

On the very idea of biological individuality

Abstract

The burgeoning debate over biological individuality raises deep issues, philosophical and scientific, but suffers from pervasive 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 think that the expression “biological individual” is a *sortal*, when in fact it is not. This diagnosis sheds light on a number of otherwise puzzling aspects of the debate.

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 Szathmary 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 (Dupre 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. Indicative of the disconnect is that expressions such as “individual”, “object”, “identity” and “individuate” are widely used in the philosophy of biology literature, but not always with exactly 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 the concept of an individual within biology itself (cf. Lidgard and Nyhart 2017). Moreover, they could add that the issues discussed in the literature on biological individuality require serious engagement with empirical details, and 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 certain conceptual unclarities, though it is not easy to pinpoint their source. This has been noted by Pradeu (2016), one of the main contributors to the literature, who admits that “there is considerable confusion over the definition of the notion of a ‘biological individual’ and related terms” (p.765). In this paper I wish to suggest 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, is guilty of a category mistake. The mistake is to think that the expression “biological individual” is a *sortal*, when in fact it is not. This diagnosis sheds light on various aspects of the debate, and it shows that the methods of traditional analytic philosophy can play a role, albeit a modest clarificatory one, in achieving a clearer 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. That would be a rash claim indeed. The debate on this topic is large and multi-faceted, arguably encompassing more than a single issue.¹ Nonetheless, I believe that my critique applies quite widely. Secondly, I do not say that the debate on biological individuality is without value, or irredeemably confused. On the contrary, I believe that 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 sensibly talk of

¹ This point is emphasized by Love and Brigandt (2017).

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 four 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* 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 these entities are not even *candidates* for being biological individuals in the sense of the current debate. Why not?

3. The word “individual”

² Philosophers have of course discussed ontological issues in astronomy, chemistry and even geography. My point is simply that the term “individuality” does not feature prominently in these philosophical 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 (e.g. French 2019), but the operative sense of “individual” is quite different from the sense(s) at work in the discussion of biological individuality.

³ See Bouchard and Huneman (eds.) (2013); Guay and Pradeu (eds.) (2016); Lidgard and Nyhart (eds.) (2017); 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).

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 (2016) among others.

Let us take a step back and focus on the word “individual”. In ordinary English, the word “individual” can be used either as a substantive, as in “police are hunting an armed individual”, or an 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 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” (p.43). Secondly, some philosophers use “individual” in a more restrictive sense, according to which not everything that exists is an individual. For example, E.J. 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”.⁶ 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.

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

⁶ Lowe suggests a slime mould as a possible biological example of a plurality, hence a non-individual in his terms.

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.⁷ 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.

It seems unlikely that the logical subject sense is at work.⁸ 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) tells us that by “individuals” he means “spatiotemporally localized cohesive and continuous entities” (p.336). In a similar vein, Sober (1991) tells us that individuals are “objects” that are characterised by “the integration and interdependence of the parts of a whole” (p.294). 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

⁷ An anonymous referee suggests that “biological individual” is a technical term in biology that has been invested with a special technical meaning. Even if this were so, it would not follow that it is not semantically compound, for it could be that “individual” itself has been invested with a technical meaning. In any case, I do not think that “biological individual” is a technical term in biology. While the term “individual” is widely used in biology (usually to mean individual organism), the term “biological individual” occurs mostly in philosophical reflections on biology.

⁸ Here I concur with Chauvier (2016).

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 the contrary notwithstanding, it is the sortally-restricted sense of “individual” that is really at work in most discussions of biological individuality; and is the sense usually found in biology itself. This point is argued in section 5.

4. Sortals

The notion of a *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, i.e. its persistence over time.⁹ 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 tells us whether or not one entity that falls under the sortal is (numerically) the same as another, at a given time or a different time.¹⁰

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 *Xs* 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 *Xs*, and that is what a criterion of identity for *Xs* 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

⁹ This corresponds to the conception of sortal in Strawson (1959). There are alternative conceptions too; see Grandy (2016) for a recent discussion.

¹⁰ 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 a question of the form “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 the philosophy of biology, perhaps because of its traditional association with essentialism.¹¹ 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 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.

