Does the anti-essentialist consensus about species rest on a mistake?

Abstract

A long-established consensus in the philosophy of biology holds that biological species are not natural kinds with intrinsic essences, despite what Putnam (1975) and Kripke (1980) thought. This anti-essentialist consensus has recently been challenged by Michael Devitt, who insists that it rests on a mistake. According to Devitt, philosophers of biology have failed to recognise the distinction between two quite different questions one can ask about species: the Category question and the Taxon question. The various "species concepts" found in the biological literature are attempts to answer the former but are silent about the latter, Devitt claims, so do not conflict with essentialism, *pace* what philosophers of biology believe. By carefully attending to the logical relation between the Category and Taxon questions, Devitt's claim that the anti-essentialist consensus rests on a mistake is shown to be untenable.

1. Introduction

In a series of articles and a recent book, Michael Devitt describes the broad anti-essentialist consensus regarding the nature of species that holds sway in the philosophy of biology (Devitt 2008, 2018, 2021, 2023). As Devitt notes, philosophers of biology are virtually unanimous in rejecting the idea that biological species are natural kinds with intrinsic essences, as chemical and physical kinds are often thought to be.[1] What determines whether an organism belongs to a given species, according to most philosophers of biology, is not the organism's intrinsic make-up (for example, its genetic properties), but rather its genealogical history. That is, although the organisms in a species will usually share many genetic and phenotypic similarities, it is not in virtue of this that they belong in the same species; thus species are "historical entities", not natural kinds defined by intrinsic essences.

[1] This anti-essentialist consensus took root in the 1980s thanks to works by Hull (1978), Sober (1980), Dupré (1981) and Kitcher (1984), all of whom were influenced by the biologist Ernst Mayr. Other defences of anti-essentialism include Griffiths (1999), Okasha (2002), Ereshefsky (2010), Pedroso (2012) and Slater (2013). In addition to Devitt, the consensus has recently been challenged by Austin (2018).

This conception of species, philosophers of biology argue, fits best with the "species concepts" used in modern biology. Many biologists concur with this assessment.

Devitt insists that this anti-essentialist consensus is deeply mistaken. He defends a view that he calls *Partly Intrinsic Biological Essentialism* (*PIBE*), according to which biological species have "partly intrinsic, probably genetic, essences" (2018 p.67; 2023 p.23). That is, for any biological species *S*, there is an intrinsic property I_S which is part of *S*'s essence, meaning that an organism belongs to species *S* partly in virtue of having property I_S. Devitt allows that a species' essence may also comprise a non-intrinsic or historical component but insists that the intrinsic component cannot be done away with. Devitt's position is thus at odds with mainstream opinion in philosophy of biology, as he willingly acknowledges.

Devitt defends *PIBE* by means of a positive and a negative argument. His positive argument is that species must have partly intrinsic essences if they are to play the explanatory role in biology that he thinks they do play. According to Devitt, biologists often explain why an organism has the phenotypic traits it does by saying what species it belongs to. ("Why does that animal have a hump on its back? Because it's an Arabian camel.") Such explanations could only work if species had partly intrinsic essences, Devitt claims.

Devitt's negative argument is that the anti-essentialist consensus rests on a conflation of two questions. The *Species Category question* asks in virtue of what a given group of organisms constitutes a species (rather than a sub-species, variety or family, for example). It thus asks what the common element is among all the groups of organisms that are in the species category, in virtue of which they belong in that category. The *Species Taxon question* asks, of some particular species, what makes an organism a member of that species. It thus asks what the common element is among all the organisms in a given species, in virtue of which they belong in that species and not some other. Devitt argues that the various species concepts discussed in modern biology offer answers to the Category question but are "silent" about the Taxon question. However, the Taxon question is what is at stake in the debate over essentialism and is the question to which Devitt's *PIBE* is an answer. By failing to distinguish the two questions, Devitt argues, philosophers of biology have wrongly thought that modern biology implies an anti-essentialist answer to the Taxon question when in fact it only speaks to the Category question.

Devitt's positive argument has received extensive discussion and will not be dealt with here.[2] His negative argument has been less discussed (though Barker 2010 is a notable exception). This is somewhat surprising, since the argument poses a direct challenge to the orthodoxy in philosophy of biology. My aim here is to rise to this challenge, by exploring in detail Devitt's charge of conflation between the Taxon and Category questions. I argue that although Devitt makes a number of sound points, his negative argument ultimately fails. But it does serve a valuable function, as it forces anti-essentialists to clarify certain key issues.

The structure of this paper is as follows. Section 2 sets out Devitt's main claims and offers some preliminary clarifications. Section 3 introduces some metaphysical machinery needed to evaluate Devitt's negative argument. Section 4 studies the logical links between the Category question, the Taxon question and a third question that Devitt calls the Con-Specificity question. Section 5 examines Devitt's contrast between intrinsic and non-intrinsic answers to these three questions. Section 6 evaluates Devitt's main claims. Section 7 concludes.

2. Devitt's claims and some initial clarifications

Devitt's *PIBE* says that "biological taxa have essences that are partly intrinsic underlying, probably largely genetic, properties" (2023, p.35). The "biological taxa" he is mostly concerned with are species, but Devitt regards his essentialist thesis as equally applicable to higher taxa too, that is, taxa that belong to supra-specific Linnean ranks such as families, orders and genera. Devitt's assumption that what applies to species also applies to higher taxa is questionable, given the widespread belief in biology that species are "real" in a way that higher taxa are not. In any case, my focus here is on *PIBE* as it applies to species.

