but are not relevant to the coincidence cases that concern us here. P-properties generally are not properties that organisms have essentially (if Descartes is diabetic, he is not essentially so), so it is not generally the case that their actual possession explains their essential possession. The way P-properties ground essential properties and persistence conditions is different. Their actual possession explains why they persist as certain parts come and go, so their actual possession explains why *other* properties are essential or not. A female mammal’s being fertile, for example, requires that she can persist through the development and eventual degradation of an ovarian follicle. The property *being alive* might be an exception here, as it is plausible that it is an essential property of biological organisms. After losing this property, the remaining corpse is not undergoing any physiological processes, and hence loses all its P-properties. After death, there seems no candidate left for a nonmodal, occurrent difference between a mereological sum and a biological organism. What we ought to say here is that with death, the organism does not survive. All that is left is the matter which formerly composed it. But that an organism does not survive death is exactly what we want to say. Perhaps *being alive* is one of the properties Sosa was seeking, whose essential possession is explained by its actual possession.

There remains another supervenience principle that has been employed against coincidence. Coincident entities are supposed to be composed of the same parts, and thus friends of coincidence need to reject a principle van Inwagen (1990) calls *Uniqueness*, that any objects compose at most one thing. Descartes and D-minus have the same parts, but those parts compose two distinct things at the moment when they coincide. van Inwagen argues in the following manner that Uniqueness follows from the Identity of Indiscernibles together with a supervenience principle (1990, p. 53):

- (1) If x , y share all the same intrinsic and relational properties, then $x = y$. (Identity of Indiscernibles.)
- (2) For any x s, if the x s compose an object z , then both the intrinsic and relational properties of z are completely determined by the intrinsic and relational properties of the x s. (Supervenience.)

Therefore,

- (3) For any x s, if the x s compose an object z , then for any w such that the x s compose w , $w = z$.

According to van Inwagen, in order to reject Uniqueness, the coincidentalists must reject the supervenience principle, since coincident objects have different modal properties while being composed of the same parts. Note that he employs a stronger supervenience principle than the one considered above. I have shown how the biological-mereological coincidentalists can uphold the supervenience principle that modal differences require (and are determined by) nonmodal differences. van Inwagen’s supervenience principle states that all differences (including modal

differences) are determined by differences in the properties of the *parts* of distinct things. Let us call this *Composition Supervenience*.¹⁰ Any coincidentalists would need to reject Composition Supervenience, since coincidence explicitly involves modally distinct entities sharing the same parts, and in the same arrangement.¹¹ But at least in the case of biological-mereological coincidence, doing so does not leave us with brute modal differences. The modal differences are always grounded in a difference in P-properties, even if there is no difference in parts. It is also a violation of Composition Supervenience that at t_0 , Descartes but not D-minus has certain P-properties while they share the same parts. Again, we do not want to say this difference is brute; it deserves an explanation. The explanation is that P-properties have a broader supervenience base than that suggested by Composition Supervenience. The supervenience base of P-properties includes the properties of the parts that compose an organism over a period of time that includes times other than the time at which the organism has the P-property. The P-properties Descartes has at t_0 depend on the organism undergoing time-consuming physiological processes, so that they supervene not just on the features of Descartes' parts at t_0 , but also on the features of distinct collections of parts that compose Descartes at times other than t_0 . Consider Descartes' property of being alive at t_0 . In order for Descartes to be alive at t_0 , it is required that Descartes undergo metabolic processes for a period of time extending beyond t_0 , such that Descartes is composed of distinct sets of parts at different times during that period of time. Descartes' being alive at t_0 depends not just on the properties of Descartes' parts at t_0 , but also on the properties of Descartes' parts at times other than t_0 . Given the explanations for supervenience I have provided, Composition Supervenience can be rejected by the biological-mereological coincidentalists in good conscience, together with the principle of Uniqueness. Composition Supervenience is too restrictive in supposing that all properties of an object at a time t are determined by the properties of its parts at t . The modal properties of an organism may be determined in part by its P-properties, and its P-properties are determined by the properties of its parts across different times.

An additional worry that may arise for this account of biological-mereological coincidence is that it gets the order of dependence reversed: only something that can persist through changes in parts can be alive, so P-properties depend on an organism's persistence conditions. If this is right, it is not obvious we have solved the grounding problem, for it is the different modal profiles that distinguish coincident entities, and these remain unexplained. Two points should be emphasized in response. First, an important feature of the account is that it avoids any commitment to coincident entities that differ *only* in their modal profiles. In biological-mereological coincidence cases, the different modal profiles are always

¹⁰ Olson (2001) also emphasizes this supervenience principle as one the coincidentalists cannot accommodate.

