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On the Very Idea of Biological Individuality

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Abstract

The burgeoning debate over biological individuality raises deep issues, philosophical and scientific, but suffers from conceptual unclarity. This paper offers a diagnosis of what has gone wrong. It is argued that the problem of biological individuality, as it is often formulated in the literature, rests on a category mistake. The mistake is to treat the expression 'biological individual' as if it were a *sortal*, when in fact it is not. This diagnosis sheds light on a number of otherwise puzzling aspects of the debate.

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1 Introduction

There has been considerable discussion in recent philosophy of biology of 'the problem of biological individuality'. The problem is no mere philosophers' quibble, but addresses matters that practising biologists have long recognised as troublesome and important. The basic issue is often set up as follows. The paradigm of a biological individual is a metazoan, or multi-celled animal, such as a dog or chimpanzee. Such animals develop from a single fertilized zygote; to a close approximation, they are genetically homogenous, genetically

unique, have contiguous parts, are functionally integrated, have clear spatial boundaries, and exhibit little internal conflict. However, many other biological entities, such as certain plants, fungi and marine invertebrates, lack some or all of these attributes, or exhibit them only partially; so it is often unclear how to apply the concept of an individual in these taxa (Clarke [2010]). A further difficulty arises from the existence of collective entities such as honey-bee colonies and bacterial biofilms, and symbiotic associations such as lichens, which in some cases are highly integrated (Queller and Strassman [2009]). Whether such entities count as biological individuals is a tricky issue; and it is complicated further by the observation that a multi-celled organism is in a way a collective entity itself, composed out of cells, and similarly for a eukaryotic cell (Maynard Smith and Szathmáry [1995]). Finally, still more pressure on the concept of a biological individual comes from the observation that a typical metazoan is really more akin to a multi-species assemblage, once its resident microbiota are taken into account (Dupré and O'Malley [2009]). So the biological individual concept is much less clear-cut than it seems at first sight.

In a recent overview of the literature on biological individuality, Guay and Pradeu ([2016]) make an interesting sociological observation. They note a disconnect between how philosophers of biology and analytic metaphysicians think about individuality and related topics. Guay and Pradeu are right about this (though there have been recent attempts to bridge the gap.¹) Indicative of the disconnect is that expressions such as 'individual', 'identity' and 'individuate' are widely used in the philosophy of biology literature, but not usually with the technical senses that analytic metaphysicians give to these terms. How big a problem is this? Perhaps it does not matter too much. Philosophers of biology could respond that analytic metaphysicians do not have a monopoly on terminology; and could point to the long history of discussing ontological questions in biology itself, often under the rubric of 'individuality' (Lidgard and Nyhart [2017]). Moreover, they could add that the issues discussed in the literature on biological individuality require engagement with empirical details, so are unlikely to be resolved by *a priori* metaphysical theorizing.

These points are all valid, but still the disconnect is troubling. For the literature on biological individuality, for all its merits, is beset by conceptual unclarity, though it is not

¹ A number of the essays in (Bueno, Chen and Fagan [2018]) and (Meincke and Dupré (2020)), in particular the editors' introductions, address this point.

easy to pinpoint its source. This unclarity has been noted by Olson ([2020]), a metaphysician, and by Pradeu ([2016a]), a philosopher of biology and major contributor to the biological individuality debate. Indeed, Pradeu ([2016a], p. 765) admits that ‘there is considerable confusion over the definition of the notion of a “biological individual” and related terms’. In this paper I offer a diagnosis of what has gone wrong. My diagnosis is that the recent debate on biological individuality, or at least a central part of it, commits a category mistake in how it sets up the main issue. The mistake is to treat the expression ‘biological individual’ as if were a sortal when in fact it is not. This diagnosis sheds light on various aspects of the debate, helping to clarify the relation with traditional metaphysics. And it shows that the methods of analytic philosophy can play a role, albeit a modest clarificatory one, in sharpening our understanding of what the debate is about.

Two qualifications are needed here. Firstly, I do not claim that every author who has written on biological individuality is guilty of the category mistake in question. The debate on this topic is large and multi-faceted, encompassing more than a single issue, as has recently been emphasized (Love and Brigandt [2017]; Kaiser and Trappes [2021]). Nonetheless, I believe that my critique applies widely, in particular to those discussions that set up the issue in the manner of my opening paragraph. Secondly, I do not say that the debate on biological individuality is without value, or irredeemable. On the contrary, the debate is important and addresses real questions. My aim is not to dismiss these questions, nor to defend particular answers to them, but to better understand their nature.

The paper proceeds as follows. Section 2 notes four puzzling aspects of the literature on biological individuality, which collectively raise the suspicion that something is amiss. Section 3 steps back and discusses the word ‘individual’ as used in everyday English, analytic philosophy, and philosophy of biology. Section 4 introduces the notion of a sortal and explains its significance. Section 5 argues that ‘biological individual’ is not a sortal but that much work on biological individuality treats it as if it were. Section 6 argues that the term ‘organism’, unlike ‘biological individual’, is a sortal. Section 7 examines the idea, popular in the recent literature, that there are two different types of biological individual. Section 8 traces some implications of the foregoing diagnosis. Section 9 concludes.

2 Four puzzles

The first puzzle is this. Is the problem of biological individuality *sui generis* to biology, or a special case of a problem that arises in other sciences too? Clearly, biology is not the only science that includes individual entities in its ontology—think of the stars of astronomy, the molecules of chemistry or the mountains of geography, for example. We can talk sensibly of an individual star, an individual molecule, or an individual mountain. Should we then think of biological individuality as simply one sort of individuality, on a par with astronomical, chemical and geographical individuality? If so, why are the terms ‘astronomical individuality’, ‘chemical individuality’ and ‘geographical individuality’ rarely if ever found?² And if not, why does biology require a proprietary individuality concept when other sciences lack one?

The second puzzle is this. Much of the early philosophical interest in biological individuality focused on the ‘species are individuals’ thesis made famous by Hull ([1978]). This thesis continues to be discussed today. But in the recent literature on biological individuality, exemplified in six recent edited collections³, species are hardly in the picture. Rather, the focus is on entities such as clonal plants, social insect colonies, hydrozoan colonies, biofilms, chimera, and symbiotic unions.⁴ It seems implausible that if species were included alongside these entities, a natural kind would result. So how does the concept of individual at work in the debate over whether species are individuals relate to the concept at work in debates over whether biofilms and termite mounds, for example, are individuals?