Devitt tells us that by "essence", he means the essence of a kind, that is, the property or properties *in virtue of which* an object belongs to the kind, or which *make* an object a member of the kind. The essence of a kind *K* can be a single property or a "sum" (i.e. conjunction) of properties. Devitt insists that every kind must have an essence in this sense, on the grounds that it is not simply a brute fact about an object *o* that it belongs to the kind

[2] See in particular Wilson et al. (2007), Barker (2010), Ereshefsky (2010), Richards (2010), Lewens (2012), Leslie (2013), Slater (2013) and Godman and Papineau (2020). Devitt (2023) offers replies to all of these critiques.

K; rather, *o*'s belonging to *K* must hold in virtue of something about *o*. Devitt does not say much about the notion of "in virtue of", though he expresses sympathy for Kit Fine's view that essence is prior to modality (Fine 1994). Thus Devitt would presumably agree that if properties P_1 & P_2 are the essence of kind *K*, this entails that necessarily, all and only objects with P_1 & P_2 belong to *K*; but not vice-versa. Note that if we focus on just one of the properties that make up the kind's essence, e.g. P_1, the corresponding entailment is that necessarily, all the objects in *K* have P_1. This is a fairly standard view of the relation between kind essence and modality, and one that I assume here.[3]

Devitt notes that some philosophers of biology hold that biological species are not kinds at all, but rather "extended individuals" of which organisms are parts rather than members. However, Devitt follows Okasha (2002) in arguing that this is orthogonal to the issue of intrinsic essentialism. For even if we endorse the "species-are-individuals" thesis, we can still ask in virtue of what a given organism is a part of species *X* rather than *Y*; and we can thus contrast answers to this question that appeal to organisms' intrinsic properties with answers that do not. So without loss of generality, we may assume with Devitt that species are kinds.

Devitt's *PIBE,* then, says that every biological species has an essence that is partly intrinsic. So if *PIBE* is true, then for any species we pick, e.g. *Canis familiaris*, there must be some intrinsic property or properties which all and only organisms in *Canis familiaris* have, partly in virtue of which they belong in that species. This sounds fairly similar to traditional Kripke / Putnam essentialism – to which Devitt is sympathetic – but there is a key difference. For Devitt's claim is that the essence of any species is partly, not fully, intrinsic. Thus he allows that a species' essence may include "historical" properties, such as having a particular genealogy or phylogenetic history; but he insists that an intrinsic property must also be part of a species' essence. Devitt rightly sees a clash between *PIBE* and the dominant view in philosophy of biology, which is that organisms belong to their species entirely in virtue of facts about their genealogy / phylogeny rather than their intrinsic natures.

[3] There is an ongoing debate in metaphysics about whether "o is essentially F" implies "necessarily, o is F"; see for example Mackie (2020) and Leech (2018). However, this debate focuses on individual essentialism rather than kind essentialism, so is not directly relevant here. Note also that on Devitt's conception of kind essentialism, the homeostatic property cluster (HPC) view of kinds constitutes a rival to, not a version of, essentialism.

Devitt insists on a distinction, due originally to Ernst Mayr (1982), between two different questions one can ask about biological species. The Taxon question asks "in virtue of what is an organism an *F*?" or "what is the essence of being *F*?", where *F* is the name of a particular species taxon.[4] Thus an instance of the Taxon question is "in virtue of what is my family pet a member of *Canis familiaris* rather than *Canis Lupus*?" This is the question to which Devitt's *PIBE* offers an answer. The Category question, by contrast, asks "in virtue of what is a given taxon a species?" – rather than a subspecies, family or genus, for example. This is a question about the essence of the species *category*: it asks, of all the different taxa that are in species category, what it is they have in common in virtue of which they belong in that category rather than some other.

Devitt is right to emphasize this distinction, but his formulation of the Category question ("in virtue of what is a taxon a species"?) is not optimal, for it presupposes that we know whether a particular collection of organisms is a "taxon" in the first place. Now some approaches to biological classification, such as phylogenetic systematics, do indeed offer an independent criterion for what a taxon is, modulo which we can ask Devitt's Category question.[5] But others do not. A more general formulation of the Category question eschews reference to a "taxon" and simply asks: "in virtue of what does a collection of organisms belong in the species category"? (A "collection" just means any group of organisms in the same possible world.) This is the formulation that I shall operate with henceforth. Note that if a collection of organisms does not belong in the species category, this may be because it belongs in a different taxonomic category (such as genus or family); or it may be because it belongs in no taxonomic category at all, e.g. if it is an arbitrary grouping of organisms, or if it contains organisms that are con-specific with others that are not in the collection.

Devitt's core claim is that the anti-essentialist consensus rests on a conflation of the Taxon and Category questions. The anti-essentialists argue that when we inspect the various "species concepts" found in modern biology (rather than the folk species concept), we find that they are all incompatible with the existence of intrinsic species essences. Thus Devitt

[4] Devitt often writes "Taxon problem" in lieu of "Taxon question", and similarly for the Category question.
[5] In phylogenetic systematics, every non-basal taxon is required to satisfy the criterion of monophyly, that is, to contain all and only the descendants of a common ancestor. Whether the basal taxa (species) must themselves be monophyletic is a point of dispute among phylogeneticists.

quotes from a paper by Okasha (2002) who writes: "on all modern species concepts…the property in virtue of which a particular organism belongs to one species rather than another is a relational rather than intrinsic property of it" (Okasha 2002 p.19, quoted by Devitt 2023 p.10). Devitt treats Okasha's claim as representative of the anti-essentialist consensus; this seems fair, since similar claims have been made by many other philosophers of biology.[6] But Devitt insists that the claim is false. The species concepts found in biology offer answers to the Category question, Devitt tells us, but they are "silent on what it is for an organism to be an *F*", and thus do not speak to the Taxon question (2023, p.16). But Devitt's interest is in defending a (partly) essentialist answer to the Taxon question. His *PIBE* is thus perfectly compatible with what contemporary biology has to say about what a species is, he claims, *pace* Okasha and other philosophers of biology.