¹¹ At least in the sense van Inwagen intends, Composition Supervenience must be rejected by the coincidentalists. For van Inwagen, "parts" are material parts. A coincidentalists could accept Composition Supervenience by developing an account of parts of objects that are not material parts, and which would not be shared by coincident entities. See for example Paul's (2006) account of qualitative parts, and Koslicki's (2008) account of structural parts.

accompanied by the obtaining of P-properties by one entity and not the other. The truly mysterious cases we wished to avoid involved empirically indistinguishable but modally and numerically distinct entities. These cases are avoided, and supervenience is not violated. Second, I do not think the account gets the order of dependence wrong. P-properties depend on what an organism *actually* does, not on what it *can* do. It is alive because it is actually the subject of certain physiological processes extending through a period of time. For this reason, an organism's P-properties supervene not on its modal properties but on its temporal properties. Consider again the instantaneous "swamp creature" created by a random lightning bolt and destroyed the next moment by another. Nothing exists in that moment with any P-properties. There is a mass of matter, certainly with an interesting organization, but no living thing coincident with the mass of matter. We might wish to call it an "instantaneous organism" nonetheless, just as we might wish to call a corpse a "dead organism". But we have no grounds for saying such instantaneous or dead "organisms" are numerically distinct from masses of matter. If there had not been a second lightning bolt, certain processes would have ensued, caused by the arrangement of matter produced by the first lightning bolt. Had such processes ensued, there would have existed a second object as the subject of those processes and the possessor of a distinctive set of P-properties. And it would have existed from the first, since the ensuing processes include the initial state. This reflects the fact that P-properties supervene on temporal properties. Whether there are any P-properties and hence a living thing that has those P-properties at the initial moment following the first lightning bolt depends on what happens next. An organism's P-properties at a time t depend on its undergoing physiological processes over a period of time that includes times other than t . Furthermore, while P-properties supervene on temporal properties, they are not themselves temporal properties. P-properties are occurrent properties that an organism has at a time when it coincides with a mereological sum, and which distinguish the organism from that mereological sum.

6 Concluding remarks

I have provided an explanation for how biological organisms and mereological sums can be distinct while occupying the same spatial region at a time and sharing the same parts at that time. The distinction between these two types of entities is explained by a difference in a certain class of physiological properties, what I have called P-properties, that we commonly attribute to biological organisms and that mereological sums lack. This is a difference in occurrent, nonmodal properties, that serves to distinguish coincident entities. This difference explains why the distinct entities have different modal profiles: P-properties require that their possessors actually persist through certain kinds of changes of parts, and such actual persistence entails certain persistence conditions. We do not need to impose a sortal concept and a set of persistence conditions onto the living things we encounter, but we can actually *discover* that something has a particular modal profile based on its having certain observable properties requiring such a modal profile, properties like

being fertile, being diabetic, and being alive. My solution to the problem of coincident biological organisms and mereological sums allows us to retain intuitions regarding the existence of both biological organisms and mereological sums. We can also retain an endurantist picture of the persistence of biological organisms, and can accept the supervenience of modal properties on the nonmodal. The P-properties employed to explain the distinction between coincident entities are not esoteric properties discovered by the metaphysician, but standard biological properties that we would want to be able to attribute to biological organisms on any account of their metaphysics.

The biological-mereological coincidence I have defended is an important kind of coincidence, even if it does not entail a more general account of coincidence. In fact, it may be more illuminating precisely because it identifies a special metaphysical structure of a natural category—biological organisms—as distinguished from artifacts. When considering statues and lumps of bronze, it is much easier to reject coincidence. It is not a major loss to our ordinary way of thinking about statues if we say there is no material object in the vicinity other than some bronze in a particular shape. The analogous claim about biological organisms is less plausible. Because of the important role that organisms play as the subjects of biological investigations, and because of the distinctive properties attributed to biological organisms, it is much harder to deny that organisms are material objects distinct from mere masses of matter or collections of parts. Aristotle got us started using artifacts—bronze spheres—as a way to understand the metaphysical structure of primary substances—viz. individual organisms.¹² However useful it may be to think about the metaphysics of artifacts, organisms and artifacts do not need to be treated as on the same footing ontologically.

Acknowledgments For helpful comments and feedback on this paper I am indebted to Berit Brogaard, Dan Korman, Skip Larkin, Bill Lycan, Laurie Paul, John Roberts, and Irem Steen.

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¹² See for example *Metaphysics* viii 6.

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