The third (related) puzzle is this. There is a longstanding ambiguity in the literature about how ‘organism’ relates to ‘biological individual’. A number of authors explicitly equate these terms; many others do not, but even they allow that the equation is *prima facie*

² Philosophers have discussed ontological issues in astronomy, chemistry and even geography. My point is simply that the term ‘individuality’ does not feature prominently in these discussions, nor in the scientific literature itself (though (Lewowicz and Lombardi [2013]) is a partial exception in relation to chemistry). There is an extensive discussion on ‘quantum individuality’ in the philosophy of physics (for example, French [2019]), but the operative sense of ‘individual’ is quite different from the sense(s) at work in the biological individuality debate.

³ See (Bouchard and Huneman (eds.) [2013]; Guay and Pradeu (eds.) [2016]; Lidgard and Nyhart (eds.) [2017]; Bueno, Chen and Fagan [2019]; Meincke and Dupré [2020]); and a special issue of *Biology and Philosophy* 2016 (volume 31, issue 6, edited by T. Pradeu).

⁴ Hull was of course interested in the status of these entities too; see in particular (Hull [1980]).

plausible, arguing that it fails in the light of sophisticated theoretical considerations.⁵ But this is somewhat odd. For both grammatically and logically, ‘organism’ and ‘biological individual’ are different types of expression. The former is semantically compound while the latter is not; and arguably only the former is a sortal, as we shall see. Why then did the equation ever seem plausible?

The fourth puzzle is this. There exist biological entities of many sorts that can clearly be counted, and of which we can sensibly talk about an individual of one of those sorts—for example kidneys, flagella, leaves, and microtubules. (Thus we can ask how much an individual kidney weighs, or what the diameter of an individual microtubule is.) Yet participants in the current debate (with a few exceptions) appear to take for granted that these entities are not biological individuals in the relevant sense, but rather parts of other individuals.⁶ Why is this?

To expand briefly on this fourth puzzle. There has been much discussion of whether a biological individual can contain another biological individual as a proper part (e.g. a cell in a multi-celled organism). Some authors say yes, others no. But even those who say yes typically do not think that it applies to all parts, only to some. That is, authors on both sides of this issue accept that a biological individual contains some parts that are not individuals.⁷ My point is that many parts of this sort, such as flagella, are perfectly easy to count and re-identify, and thus we can sensibly talk about ‘an individual flagellum’. Why then are flagella not *bona fide* biological individuals?

3 The Word ‘Individual’

Let us take a step back and focus on the word ‘individual’. In ordinary English, ‘individual’ can be used either as a substantive, as in ‘police are hunting an armed individual’, or an

⁵ Those in the first camp include Queller and Strassman ([2009]), Pepper and Herron ([2008]) and Clarke ([2013]); those in the second, Sober ([1991]), Godfrey-Smith ([2013]) and Pradeu ([2016a]) among others.

⁶ Thus Clarke ([2013]) explicitly characterizes the problem as how to decide whether a given entity is a biological individual *as opposed to* a part, or a group. The idea that some parts (such as organs) are themselves biological individuals has occasionally been defended, for example by Wilson and Barker ([2021]) and Ghiselin ([2005]).

⁷ This is reflected in the fact that in the literature on part and wholes in biology, it is usually biological objects, rather than individuals, that are said to stand in part-whole relations (as for example in (Kaiser [2018]).)

adjective, as in ‘an individual chopstick is not much use, you need a pair’. When used as a substantive, the context typically implies a restriction to an individual of a particular sort, such as a person; so ‘armed individual’, in the sentence above, really means armed person. When used as an adjective, ‘individual’ always modifies a count noun, so while ‘individual chopstick’ makes sense, ‘individual butter’ does not, since ‘chopstick’ is a count noun but ‘butter’ is not. Therefore, in its vernacular usages, substantival and adjectival, ‘individual’ generally, and arguably always, refers to an individual of a particular sort, implicitly or explicitly.

In analytic philosophy, three different uses of ‘individual’ can be distinguished. Firstly, some authors use ‘individual’ in a highly inclusive sense, to refer to anything that exists, or at least anything that can be the subject of a true predication—what Strawson ([1959]) calls a ‘logical subject’. Thus for example, Russell ([1903]) says that he will treat as synonymous the words ‘term’, ‘unit’, ‘individual’ and ‘entity’. Russell ([1903], p. 43) continues: ‘a man, a moment, a number, a class, a relation, a chimera, or anything else that can be mentioned, is sure to be a term’. Secondly, some philosophers use ‘individual’ in a more restrictive sense, according to which not everything that exists is an individual. For example, Lowe ([2016]) cites ‘pluralities’ and ‘quantities of matter’ as putative examples of things that exist but are not individuals, as they lack the attribute of ‘unity’.⁸ Similarly but for different reasons, French ([2019]) argues that the sub-atomic particles of quantum mechanics exist but are not individuals. Those who favour this second usage typically employ a different word, such as ‘entity’ or ‘thing’, to cover individuals and non-individuals alike—for they need a way of referring to the non-individuals that they take to exist. Thirdly, many philosophers use ‘individual’ in the context of specific philosophical debates, with an implied restriction to individuals of a particular sort. Thus for example Dasgupta ([2009]), in a discussion of physicalist ontology, uses ‘individual’ to mean individual material object; while Schweikard and Schmid ([2013]), in a discussion of collective intentionality, use ‘individual’ to mean individual person. I refer to these three senses of ‘individual’ as the ‘logical subject’, ‘unitary entity’, and ‘sortally-restricted’ senses respectively.

⁸ Lowe suggests a slime mould as a possible biological example of a plurality, hence a non-individual in his terms.

Note that the first two senses are bound up with questions of fundamental ontology. A philosopher who uses 'individual' to mean logical subject will need some account of what exists; while one who uses 'individual' to mean unitary entity will need some account of the attribute of 'unity' that some entities have and others lack. This reflects the fact that 'individual' in both these senses picks out an ontological category (the most general ontological category and a sub-category thereof, respectively). By contrast, 'individual' in the sortally-restricted sense is not similarly bound up with issues of fundamental ontology. Clearly, a philosopher who uses 'individual' as shorthand for 'individual person' must have something to say about what a person is, and arguably needs to have some criterion for whether person *x* is the same as person *y*. But they need have no general story about what an individual of an arbitrary sort is, nor about what the attribute of 'individuality' amounts to, if indeed there is such an attribute. The significance of this will become clear.