What exactly are these "species concepts" to which Okasha and Devitt refer? They are attempts to solve what biologists call "the species problem", which means (roughly) the problem of "defining what a species is". Biologists have discussed the species problem for decades, leading to a bewildering number of species concepts in the scientific literature; Mayden (1997) reported no fewer than twenty-eight and the situation has not changed since then. Devitt follows a standard approach by grouping them into three families: (i) the "biological species concept (BSC)" and its variants; (ii) the "phylogenetic species concept" (PSC) and its variants; (iii) the "ecological species concept" (ESC) and its variants.[7] Though there are genuine differences, extensional and intensional, between concepts (i)-(iii), they nonetheless share a common core, as the biologist Kevin de Quieroz has shown. The common core is that a species is "a separately evolving lineage", where a lineage is an ancestor-descendent sequence of populations (de Quieroz 1999, 2007). In effect, the different species concepts simply represent different ways of spelling out what makes a lineage into a "separately evolving" one (e.g. it must be reproductively isolated, or occupy a distinct ecological niche, or be monophyletic). The various species concepts thus agree that the organisms in a species must form a single lineage, hence be genealogically related to one another, but differ in how they spell out the precise meaning of this.

[6] This point is carefully documented by Devitt (2023) chapter 1.

[7] Devitt talks about the "ecological niche concept" in lieu of the ecological species concept, and the "phylogenetic-cladistic species concept" in lieu of the phylogenetic species concept. Here I adopt the more usual terminology.

Devitt is right, I think, that the various species concepts found in the biological literature (henceforth "the species concepts") are addressed to the Category question in the first instance. That is, they are attempts to say why some collections of organisms count as species while other collections do not. Now Devitt concedes that these species concepts all offer a "relational" answer to the Category question (2023, p.13). (What exactly this means, and whether Devitt is right to concede it, is examined in section 5.) However, Devitt insists that this does not imply a "relational non-intrinsic" answer to the Taxon question, and so does not conflict with *PIBE*'s claim that species taxa have partly intrinsic essences. Philosophers of biology have erred, Devitt argues, in thinking that a "relational non-intrinsic answer" to the Category question implies a "relational non-intrinsic answer" to the Taxon question.

Devitt offers an interesting diagnosis of why philosophers of biology have made this alleged error: it is because they have fallen prey to a "tempting supposition about con-specificity" (2023, p.64). In defence of this diagnosis, Devitt introduces a third question, distinct from the Taxon and Category questions. This is the Con-Specificity question, which asks in virtue of what two organisms belong in the same species. Devitt then suggests that some philosophers have taken the species concepts to imply "a relational non-intrinsic answer" to the Con-Specificity question, from which they infer that the Taxon question must also have a "relational non-intrinsic" answer. Devitt allows that the second of these implications goes through: if the con-specificity of a pair of organisms is a wholly non-intrinsic matter, then an organism's belonging to a given species must also be wholly non-intrinsic. But he argues that the species concepts do *not* in fact imply a "relational non-intrinsic" answer to the Con-specificity question: they are silent about what makes two organisms con-specific.

To assess Devitt's arguments, we need to look carefully at the logical relations between the Taxon, Category and Con-Specificity questions. But firstly some metaphysical preliminaries.

3. Metaphysical Preliminaries

Devitt's argument relies heavily on the notion of intrinsic property. He does not say much about what "intrinsic" means, but it would be unfair to criticize him on this score. Any philosophical argument must start from somewhere, and intrinsic property is a widely used notion in philosophy. Moreover, the genetic properties that Devitt regards as part of a

species' essence would likely count as intrinsic under all of the candidate analyses of intrinsicality in the literature.[8]

More problematic is Devitt's tendency to contrast intrinsic with "relational" properties. This is problematic for two reasons. Firstly, many philosophers hold that some properties are both intrinsic and relational (e.g. having longer arms than legs), so the intrinsic / relational contrast is arguably misplaced. Secondly, at a key juncture of his argument Devitt asks whether con-specificity is or is not an intrinsic matter. Thus he needs the intrinsic / non-intrinsic distinction to apply to relations as well as to monadic properties (since con-specificity is a relation). This is not a problem per se; indeed, many authors hold that relations as well as properties can be classified as intrinsic or not.[9] However, confusion then beckons if, when dealing with monadic properties, one takes the opposite of intrinsic to be relational. For these reasons, I will take the relevant contrast to be intrinsic versus extrinsic (or non-intrinsic) and will express Devitt's argument in these terms.