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” (or “object”) 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-

¹¹ 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.

identify them); but they do not need to have, 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, in fact 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 many things there are in the larder, for example, it is quite unclear how to proceed. Does a spice jar count as one thing? Or two, if its lid screws off? Or three, if we count the label on the jar? Does each fennel seed in the jar count as a single thing? Or two, if its husk detaches? Clearly, there is no way that these questions can be answered. The moral is that until it is clear what *sort* of object you are being asked to count, e.g. jars, labels, or seeds, the instruction is meaningless (cf. 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, then 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, an implicature that 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 quite unclear how you would 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 you. 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 these that permit 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 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” (2016, p.50-1). And indeed this seems correct: for even if we accept the unity requirement on being an individual, 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 immediately 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 the contemporary debate over biological individuality has been ill-posed. Participants in that debate generally talk as if “biological individual” was a sortal expression – for their concern is precisely 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 thus presuppose that “biological individual” is a sortal, at least if it is supposed that the questions have determinate 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, with life-cycles, and with distinguishing growth from reproduction are central themes in the biological individuality debate. So the assumption that biological individuals can in principle be counted, and can be followed through time, seems to be quite widely held.

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 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”). 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 protested 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) note that although the “paradigm organism”, defined by the attributes listed above, is “not universal...neither is it rare, and deviations are often minor.” (p.625)) 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 mold 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 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*. Whether or not this principle is universally true, paradigm sortals do seem to satisfy it. So it is interesting to note that one influential definition of an organism in the literature, that of Queller and Strassman (2009), 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 (2009, p. 3144, my emphasis). 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.¹² 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.

In contrast to the idea that an organism cannot contain other organisms as parts, there is a tradition in evolutionary biology that describes a nested hierarchy of biological units, often characterized as “gene–chromosome–cell–multi-celled organism–colony–population–species”, and that emphasizes the *parity* of these units (e.g. Lewontin 1970). In particular, advocates of multi-level selection argue that natural selection can operate on units at all levels of the hierarchy, above and below the organism. The relevance of this is that “unit of selection” has sometimes been equated with “biological individual” – which would imply that “biological individual” violates the mereological principle above. Though this equation is not uncontroversial, it constitutes further indirect evidence that “biological individual” is not a true sortal.

7. Types of biological individual?

Pradeu (2011) and Godfrey-Smith (2013) both argue, for similar reasons, that we should recognize two different types of biological individual. 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 Pradeu, given his admission that “physiological individual” effectively corresponds to organism.

Now it is perhaps possible that by suitably tightening their stipulative definitions of “evolutionary individual” and “Darwinian individual”, Pradeu and Godfrey-Smith could make

¹² 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.

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 individuals; 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 begin to 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. 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”.¹³) Such compound expressions, unlike “organism”, do not appear to be true sortals.

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 if I am right, then to contrast “organism” with “Darwinian individual” is to commit a category mistake, since only the former is a true sortal. Moreover, it is misleading to think of organism (or physiological individual) and Darwinian individual as refinements of the more general concept of a biological individual, as Pradeu and Godfrey-Smith do. For there are many biological entities that fall under sortals, so can be counted, such as kidneys, telomeres and flagellae, but are neither physiological 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 Darwinian individuals constitute the two fundamental modes of biological individuality.

¹³ These expressions come from Godfrey-Smith (2009) and di Frisco (2018) respectively.

8. Implications

Let us return to the four puzzles we started with. The first was whether biology is somehow 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 there are in other sciences. One of these sorts is “organism”, a sort that is particularly interesting and is central to much biological enquiry, past and present. 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, e.g. 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 rather with the concept of a planet. Similarly, the debate over the status of termite mounds does not involve the concept of biological individuality, but the concept of an organism.

Our second puzzle was how the concept of individual at work in the species-as-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 in fact 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, e.g. 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.¹⁴ 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”.

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, recall that in debates about whether an entity is or is not an organism, the relevant alternative is often “as opposed to a group”. 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.

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

¹⁴ Hull (1978) 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” (p.347).

“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) argues, in the context of general ontology, that there cannot be “degrees of being an individual” (p.290).) 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

Many philosophers of biology incline towards the view that traditional analytic philosophy has little to offer them. Whether or not this is generally true, in the case of the recent biological individuality debate, I hope to have shown 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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