What then of 'biological individual'? Presumably, this expression should mean 'individual, that is biological'. That is, the expression serves to pick out, from the class of all individuals, those that are biological rather than non-biological (however exactly that distinction is drawn). This observation may sound trivial, and in a way it is. But it draws attention to the fact that 'biological individual' is a semantically compound expression, and not a term-of-art that has been invested with a new meaning entirely unrelated to the meanings of its constituents.⁹ That is, the inferences from 'x is a biological individual' to 'x is an individual' and 'x is biological' are valid. Semantic compoundness of 'biological individual' is the natural default assumption, and would, I think, be accepted by all parties to the debate. Of course, this does not take us very far, for it is compatible with very different accounts of what 'individual' means. So let us ask which of the three philosophical senses of 'individual' best captures the meaning of 'biological individual' in the philosophy of biology literature.

⁹ Here it is important to note that 'biological individual' and 'biological individuality' are not technical terms in biology; rather they feature primarily in philosophical reflections on biology. A Web of Science search for articles published since 1970 containing 'biological individual' or 'biological individuality' in the title or abstract reveals a fairly modest number of articles, the preponderance of which, and the most cited, are in philosophy journals. This confirms a point made by Smith-Ferguson and Beekman ([2019]), who note that biologists do not generally talk about 'biological individuality' in the way that philosophers of biology do. On this point, see also (Trappes [2022]).

It seems unlikely that the logical subject sense is at work.¹⁰ For this would yield a large cast of biological individuals indeed. Ecosystems, flagella, signalling pathways, leaves, telomeres, plasmids and forests would all be included, for such entities clearly exist, are biological rather than non-biological, and can be counted, quantified over, and referred to with singular terms. Moreover, on one standard metaphysical view, events as well as objects count as individuals in the logical subject sense—so biological events such as reproduction, gastrulation and meiosis would be included too. To make matters worse, abstract as well as concrete entities can be logical subjects, and some abstract entities are presumably biological, for example biological theories. Clearly, this does not fit with what those in the debates over biological individuality intend.

What about the unitary entity sense? This seems more to the point, and it appears to fit with what some authors say. For example, Hull ([1978], p. 336) tells us that by ‘individuals’ he means ‘spatiotemporally localized cohesive and continuous entities’. In a similar vein, Sober ([1991], p. 294) tells us that individuals are ‘objects’ that are characterized by ‘the integration and interdependence of the parts of a whole’. Both Hull and Sober try to spell out more precisely the nature of the attributes (cohesion, continuity, interdependence, integration) that an ‘entity’ or ‘object’ must have to qualify as an individual by their lights. But for the moment, it is not the details but the broad contours of their view that matters. Both authors adopt a metaphysical picture on which there exist some entities (objects) that are individuals and others that are not. There may also be borderline cases, as Sober notes.

From this, it is tempting to conclude that the unitary entity sense of ‘individual’ is indeed the relevant one, in the philosophy of biology. We can read Hull and Sober as endorsing a metaphysics akin to that of Lowe ([2016]) and attempting to spell out what the attribute of unity, that makes an entity into an individual, amounts to in a biological context. That is, ‘biological individual’ means ‘individual, that is biological’, and ‘individual’ means, roughly, ‘entity that is sufficiently cohesive / integrated.’ This sounds plausible, and it appears to fit with how Hull and Sober frame the issue. But in fact, it yields a misleading picture of what is going on in most of the philosophy of biology literature. Appearances to

¹⁰ Here I concur with Chauvier ([2016]).

the contrary notwithstanding, it is the sortally-restricted sense of 'individual' that is really at work in most discussions of biological individuality. (This is not a criticism; many sciences use 'individual' in precisely this sense.) This point is argued in section 5.

4 Sortals

The notion of sortal is widely used in contemporary philosophy and has a long history. A sortal term or predicate, as usually understood, is one for which there exists a criterion for counting (enumerating) the entities to which it applies, and a criterion for determining the continued existence of an entity of the sort, that is, its persistence over time.¹¹ Thus 'table' and 'chair' are both sortals, for we can sensibly ask how many tables or chairs there are in a room; and whether a particular table is the same table as the one in the hallway yesterday, for example. Sortal terms contrast with what Dummett ([1973]) calls adjectival (or characterizing) terms, such as 'red'. The key difference, Dummett argues, is that to grasp an adjectival term one need only know its 'criterion of application'; but to grasp a sortal term one needs to know in addition its 'criterion of identity', which determines whether an entity that falls under the sortal is or is not (numerically) the same as another, at a given time or a different time.¹²

Though criteria of identity are not always easy to state explicitly, it seems clear that the practice of counting objects, and re-identifying objects over time, presupposes the existence of such criteria. For to count the X s at a time, or to judge whether a given X is the same X as one at an earlier time, one needs to be able to settle questions about the identity and distinctness of X s, and that is what a criterion of identity for X s is meant to do. For example, to count the subsets of $\{a, b, c\}$, one needs to know whether the set $\{a, b\}$ is or is not identical to the set $\{b, a\}$; that is, one needs to know the criterion of identity for sets. Similarly, to count the tables in the room, one needs to know whether the table by the fireplace is or is not identical to the table by the sofa (imagine that the room is so cluttered that the answer is not obvious); and to re-identify the table over time, one needs to know

¹¹ This corresponds to the conception of sortal in (Strawson [1959]). There are alternative conceptions too; see (Grandy [2016]) for a recent discussion.

¹² Note that some philosophers use the expression 'principle of individuation' in lieu of 'criterion of identity'.

whether or not it is identical to the table in the hallway yesterday. For both tasks, one needs to know, if only implicitly, the criterion of identity for tables.