There are actually two slightly different ways of applying the intrinsic / extrinsic distinction to relations. The first way tries to extrapolate directly from the case of monadic properties. Just as a property *P* counts as intrinsic, intuitively, when an object *x*'s bearing *P* is "a fact about *x* alone", so a relation *R* counts as intrinsic when *x* and *y* standing in *R* is "a fact about the ordered pair <*x*, *y*> alone". The second way says that a relation *R* is intrinsic just in case the relation supervenes on the intrinsic properties of its relata, i.e. the intrinsic properties of *x* and *y* fully determine whether *xRy*. Thus Lewis (1983) contrasts a relation being "intrinsic to its pair" with its being "intrinsic to its relata" (p.356, n.16). Here I adopt the second definition, which is arguably clearer (though nothing important hangs on this choice).[10] (Note that what I am calling an intrinsic relation thus corresponds to what some authors call an "internal" relation.) An example of an intrinsic relation is "is taller than":

[8] See Marshall and Weatherson (2018) for a survey of these analyses.

[9] See for example Langton and Lewis (1998).

[10] There is a further issue about how exactly the supervenience claim should be formulated, e.g. weak versus strong supervenience *sensu* Kim (1993). The formulation best suited for our purposes is this. *R* is internal $\equiv_{df}$ for all possible worlds *w*, *w'*: if *x* in *w* is an intrinsic duplicate of *x'* in *w'* and *y* in *w* is an intrinsic duplicate of *y'* in *w'*, then *xRy* iff *x'Ry'*; where intrinsic duplicates are objects that share all their intrinsic properties. Note that on this formulation, the relata of the *R* relation are always objects in the same possible world. This simplifies the analysis in section 4 (cf. footnote 10.)

whether *x* is taller than *y* supervenes on *x*'s height and *y*'s height, and height is an intrinsic property.

Extrinsic relations can usefully be sub-divided into two sorts. An extrinsic relation is *partly intrinsic* just if its supervenience base contains some intrinsic properties of the relata; while it is *fully extrinsic* just if its supervenience base contains no intrinsic properties of the relata. (The supervenience base *B* of a relation *R* is the least inclusive set of properties such that whether objects *x* and *y* are *R*-related is fully determined by whether *x* and *y* possess each of the properties in *B*.) Thus the relation "lives in the same country as" is fully extrinsic; its supervenience base contains 195 properties, one for each country in the world, each of which is extrinsic ("lives in England", "lives in France", "lives in Italy" etc.) By contrast, the relation "is taller than and lives in the same country as" is partly intrinsic; its supervenience base contains the 195 country properties and a set of intrinsic height properties. We need this three-fold taxonomy of relations (intrinsic, partly intrinsic, fully extrinsic) to capture Devitt's claims.

4. The Taxon, Category and Con-Specificity Questions

Let us return to the three questions that Devitt distinguishes – the Taxon, Category and Con-Specificity questions. We need to examine the logical relations (or lack thereof) between answers to the three questions.

A complete answer to the Taxon question would tell us, for each species taxon *S*, what makes an organism a member of *S*, which in turn implies something about the necessary and sufficient conditions for belonging to *S*. Thus, the answer will imply a set of statements, one for each species, of the following form:

(TAX) Necessarily, for any organism o, o is a member of $S \leftrightarrow$ o has E_S

where "E_S" denotes the essence, or conjunction of essential properties, of species *S*. Giving a complete answer to the Taxon question is obviously a formidable task, given the large number of biological species that exist. But a *generic* answer to the Taxon question may be possible, if each species essence is of the same general sort. Devitt's *PIBE* is an example of such a generic answer; it says that the E_S of each species taxon *S* comprises a conjunction of

intrinsic and historical properties. In what follows, we assume that a generic answer is possible (as does Devitt); and we take an "answer to the Taxon question" to mean a generic rather than a complete answer.

An answer to the Category question tells us what the essence of the species category is, that is, what makes a collection a member of that category. Again, this implies something about the necessary and sufficient conditions for belonging to the species category. Thus, an answer to the Category question implies a statement of the following form:

(CAT) Necessarily, for any collection *C*, *C* belongs to the species category $\leftrightarrow$ *C* has the property *SP*

where *SP* denotes the "species-making property", that is, the property in virtue of which a collection of organisms counts as a species. Rival answers to the Category question will offer different accounts of what *SP* is.

An answer to the Con-Specificity question tells us what makes two organisms con-specific, i.e. members of the same species. Again, this implies something about the necessary and sufficient conditions for a pair of organisms to be in the same species. Thus, an answer to the Con-Specificity question implies a statement of the following form:

(CON) Necessarily, for any organisms o_i and o_j, o_i and o_j are con-specific $\leftrightarrow$ o_i R_{con} o_j

where R_{con} is the "con-specificity making relation", that is, the relation in virtue of which a pair of organisms are con-specific. Rival answers to the Con-specificity question will offer different accounts of what R_{con} is.

Though Devitt is right to distinguish these three questions, there are important logical constraints on joint answers to them. For if two organisms both have the essence of a species *S*, they must be con-specific; and if they are con-specific, there must be some species whose essence they both have. Also, if two organisms are con-specific, they must belong to a collection that is in the species category, and vice-versa. Finally, if a collection is in the species category, then the organisms within the collection must be pair-wise con-specific, and none can be con-specific with any organism not in the collection; and vice-versa. I take it that these points are beyond dispute; they are a priori truths that stem from

the meanings of the relevant terms ("con-specific", "essence", "collection" and "species category".)