Defining a sortal by the counting and persistence conditions is standard in the literature. However, two further conditions are sometimes invoked (Grandy [2016]). The first is that a sortal tells us the ‘essential nature’ of the things to which it applies, or supplies an answer to the question ‘what is it?’ (‘What’s that funny-looking thing on your desk? It’s a pen.’) The second is that sortals are thought to satisfy the mereological principle that if object *o* falls under the sortal *S*, then no proper part of *o* falls under *S*. Thus no proper part of a table is itself a table, and similarly for pens and chairs. However, Feldman ([1973]) showed that the counting condition for sortal-hood is logically independent of both the essentialist and the mereological conditions, so the latter are not taken to be definitive of a sortal here. Rather, we define sortals by the counting and persistence conditions alone.

The notion of a sortal is rarely used in philosophy of biology, perhaps because of its traditional association with essentialism.¹³ However, when sortals are defined by the counting and persistence conditions alone, it is unproblematic that there are biological sortals. For there are many biological entities that we can clearly count, and that clearly persist through time; correspondingly, many true biological statements contain sortal terms. For example, a typical adult human has one heart, two femurs, and many billions of cells, so ‘heart’, ‘femur’ and ‘cell’ are all sortals. Similarly, since some cells contain no mitochondria while others contain thousands, ‘mitochondrion’ is a sortal. Saying this does not commit us to anything about the essential properties of hearts, femurs, cells or mitochondria, if such there be, nor about whether an entity of one of these sorts is essentially of that sort or not.

Sortal terms, in biology and elsewhere, form a subset of kind terms, or predicates. Biology also contains many kind terms that are not sortals, for example ‘neural tissue’, ‘bone marrow’, and ‘cytoplasm’. We can sensibly ask how much neural tissue there is in an organism’s brain, or how much cytoplasm there is in a skin cell, but not how many. So, in biology, and probably in all sciences, we find both sortal and non-sortal terms.

¹³ Though di Frisco ([2018]) and Pradeu ([2018]) are notable exceptions. Also, Wiggins ([2016]) and Ferner ([2016]) try to link Wiggins’ sortalist metaphysics with issues in the philosophy of biology.

The sortal / non-sortal distinction reflects the fact that the world contains ‘stuff’ as well as ‘entities’, as Grandy ([2016]) puts it. It is sometimes argued that all stuff is ultimately composed of entities, in the way that neural tissue is composed (mostly) of neurons, but we need not adjudicate this issue here. Now since ‘entity’ is a rather inclusive category, it may be that not much can be said about the nature of entities in general. But in any case, use of a sortal term, in science or elsewhere, does not require us to address such metaphysical issues. Competent users of a biological sortal such as ‘chromosome’, for example, need to be able to tell whether something is a chromosome or not, and need an implicit grasp of the criterion of identity for chromosomes (so that they can count and re-identify them); but they do not need, and typically do not have, an account of the general ontological category into which chromosomes fall.

Clearly, the notion of a sortal term is closely related to that of a count noun; indeed, some philosophers treat these two notions as one. But as Wiggins ([1980]) persuasively argues, not all count nouns are sortal terms (or express sortal concepts). Expressions such as ‘object’, ‘entity’, and ‘thing’ are not genuine sortals, Wiggins holds, since they have no associated criterion of identity. If someone asks you to count how the things in the larder, for example, it is quite unclear how to proceed. Is a spice jar one thing? Or two, if its lid screws off? Or three, if we count the label on the jar? Is each fennel seed in the jar a single thing? Or two, if its husk detaches? Clearly, there is no way that these questions can be answered. Until you are told what sort of object to count, for example jars, labels or seeds, the instruction is meaningless (Lowe [1989] p. 10). (Note that the sort need not be explicitly specified; context may determine it.) Wiggins coins the expression ‘dummy sortal’ to refer to terms such as ‘object’, which grammatically are count nouns, but do not, on their own, convey a criterion of identity.

Finally, note that if *S* is a sortal, we can always meaningfully speak of ‘an individual *S*’, where this simply means: an *S*. (If this were not meaningful then *S* would not be a sortal.) Often the point of saying ‘an individual *S*’ as opposed to ‘an *S*’ is pragmatic: we wish to draw attention to the contrast between one *S* and many. For example, the statement ‘an individual country cannot do much about climate change’ has the implicature that by banding together countries can do something about climate change, which would be lost if we simply said ‘a country’. The relevance of this will become clear.

5 'Individual' is Not a Sortal

I argue that the term 'individual', in its vernacular and philosophical senses, is either a non-sortal or a dummy sortal. Take the vernacular sense first. When used as an adjectival modifier as in 'individual chopstick', the sortal term is clearly 'chopstick' not 'individual'. When used as a substantive as in 'armed individual', where the context makes clear that this is shorthand for 'armed person', the sortal in question is 'person' not 'individual'. That is, it is because 'individual' really means individual person, in this context, that the police can say how many armed individuals were at the crime scene, and that one of the armed individuals was the same individual who hijacked a car the previous day. Note that if the context fails to unambiguously indicate a sortal then it is unclear how to count individuals, in which case 'individual', used substantively, is a dummy sortal. To see this, suppose someone asks you to look out of the window and say how many individuals you can see. Clearly you would be at a loss to answer. The question invites the response 'individuals of what sort?'. Trees? Cats? Wheelbarrows? So as used in everyday English, 'individual' is either a non-sortal or a dummy sortal.

The same is true of the three philosophical senses of 'individual' identified above. Take firstly the logical subject sense of Russell and Strawson. Clearly there is no good way to count logical subjects, or things that exist; so 'individual' in this sense is a prime example of a dummy sortal. Next consider the sortally-restricted sense, in which 'individual' is used as a shorthand, in specific philosophical contexts, for an individual of a certain sort, such as a person. Again, the relevant sortal here is 'person': it is this that permits the individuals to be counted and re-identified. What about the unitary entity sense of Lowe ([2016]), in which, to recall, an entity counts as an individual only if it has the requisite 'unity'? Depending on how exactly 'unity' is cashed out, this definition might be thought to make 'individual' into a sortal. But in fact Lowe ([2016], p. 50–1) holds the opposite view; for having stressed that to be an individual in his sense something must possess unity, he goes on to say that 'ascriptions of number only make sense when they are...associated with some suitable sortal concept, as for example, set or planet'. And indeed this seems correct: for even if we accept the unity requirement on individuals, and thus the existence of some non-individuals, there is still no clear way to count individuals in the absence of a further sortal specification. Thus

in none of the three customary philosophical senses of ‘individual’ does it express a sortal concept.

What about ‘biological individual’? This expression is not a genuine sortal either. This follows from the fact that ‘individual’, in any of its senses, is either a non-sortal or a dummy sortal, and our assumption that ‘biological individual’ is semantically compound. For the qualifier ‘biological’ is clearly an adjectival predicate not a sortal one, so just as ‘red individual’ does not express a sortal concept, nor does ‘biological individual’. That is, so long as we accept that ‘biological individual’ means ‘individual, that is biological’, then since ‘individual’ is not a true sortal, nor is ‘biological individual’.

If this is correct, it suggests that some of the central questions in the biological individuality debate have been ill-posed. Participants in that debate generally talk as if ‘biological individual’ was a sortal expression—for their concern is often with how biological individuals should be counted and / or how they persist over time. Typical questions in this literature include: Is an aspen grove a single biological individual, or a collection of many individuals? When a strawberry plant sends out runners, is this the growth of a single biological individual or the production of a new one? The first is these is a question about how biological individuals are to be counted; the second about what constitutes the persistence of a biological individual over time. Both questions presuppose that ‘biological individual’ is a sortal, at least if it is thought that the questions have principled answers.

The role of counting and persistence comes across particularly clearly in Clarke’s influential account of why the problem of biological individuality matters (Clarke [2010]; [2013]). Clarke argues that evolutionists need to know which entities to count in order to apply the fitness concept that is so central to Darwinian theory; and the job of the biological individual concept, as she sees it, is to answer this question. That is, biological individuals are fitness-bearing entities. Now fitness depends on both survival and reproduction, so to meaningfully ascribe fitness to an entity requires being able to tell whether the entity has continued to exist and to count its offspring. And to make fitness comparisons among different types of entity in a population requires tracking the frequencies of those types over time, which requires counting the entities belonging to each type. Thus if Clarke is right about the role of the biological individuality concept, ‘biological individual’ must be a sortal.

Admittedly, Clarke's framing of the biological individuality debate is not the only possible one. But I think she is right that biological individuals are typically thought of as fitness-bearers, evidenced by the close association between the notions of biological individual and 'unit of selection', from Hull's work onwards. Moreover, a concern with persistence, life-cycles, and distinguishing growth from reproduction are central themes in the biological individuality debate. So the assumption that biological individuals can in principle be counted, and followed through time, seems to be widely held. Indeed much biological practice rests on this assumption, such as the ecologist's concern with how many individuals are in a population, or the developmental biologist's concern with how an adult individual arises from an embryo.

If I am right that 'biological individual' is either a non-sortal or a dummy sortal, then the question of how many biological individuals there are, in some given spatiotemporal region, cannot be answered until a sortal concept is supplied, implicitly or explicitly. For again, the question invites the response 'individuals of what sort?'. Elephants? Flagella? Stamens? Kidneys? Transposons? Plasmids? Now 'elephant', 'flagellum', 'stamen', 'kidney', 'transposon' and 'plasmid' are all sortal terms, for it is possible to count the entities to which they apply (setting aside borderline cases), and the entities have clear identity and persistence conditions. However, note that apart from elephants, none of these entities are even candidates for being biological individuals in the sense in which (most) philosophers of biology intend the term. That is, they are not the sort of thing whose status is at issue in the biological individuality debate. But taken at face value, this is odd. Since we can count kidneys, flagella and stamen, we can sensibly talk about an individual kidney, an individual flagellum or an individual stamen, so surely these are *bona fide* biological individuals? Why then are they excluded from the discussion?

Might the answer be found in the 'cohesiveness' or 'integration' criteria of Hull and Sober? This seems unlikely. A bacterial flagellum, after all, is a perfectly cohesive entity, with well-defined boundaries; and it is clearly functionally integrated, with numerous interdependent parts such as filament, basal body, hook and membrane. The same is true of a stamen, a kidney, a transposon, a plasmid, and a whole host of other biological entities too. So it is hard to see how definitions like those of Hull and Sober will succeed in excluding

these entities from the class of biological individuals (if that is their intent). In short, cohesion and integration are exhibited by entities at all biological scales.

This has two important morals. Firstly, it shows that, just as Lowe's requirement that individuals exhibit 'unity' does not make 'individual' into a true sortal term, so the Hull / Sober requirement that biological individuals exhibit 'cohesiveness' or 'functional integration' does not make 'biological individual' into a sortal either. For 'is cohesive / integrated' is a characterizing rather than a sortal predicate, so does not on its own convey any criterion of identity. So even if we accept the Hull / Sober definition or some variant thereof, this gives us no way of deciding how many biological individuals there are in a given spatiotemporal region, in the absence of a further sortal specification; nor of determining whether a given biological individual has persisted through time. That is, being told that 'individual' means 'entity that exhibits cohesiveness / integration' does not enable us to count nor re-identify biological individuals until we are told what sort of entities we are talking about.

Secondly, this shows that contrary to first impressions, the unitary entity sense of 'individual' is not the sense at work in most philosophy of biology discussions at all. Rather, it is the third sense of 'individual' noted above—the sortally-restricted sense—that is really at work. That is, the expression 'biological individual', as used in the literature on biological individuality, really means 'individual entity of a certain (biological) sort', where the sort is implicitly determined by the context. And the sort in question, most though not all of the time, is 'organism'.

This explanation, I submit, is the only way of making sense of the joint facts that the expression 'biological individual' is not itself a sortal, that philosophers of biology nonetheless believe that they can count and re-identify biological individuals, and that the count is meant to exclude many individual entities that fall under clear-cut biological sortals—such as centromeres, leaves and stamen.

6 'Organism' versus 'Biological Individual'

Here is a simple explanation of what (a large part of) the biological individuality debate is about that does not use the word 'individual'. One of the central organizing concepts in biology is that of an organism. There are many clear-cut examples of organisms, such as humans, fruit-flies and nematode worms, and many clear-cut examples of things that are not organisms, such as kidneys, RNA molecules and ecosystems. But as well as these clear-cut cases, there are a host of problem cases, or entities that exhibit some of the usual attributes of organismality but not others. Those attributes include: autonomy, self-maintenance, genetic homogeneity, the ability to reproduce, absence of internal conflict, functional complexity, and more. This raises the question of which of these attributes should be taken to define an organism, and why.