It follows that answers to the Taxon, Con-specificity and Category questions must satisfy the following three conditions:

(A) Necessarily, for all organisms o_i, o_j: $o_i R_{con} o_j \leftrightarrow$ there exists a species S such that o_i has E_S and o_j has E_S

(B) Necessarily, for all organisms o_i, o_j: $o_i R_{con} o_j \leftrightarrow$ there exists a collection C such that C has SP and $o_i, o_j \in C$

(C) Necessarily, for any collection C: C has $SP \leftrightarrow$ for all organisms $o_i, o_j \in C$, $o_i R_{con} o_j$ and for all organisms $o_k \notin C$, $\neg\, o_i R_{con} o_k$

Condition (A) says that necessarily, two organisms stand in the con-specificity-making relation if and only if there is a species whose essence they both share. (B) says that necessarily, two organisms stand in the con-specificity-making relation if and only if they are members of a collection with the species-making property. (C) says that necessarily, a collection has the species-making property if and only if every pair of organisms within the collection stand in the con-specificity-making relation to each other, and no organism within the collection stands in the con-specificity-making relation to any organism not in it.[11]

Condition (C) has an important and somewhat non-obvious logical implication, namely that necessarily, no organism belongs to more than one distinct collection that has the species-making property SP.[12] (Collections are distinct just in case they contain different organisms.) This is a welcome implication, for it is arguably part of the concept of a species, both folk and scientific, that each organism belongs to at most one species (though some

[11] Note that in each of (A)-(C), organisms o_i and o_j are in the same possible world, that is, "necessarily, for all organisms o_i, o_j…" means "For every world w, for all organisms o_i, o_j in w…". Transworld analogues of (A)-(C) could be formulated but at the cost of additional (unnecessary) complexity, as R_{con} would then have to relate organisms at different worlds, and collections would have to include organisms at different worlds.

[12] To see this, suppose that organism o_1 belongs to both C and C'. Then, consider any organism o_2 that belongs to C but not C'. By condition (C), $o_1 R_{con} o_2$, since $o_1$and o_2 both belong to C. But also, $\neg o_1 R_{con} o_2$ since $o_1$but not o_2 belongs to C'.

organisms may belong to no species at all).[13] [14] Thus condition (C) implies that an answer to the Category question must satisfy:

(D) Necessarily, for all collections *C, C'* and organisms o_i: *C* has *SP* and $C \neq C'$ and $o_i \in C$ and $o_i \in C' \rightarrow$ *C'* does not have *SP*

Note that (D) rules out certain possible answers to the Category question. To illustrate, consider the answer that says that the species-making property *SP* is the property of containing exactly 1000 organisms. This answer is not merely empirically wrong, in that it is obviously extensionally inadequate, but is logically unacceptable because it violates condition (D) (and thus (C)). Since every organism is a member of more than one distinct 1000-membered collection, this answer to the Category question *could* not be correct.

This point, though obvious, highlights an important issue. If one wishes to answer the Category question, how can one guarantee that one's answer will satisfy condition (D)? So far as I can see there is only one way, which is to specify a binary equivalence relation on the set of all organisms, and to identify a collection's having the species-making property *SP* with the collection's being an equivalence class of organisms under the relation in question. Since the equivalence classes of a single equivalence relation do not intersect, this guarantees that (D) will be satisfied. And this is in fact the form that standard answers to the Category question do have.

To see this, consider the biological species concept (BSC), which says that species are "groups of interbreeding natural populations that are reproductively isolated from other such groups" (Mayr 1969, p. 26).[15] That is, the BSC says that what makes a collection of organisms into a species is the fact that it comprises all and only those organisms that belong to a single interbreeding group (or network) of populations. Thus to be a species, a collection must be an equivalence class of organisms under the relation "*x* and *y* belong to populations that interbreed".[16] Or take the ecological species concept (ESC). In its simplest version, the

[13] Thus many biologists have held that asexually reproducing organisms do not form species, for example.
[14] This presumes that in cases of hybridization between species, the right thing to say is that it is indeterminate which species the hybrid organism belongs to, not that it belongs to both.
[15] This is the original statement of the BSC. Mayr later amended it to include "potential" as well as actual interbreeding.
[16] Notoriously, this relation may in fact fail to be transitive in certain rare cases as the phenomenon of "ring species" shows (in which case the BSC will not succeed in unambiguously assigning all organisms to species). Though this phenomenon threatens the viability of the BSC (or would do if it was common), it does not

ESC identifies a species with a collection of organisms that inhabit a single ecological niche. This is to say, in effect, that a species is an equivalence class of organisms under the relation "*x* and *y* inhabit the same ecological niche". Or take the phylogenetic species concept (PSC). In one version, the PSC says that a species is a lineage of organisms all descended from a single ancestral "founder" population that arose when an ancestral lineage split into two. This is to say, in effect, that a species is an equivalence class of organisms under the relation "*x* and *y* are descended from the same founder population". And similarly with the answers to the Category question given by other species concepts.