In my view, it is unfortunate that this issue is so often described as being about biological individuality, rather than organismality. For as stressed above, there are many different biological sortals, and thus many individual biological entities that fall under those sortals, that are certainly not organisms. The grounds for excluding those entities from the extension of 'biological individual' are obscure, until it is realised that the biological individuality debate is (mostly) about what an organism is.

The issue of whether to use 'organism' or 'biological individual' has been raised many times in the literature. But it is usually treated as a matter of little consequence, or of mere terminological preference. In fact, there is a good logical reason to prefer the former. For 'organism' is a genuine sortal term, while as we have seen 'biological individual' is not; and a failure to appreciate this point has, I believe, significantly obscured the debate. So although often it does not matter what words we use to mark the distinctions we wish to draw, in this case it does.

By what rights do I say that 'organism' is a genuine sortal? How do we know that it too is not a dummy sortal? Part of the answer is that, although the term is not easy to define, 'organism' has a good claim to be a genuine natural kind term of biology; and it is widely used in both the primary biological literature and in textbooks (unlike 'biological individual'—see footnote 9.) Moreover, in some taxa at least, notably vertebrates, it is fairly

clear how to count and re-identify organisms, and thus how to settle questions about their identity and distinctness.

Now it might be replied that in many non-vertebrate taxa, such as bacteria, protists, plants and fungi, it is less clear how to identify organisms, and problem cases abound. This is certainly true. But the fact remains that biology has not, and arguably could not, dispense with the organism concept altogether. (Pepper and Herron ([2008], p. 625) note that although the 'paradigm organism', defined by the attributes listed above, is 'not universal...neither is it rare, and deviations are often minor.')

Thus consider the question 'how many organisms are there in your garden?' Unlike 'how many individuals are there?', this question does not immediately invite a request for sortal specification. Certainly, to give a fully determinate answer we would have to confront problem cases, such as the water mould on the pond, the lichen on the wall, and the fungal mycelium in the soil. But the need to legislate on these cases, and the difficulty of doing so in a fully principled way, does not compromise the status of 'organism' as a sortal.

To see this point, note that virtually all sortals admit of borderline cases, not just in biology. Take 'book' for example. Does a twenty page pamphlet count as a book? Does a bound trilogy count as one book or three? Our uncertainty on these points may complicate the task of counting the books in my room, but 'book' is still a *bona fide* sortal. For the uncertainty here is different in kind to the uncertainty we would face if asked to count the 'things' or 'objects' in the room, for example. Similarly, our uncertainty about whether a biofilm or a lichen counts as a single organism is fully compatible with 'organism' being a sortal.

Further indirect evidence that 'organism' is a sortal can be found from the mereological principle noted above, that if an object belongs to a sortal *S*, then no proper part of it belongs to *S*. Although this principle isn't part of the definition of a sortal, as understood here, paradigm sortals do in fact satisfy it. So it is interesting to note that one influential definition of an organism in the literature, that of Queller and Strassman ([2009], p. 3144), implies that 'organism' satisfies the principle too. They define an organism as 'the largest unit of near-unanimous design', where the 'unanimity' of a biological unit means that its constituent parts exhibit a high degree of cooperation and little conflict. So by Queller and Strassman's lights, a honey-bee colony counts as an organism, as it is a broadly

cooperative unit with evolved mechanisms that suppress internal conflict. But the bees in the colony are not organisms. For although each bee does have constituent parts (cells and organs) that cooperate and is thus itself a unit of design, it is not the largest such unit—for that is the colony. So on this definition, it follows that no organism can have organismic proper parts.¹⁴ Queller and Strassman argue persuasively that their definition captures and refines our pre-theoretic notion of an organism, in the light of modern evolutionary theory. If they are right, it follows that ‘organism’ exhibits one of the hallmarks of a genuine sortal term.

7 Two Types of Biological Individual?

Pradeu ([2012]; [2016b]) and Godfrey-Smith ([2013]) both argue, for similar reasons, that we should recognize two different types of biological individual, a position often known as ‘pluralism’. Pradeu distinguishes between ‘physiological’ and ‘evolutionary’ individuals; roughly, the former are defined by having a single immune system, the latter by functioning as a unit in the evolutionary process. Pradeu suggests that ‘organism’ should only be used for physiological individuals, as this respects the historical meaning of the term. Similarly, Godfrey-Smith distinguishes ‘organisms’, which are physiologically integrated units, from ‘Darwinian individuals’, which must be able to reproduce, or form parent-offspring lineages; he also allows that some entities are both.

I have no quarrel with the distinction that these terms are intended to mark, which is surely important. But on the face of it there is a certain logical incongruity here. For since ‘individual’ is not a sortal term, qualifying ‘individual’ with an adjectival modifier such as ‘physiological’ or ‘Darwinian’ should not yield a sortal either. That is, ‘is physiologically integrated’ and ‘can reproduce’ are characterizing predicates, not sortal ones. Knowing that an entity satisfies one of these predicates does not entail knowing anything about its identity or persistence conditions. If this is right, Godfrey-Smith’s contrast pits a genuine sortal concept (organism) against a non-sortal (Darwinian individual). The same is true of

¹⁴ That Queller and Strassman’s definition has this implication is noted by Godfrey-Smith ([2013]), who also notes that, confusingly, Queller and Strassman appear to deny the implication, for they say at one point that that the bees in the colony *are* organisms.

Pradeu, given his admission that ‘physiological individual’ effectively corresponds to organism.

Now it is possible that by suitably tightening their stipulative definitions of ‘evolutionary individual’ and ‘Darwinian individual’, Pradeu and Godfrey-Smith could make these terms into genuine sortals, that is, furnish them with clear criteria of identity. And indeed Godfrey-Smith appears to assume that Darwinian individuals can be straightforwardly counted. But it is noteworthy that when he explains what he means by the expression ‘Darwinian individual’, he helps himself to *other* sortal concepts. Thus Godfrey-Smith tells us that viruses, genes and chromosomes are Darwinian individuals¹⁵; and of course the terms ‘virus’, ‘gene’ and ‘chromosome’ are all sortals. But the fact that it is fairly clear how to count and re-identify chromosomes (for example), and that chromosomes are Darwinian individuals *sensu* Godfrey-Smith, does not show that ‘Darwinian individual’ is itself a sortal. For the predicate ‘Darwinian individual’, as defined by Godfrey-Smith, applies to entities of many different sorts, whose criteria of identity do not necessarily coincide. (The same is true of ‘unit of selection’.) So in order to count Darwinian individuals, we need to be told the relevant sortal.