In the light of this point, we can re-formulate (CAT), the statement implied by any answer to the Category question. An answer to the Category question that satisfies condition (D) will identify the species-making property *SP* with the property of being an equivalence class of organisms under a relation R_{SP}. We may refer to R_{SP} as the "species-making relation"; it is that relation such that, when all and only the organisms in a collection bear the relation to each other, this makes the collection into a species. Thus an answer to the Category question will imply a statement of the following form:

(CAT*) Necessarily, for any collection *C*, *C* belongs to the species category $\leftrightarrow$ *C* has property *SP* $\leftrightarrow$ *C* is an equivalence class of organisms under the R_{SP} relation

When combined with condition (B), (CAT*) has an important consequence: necessarily, the species-making relation R_{SP} and the con-specificity making relation R_{con} relate exactly the same pairs of organisms. For condition (B) says that necessarily, two organisms are related by R_{con} just in case they belong to a collection with the *SP* property; and (CAT*) says that necessarily, a collection has the *SP* property just in case it is an equivalence class of organisms under the R_{SP} relation. Therefore (CAT*) and (B) jointly imply:

(E) Necessarily, for all organisms o_i, o_j: $o_i R_{con} o_j \leftrightarrow o_i R_{SP} o_j$

Condition (E) is a constraint on joint answers to the Category and Con-Specificity questions, given that answers to Category question are required to satisfy condition (D) and thus to imply a statement of the form (CAT*).

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undermine the point that the BSC, like other species concepts, implies that to be a species is to be an equivalence class of organisms under a certain binary relation.

Devitt repeatedly insists that an answer to the Category question does not answer the Con-Specificity question. However, condition (E) shows that it comes very close. To answer the Con-Specificity question is to say what the R_{con} relation is. An answer to the Category question does not do that, but it does identify a relation that necessarily relates exactly the same pairs of organisms as does the R_{con} relation. Of course, it might be that R_{con} and R_{SP} are simply the very same relation. But even they are distinct relations, condition (E) tells us that they are necessarily co-extensive. The significance of this will become clear.[17]

Finally, note that we can combine conditions (A) and (E) to yield a single condition that governs joint answers to the Taxon, Category and Con-specificity questions:

(F) Necessarily, for all organisms o_i, o_j: $o_i R_{con} o_j \leftrightarrow o_i R_{SP} o_j$

$\leftrightarrow$ there exists a species S such that o_i has E_S and o_j has E_S

Condition (F) tells us that necessarily, two organisms stand in the con-specificity making relation if and only if they stand in the species-making relation if and only if there exists a species whose essence they both have. Note that condition (F) follows logically from conditions (A), (B) and (C) plus the requirement that an answer to the Category question implies a statement of the form (CAT*), which it must do in order to guarantee satisfaction of condition (D), which itself follows from (C). Thus the only way to dispute condition (F) is to reject (A), (B) or (C); but this is impossible since (A), (B) and (C) reflect a priori truths.

In section 6, we will draw on condition (F) to evaluate Devitt's claim that the anti-essentialist consensus rests on a confusion.

5. Intrinsic versus Extrinsic Answers to the Three Questions.

Devitt talks about intrinsic and non-intrinsic answers to each of his three questions. But what exactly does this mean? For the Taxon question, the meaning is clear. Consider the species essence E_S for a given species S. Recall that E_S is a conjunction of organismic properties. It might be that all of the properties in E_S are intrinsic, or that some are intrinsic

[17] Barker (2010) argues against Devitt's claim that species concepts answer the Category question but not the Con-Specificity question; however, he does not note the logical constraints emphasized here.

and others extrinsic. These correspond to what Devitt calls “fully intrinsic” and “partly intrinsic” answers to the Taxon question. Alternatively, it might be that E_S contains only extrinsic (e.g. historical) properties, as per the anti-essentialist consensus that Devitt opposes. Thus we have a three-way distinction between answers to the Taxon question: intrinsic (= Devitt’s “fully intrinsic”), partly intrinsic or fully extrinsic.

What about the Con-Specificity question? Mostly, Devitt describes answers to this question as either intrinsic or not, suggesting a binary distinction. However, on occasion he uses the qualifier “fully”; and in fact, a three-fold distinction is equally possible here. Recall that a binary relation can be classified as intrinsic, partly intrinsic or fully extrinsic depending on whether its supervenience base contains only intrinsic, intrinsic and extrinsic, or only extrinsic properties of the relata. Thus we call an answer to the Con-Specificity question intrinsic just if the con-specificity-making relation R_{con} is intrinsic; partly intrinsic just if R_{con} is partly intrinsic; and fully extrinsic just if R_{con} is fully extrinsic. This appears to capture what Devitt means; and it vindicates his claim that a (fully) extrinsic answer to the Con-Specificity question is incompatible with an intrinsic answer to the Taxon question (see below).

To illustrate, consider the answer to the Con-Specificity question which says that R_{con} is the relation of being genetically alike in some respect (e.g. sharing the “species gene”); this is an intrinsic answer, since whether two organisms are genetically alike depends on their intrinsic genetic properties. But the rival answer which says R_{con} is the relation of both being descended from the same founder population is fully extrinsic – whether two organisms stand in that relation supervenes on extrinsic properties alone.

What about the Category question? Here matters get more complicated. Devitt claims that the various species concepts found in biology, such as the biological species concept (BSC) and the ecological species concept (ESC), offer a “relational” (i.e. extrinsic) answer to the Category question. Devitt’s reason for saying this is that the BSC requires that to be a species, a group be reproductively isolated *from other groups*; while the ESC, as he formulates it, requires that to be a species, a lineage occupy an adaptive zone “minimally different *from that of any other lineage*” (2023 p.13, my emphasis). Devitt writes: “these answers…entail that being a species is relational: a group is a species in virtue of its breeding or niche relations to other groups” (ibid p.13).