To make this point more concrete, suppose a molecular biologist directs our attention to two (token) DNA sequences in a lab, and asks whether these two sequences belong to the same Darwinian individual or not? (Just as we might ask, of two snake segments visible in a large reptile cage in a zoo, whether they belong to the same snake or not.) There is no good answer to this question. For it might be that the two sequences belong to the same chromosome but not the same gene—and chromosomes and genes are both Darwinian individuals. So the question of how many Darwinian individuals we have before us cannot be answered in the absence of sortal specification, for otherwise we have no idea where one Darwinian individual begins and the next starts.

The same is true, I suggest, of the various other sub-categories of biological individual that have been described in the literature (such as ‘metabolic individual’ and ‘functional individual’.¹⁶) *Prima facie*, such compound expressions, unlike ‘organism’, are not

¹⁵ Though genes are usually ‘marginal’ Darwinian individuals, Godfrey-Smith ([2009]) tells us.

¹⁶ These expressions come from Godfrey-Smith ([2009]) and di Frisco ([2018]) respectively.

themselves sortal terms. Thus in order to count and / or re-identify functional and metabolic individuals, either a criterion of identity must be supplied, thus converting the terms into genuine sortals by stipulation; or the use of these terms must be explained by reference to other biological sortals, as in the case of Godfrey-Smith's 'Darwinian individual'.

Importantly, none of this means that pluralism about biological individuality is wrong-headed. On the contrary, if pluralism is the thesis that there is more than one type of biological individual, then pluralism fits naturally with the position defended here. For if 'individual' has its sortally-restricted sense – which I have argued to be the operative sense in much philosophy of biology, and a perfectly respectable sense – it follows immediately that there are many types of biological individual, because there are many different biological sortals. And there may well be significant groupings of these into kinds defined by functional, metabolic, evolutionary and other criteria.

To conclude, I think that Pradeu and Godfrey-Smith have put their finger on an important distinction; my concern is with how they express and conceptualize it. It may well be that 'entity which can reproduce' denotes an important biological kind, that is needed to understand evolutionary biology, and that many biological entities falling under this kind do not fall under the kind organism, and vice-versa. But contrasting 'organism' with 'evolutionary individual' (or 'Darwinian individual'), as if these were expressions of the same logical type, is problematic, since only the former is a true sortal. Moreover, it encourages the misleading notion that there are exactly two types of biological individual. But the fact is that there are many biological entities that fall under sortals, so can be counted, such as kidneys, telomeres and flagella, that are neither organisms nor evolutionary individuals. There seems no good reason to exclude these entities from the category of biological individual, and thus no reason to think that physiological and evolutionary individuality constitute the two fundamental modes of biological individuality.

8 Implications

Let us return to the four puzzles we started with. The first was whether biology is special among the sciences in requiring its own individuality concept. The answer is no. Contrary to the impression created by the phrase 'biological individual', biology has no need for, and

does not in fact operate with, a proprietary individuality concept. In biology, there are individual entities of various sorts, just as in other sciences. One of these sorts is ‘organism’, a sort that is particularly interesting and is central to much biological enquiry. It turns out to be quite hard to say what exactly an organism is, and the reasons why it is hard are interesting, scientifically and philosophically. But note that the type of problem we face here—providing a principled definition of a key scientific concept—arises quite generally in science. Think for example of the debate in chemistry about what a covalent bond is, or in astronomy about what a planet is. These debates are entirely on a par, logically and metaphysically, with the debate over what an organism is, which as we have seen is what the biological individuality debate is mostly about.

The temptation to think that there is something special going on in the biological debate arises, I suspect, from an interesting though ultimately incidental feature of the ‘problem cases’ for the organism concept. Such cases often involve entities, for example termite mounds, of which it is hard to say whether they are organisms as opposed to groups of organisms. Now it is very natural to describe this as the question of whether a termite mound is or is not an individual organism, given that ‘individual’ in English often contrasts with ‘group’. This description is fine, so long as we realize that the adjective ‘individual’ is adding nothing here. That is, the question is simply whether the termite mound is an organism or not. The fact that those who answer ‘no’ typically hold that the termites in the mound are organisms may invite the use of the adjective ‘individual’; but it should not blind us to the fact that, at root, the issue is just about whether a given entity (the mound) does or does not lie in the extension of a particular sortal (‘organism’). This debate is no different, logically, from the debate in astronomy about whether Pluto lies in the extension of the sortal ‘planet’. Now participants in that debate do not describe themselves as being concerned with the concept of ‘astronomical individuality’, but with the concept of a planet. Similarly, the debate over the status of termite mounds is a debate about the concept of an organism.

Our second puzzle was how the concept of individual at work in the species-are-individuals debate relates to the rest of the biological individuality debate. The answer, I think, is as follows. In both debates, the operative sense of ‘individual’ is the sortally-restricted sense, or at least should be. For in effect, the species-are-individuals thesis

amounts to the claim that a species is an individual lineage (or more precisely: an individual segment of the phylogenetic tree bounded by speciation and extinction events). The term 'lineage' in biology, on one standard definition, describes a sequence of entities (organisms, cells, populations or genes) that are connected by an unbroken chain of ancestor-descendant relations. The idea that a species is a lineage in this sense, comprising all and only the organisms descended from a single founder population, stands in sharp contrast to the rival species-as-natural-kinds idea, and is the clearest way, I submit, of expressing the species-are-individuals thesis.

Now this is not how Hull ([1978]) originally presented that thesis (though he does endorse the claim that a species is a lineage.) As we have seen, Hull attempted a quite general definition of 'individual' in terms of cohesion, spatiotemporal localization and continuity; and then argued that species satisfy that definition. However, in retrospect this was not the best way to make his point, for two reasons. Firstly, it invites the objection that some species, for example those with little gene-flow between their constituent populations, are not especially cohesive. This objection is correct but beside the point, for it does not threaten the idea that a species is a lineage, and it does not lend support to the rival species-as-natural-kinds position. Secondly, since organisms are the paradigm biological individuals, Hull's formulation fostered the impression that the grounds for the species-are-individuals thesis relied on analogizing a whole species to an organism.¹⁷ Critics objected that this analogy is rather thin, given that species lack the functional integration that characterizes organisms. Again, this criticism is correct but beside the point.