It seems therefore that Devitt's conception is this. An intrinsic answer to the Category question is one on which the species-making property *SP* – in virtue of which a collection of organisms belongs in the species category – is an intrinsic property of the collection. An extrinsic answer to the Category question is one on which *SP* is extrinsic. Devitt's point is that on the BSC and the ESC, the *SP* property is extrinsic: whether a collection has the property depends on the collection's relations to other things. Again, we could then subdivide extrinsic answers into the partly intrinsic and fully extrinsic, depending on whether *SP*'s supervenience base includes some, or no, intrinsic properties.

This sounds sensible but on reflection is highly problematic. For it is *impossible* that the Category question could receive an intrinsic answer by the above criterion: the *SP* property *cannot* be intrinsic to a collection. To see why, note that for a collection *C* to have *SP*, it is necessary that all the organisms in *C* be con-specific with each other *and that none be con-specific with any organisms not in C* (see condition (C) above). So in order for *C* to have *SP*, there is a requirement on those organisms *not* in *C*. That is, a collection that has property *SP* could be made to lose that property by making hypothetical changes to organisms not in the collection. This remains true whatever species concept we adopt – even on a pre-Darwinian conception according to which each species has a fixed Platonic essence. It has nothing to do with the details of the species concepts found in biology; it is simply a matter of logic.

Must we then abandon the idea that answers to the Category question can be classified as intrinsic or not? No. Instead of taking an intrinsic answer to mean that the *SP* property is intrinsic to a collection, which is impossible, we should take it to mean that the R_{SP} relation is intrinsic. Recall that answers to the Category questions that are logically adequate – i.e. that satisfy condition (D) – characterize the *SP* property by means of the R_{SP} relation: they say that for a collection to have the *SP* property is for it to be an equivalence class of organisms that bear R_{SP} to one another. Therefore, answers to the Category question can be classified as intrinsic, partly intrinsic or wholly extrinsic, depending on whether they take the R_{SP} relation to be intrinsic, partly intrinsic or wholly extrinsic.

To illustrate, consider the phylogenetic species concept (PSC). As we have seen, in one of its versions, the PSC identifies the R_{SP} relation with "*x* and *y* are descended from the same founder population"; this relation is wholly extrinsic, for it supervenes on organisms' extrinsic properties alone. Thus the PSC yields a wholly extrinsic answer to the Category

question. But other possible answers are intrinsic. Thus, if one held that for a collection to be a species is for it to contain all and only the organisms that partake of the same Platonic essence, this would be to give an intrinsic answer to the Category question.

The status of the biological species concept's answer to the Category question merits brief discussion. The BSC takes the R_{SP} relation to be "*x* and *y* belong to populations that interbreed". It is clear that this relation is not intrinsic, i.e. does not supervene on intrinsic properties; for even if two organisms were intrinsic duplicates, this does not guarantee that they belong to populations that interbreed.[18] One might think that R_{SP} is partly intrinsic, on the grounds that unless two organisms shared certain genetic properties, they could not successfully breed. But while the latter claim is plausibly true, it is beside the point for two reasons. Firstly, the claim is true in the sense of nomological rather than metaphysical impossibility, but the latter is what we are concerned with. Secondly, the BSC does *not* imply that every pair of con-specific organisms can breed; rather, it implies that they must belong to *populations* that can interbreed. Two same-sex organisms obviously cannot breed with each other; and an organism with a genetic mutation that renders it sterile cannot breed with anyone, yet it is still con-specific with other population members. Therefore, membership in a group of interbreeding populations does not require any particular genetic properties; it is always possible that a mutant could arise that lacked those properties but was still a member. The relation "*x* and *y* belong to populations that interbreed" is therefore fully extrinsic.

5.1 The fundamental fact

To sum up so far: answers to each of the Taxon, Category and Con-Specificity questions can be classified as intrinsic, partly intrinsic, or fully extrinsic. We can then establish the following fundamental fact: *necessarily, answers to the three questions go hand in hand, in respect of whether they are intrinsic, partly intrinsic or fully extrinsic.* That is, the Taxon question has an intrinsic answer if and only if the Category question has an intrinsic answer

[18] If an intrinsic duplicate of an organism was found on Mars, with no historical connection to earthly life-forms, it would not be a con-specific according to the BSC.

if and only if the Con-specificity question has an intrinsic answer; and the same is true if we replace "intrinsic" with partly intrinsic or fully extrinsic in the previous sentence.

How do we know this? That answers to the Con-Specificity and Category questions go hand in hand follows from the fact that R_{con} and R_{SP} are necessarily co-extensive (condition (E)). For if two relations relate exactly the same pairs of objects in all possible worlds, then their supervenience bases are identical; therefore, either both or neither of the relations are intrinsic, and similarly for partly intrinsic and fully extrinsic.

It remains to be shown that the answer to the Con-Specificity question must go hand in hand with the answer to the Taxon question, in respect of being intrinsic, partly intrinsic or wholly extrinsic. Take the intrinsic case first. Suppose that the Con-Specificity question has an intrinsic answer, so R_{con} is intrinsic. Consider a pair of organisms o_1 and o_2 at world w such that $o_1 \, R_{con} \, o_2$. By condition (A), there exists a species S such that o_1 and o_2 both have the essence of that species E_S. Suppose for reductio that E_S contains an extrinsic property. Therefore, there exists a possible world w' which contains intrinsic duplicates of o_1 and o_2, denoted o'_1 and o'_2, both of which have E_S, and also contains intrinsic duplicates of o_1 and o_2, denoted o''_1 and o''_2, both of which lack E_S. Now since R_{con} is intrinsic and $o_1 \, R_{con} \, o_2$, it follows that $o'_1 \, R_{con} \, o'_2$ and $o''_1 \, R_{con} \, o''_2$. Similarly, it follows that $o'_1 \, R_{con} \, o''_2$ and $o''_1 \, R_{con} \, o'_2$. By transitivity of R_{con}, this gives $o'_1 \, R_{con} \, o''_1$ and $o'_2 \, R_{con} \, o''_2$. So o'_1 is con-specific with o''_1, and similarly for o'_2 and o''_2. But o'_1 belongs to species S, since it has E_S, so o''_1 must belong to S too; and similarly for o''_2. Therefore o''_1 and o''_2 have E_S, which is a contradiction. Therefore, E_S must contain only intrinsic properties. So the Taxon question has an intrinsic answer.