It follows, therefore, that there need be no semantic incongruity between 'individual' in the sense in which it is asked whether a species is an individual, and whether a bacterial biofilm (for example) is an individual. In both cases, 'individual' is being used in its sortally-restricted sense, but relative to a different sortal. In the former case, the relevant sortal is 'lineage'; in the latter, it is 'organism'.

¹⁷ Hull ([1978], p. 347) was actually rather non-committal about this analogy. He discusses Eldredge and Gould's idea that species often exhibit 'stasis' with approval and adds 'if Eldredge and Gould are right, species are more like organisms than anyone has previously supposed'.

Our third puzzle was why ‘biological individual’ and ‘organism’ might ever have been thought equivalent. Two things can be said by way of explanation. Firstly, though there exist individual biological entities of many different sorts, ‘organism’ is a particularly important sort. For as Queller and Strassman ([2009]) stress, organisms are the entities that exhibit adaptations, and explaining adaptation is a major task of biology. A world that contained biological matter but lacked organisms would look very different indeed from the actual world. Secondly, in debates about whether an entity is or is not an organism, the relevant contrast is often ‘as opposed to a group of organisms’, as noted above. This may explain why the tradition of using ‘organism’ and ‘individual’ interchangeably has taken root, given the established linguistic practice of contrasting groups with individuals.

The use of the term ‘biological individual’ in lieu of ‘organism’ has encouraged many philosophers of biology to talk about ‘individuation’.¹⁸ However, very often they do not use this term in its technical philosophical sense.¹⁹ For example, Clarke ([2010], p. 334), in a discussion of the well-known ‘ramet versus genet’ question in plant biology, asks what the ‘individuation criteria’ in plants should be. However, the question that Clarke is actually concerned with is how to decide whether a genet containing many ramets counts as a single organism or a group of organisms; equivalently, about whether production of a new ramet constitutes reproduction or growth.²⁰ No issues of individuation arise here, since it is generally perfectly clear what the identity and persistence criteria for both genets and ramets are. That is, plant biologists encounter no difficulties of principle in saying how many ramets or genets they are dealing with, nor in judging whether two ramets do or do not belong to the same genet, nor in judging whether a ramet or a genet has ceased to exist. The difficulty they face, rather, is deciding whether genets or ramets are organisms.

¹⁸ See for example the essays in (Bueno, Chen and Fagan [2018]). Though the editors’ introduction to this volume includes a careful discussion of the meaning of ‘individuate’, the term is used in a wide variety of senses by the contributors.

¹⁹ By this I mean what Lowe ([2003]) calls the metaphysical sense of ‘individuate’, in which what individuates an entity is what makes it the entity it is, distinct from other entities—as for example when we say that a set is individuated by its members. Lowe distinguishes this from the cognitive sense of ‘individuate’ found in psychology, which refers to the act of singling out an individual entity in thought or perception.

²⁰ A ‘genet’ refers to all the mitotic products of a single episode of sexual reproduction, while a ‘ramet’ refers to a physically coherent structural unit, such as a bush. Thus an aspen grove, for example, may contain a single genet but numerous ramets. See (Clarke [2010] p. 323).

If 'individuate' is used in its standard philosophical sense, there is no particular link to the biological individuality debate. For note that one can sensibly ask how to individuate biological things of many different sorts, including traits, genotypes, theories and explanations. For each of these sorts, we can sensibly ask whether an x of the sort and a y of the sort are numerically identical or not. But things falling under these sorts are not biological individuals in the usual sense, if only because theories and explanations are abstract objects, while traits and genotypes are properties rather than objects.

Our fourth puzzle was why so many countable biological entities, with determinate identity and persistence conditions, are not even candidates for being biological individuals in the sense of the current debate. The answer is simply that these entities do not belong to the sorts, notably organism, that the debate is mostly concerned with.

One final point deserves mention. Our diagnosis of the biological individuality debate helps to explain a point that has been widely discussed but is puzzling until one realizes that 'individual' is being used in its sortally-restricted sense. Many authors have argued that biological individuality comes in degrees—some entities seem to have more of it than others. Now if 'individual' denotes a fundamental ontological category, this can seem puzzling. How can there be a half-way house? (Indeed Simons ([1987], p. 290) argues, in the context of general ontology, that there cannot be 'degrees of being an individual'.) However, once we appreciate that the expression 'biological individual' refers to an entity that falls under a given biological sortal, usually but not always 'organism', the puzzle is resolved. For it is a familiar point that almost all predicates, including sortal predicates, are vague. So there is no great difficulty in understanding how the concept of an organism can admit of borderline cases, such as termite mounds or viruses, for example. But note that it is usually quite clear how to count such entities—we can sensibly ask how many termite mounds are in a forest, or how many virus particles in a sample. Therefore, these borderline cases, and others like them, are not usefully described as entities that 'are not quite individuals'; rather, they are individual entities, of particular biological sorts, that only partly satisfy the criteria for being an organism.

9 Conclusion

The debate over biological individuality is thriving in the philosophy of biology, yet by the admission of leading participants in the debate, suffers from conceptual unclarity. In part, this is because central terms used in the debate lack universally-accepted definitions, making it difficult to determine whether disagreements are substantive or terminological. This paper has developed a suggestion about the source of the unclarity, namely that the term ‘biological individual’ has been treated as if it were a sortal when in fact it is not. This diagnosis sheds light on a number of otherwise puzzling aspects of the debate and helps to clarify the metaphysical status of the question ‘what is a biological individual?’.

The methodology employed in this paper—attending carefully to the linguistic formulations used to set up an issue—is a relatively uncommon one in the philosophy of biology. Indeed, I suspect that many philosophers of biology incline towards the view that traditional analytic philosophy, particularly of the ‘linguistic analysis’ sort, has little to offer them. Whether or not this is usually true, in the case of the biological individuality debate I think that it is untrue. Careful attention to the use of language, combined with some distinctions and tools from analytic philosophy, can improve our formulation of, and thus understanding of, the issues in that debate. Obviously this cannot resolve the substantive questions at stake, but it can help to clarify what they are.

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