Conversely, suppose that the Taxon question has an intrinsic answer. Consider two organisms o_1 and o_2 at world w, and two intrinsic duplicates of o_1 and o_2, denoted o'_1 and o'_2, at world w'. We wish to show that R_{con} is intrinsic, i.e. that $o_1 \, R_{con} \, o_2$ iff $o'_1 \, R_{con} \, o'_2$. Suppose (case 1) that $o_1 \, R_{con} \, o_2$. By condition (A), there exists a species S such that o_1 and o_2 both have E_S, where E_S contains only intrinsic properties. Therefore o'_1 and o'_2 have E_S, so belong to S, so are con-specific, so $o'_1 \, R_{con} \, o'_2$. Suppose (case 2) that $\neg \, o_1 \, R_{con} \, o_2$. Suppose for reductio that $o'_1 \, R_{con} \, o'_2$. Then, there exists a species S' such that o'_1 and o'_2 both have $E_{S'}$, where $E_{S'}$ contains only intrinsic properties. Therefore, o_1 and o_2 at world w both have $E_{S'}$, so

$o_1 R_{con} o_2$, which is a contradiction. Therefore $\neg\, o'_1 R_{con} o'_2$. Hence R_{con} is intrinsic, i.e. the Category question has an intrinsic answer.

This shows that the answer to the Con-Specificity question is intrinsic if and only if the answer to the Taxon question is intrinsic. Parallel reasoning shows that the same is true for fully extrinsic answers to these two questions. And since {intrinsic, partly intrinsic, fully extrinsic} is a partition of the possible answers, the same is true of partly intrinsic answers too. Therefore, the answer to the Con-Specificity question must go hand in hand with the answer to the Taxon question, which establishes our fundamental fact.

6: Assessment of Devitt's claims

Devitt's contention that the anti-essentialist consensus rests on confusion is based on the following ten claims:

(D1) the "species concepts" found in modern biology are answers to the Category question in the first instance.

(D2) the species concepts are silent about the Taxon question.

(D3) the species concepts imply a non-intrinsic answer to the Category question.

(D4) a non-intrinsic answer to the Category question doesn't imply a non-intrinsic answer to the Taxon question.

(D5) the biological species concept (BSC) and the ecological species concept (ESC) are fully compatible with the *PIBE* thesis.

(D6) the phylogenetic species concept (PSC) is compatible with the *PIBE* thesis so long as the PSC is divested of certain unwanted features.

(D7) philosophers of biology have wrongly taken the Con-Specificity question to offer a bridge between the Category and Taxon questions.

(D8) an extrinsic answer to the Con-Specificity question implies an extrinsic answer to the Taxon question.

(D9) an answer to the Category question does not answer the Con-Specificity question.

(D10) the species concepts, in particular the BSC and PSC, do not imply an extrinsic answer to the Con-Specificity question.

Let us consider these in turn.

(D1) is certainly true: the species concepts developed by biologists are indeed attempts to answer the Category question in the first instance. However (D2) is false: those answers *strongly constrain* the admissible answers to the Taxon question. For the fundamental fact tells us that answers to the Category and Taxon questions go hand in hand, in respect of being intrinsic, partly intrinsic or fully extrinsic. So although an answer to the Category question does not tell us what the essence of any particular species taxon is, it does tells us what sort of properties the essence contains. For example, if the answer to the Category question is fully extrinsic, then the (generic) answer to the Taxon question is also fully extrinsic, so no species taxon can have an intrinsic or partly intrinsic essence.

(D3) is true, though not for the reasons that Devitt gives. As we saw, Devitt endorses (D3) because he takes a "non-intrinsic answer to the Category question" to mean that the species-making property *SP* is a non-intrinsic property of a collection, and he thinks that the main species concepts imply that the *SP* property is "relational", i.e. extrinsic. But since the *SP* property has *got* to be extrinsic, irrespective of the answer to the Category question, this reasoning is flawed. However, relative to our preferred definition of what makes an answer to the Category question intrinsic, partly intrinsic or fully extrinsic, claim (D3) is still true of the BSC, ESC and PSC, since on all of these species concepts, the R_{SP} relation is non-intrinsic.

(D4) is false. The fundamental fact shows that a non-intrinsic answer to the Category question *does* imply a non-intrinsic answer to the Taxon question. To illustrate, suppose that the answer to the Category question is given by the PSC, so what it is for a collection to have the *SP* property is to be an equivalence class of organisms that all bear the relation "is descended from the same founder population as" to each other. Since that relation is non-intrinsic, indeed is fully extrinsic, the R_{con} relation, with which it is necessarily co-extensive, is fully extrinsic too. So the generic Taxon question must have a fully extrinsic, hence non-intrinsic, answer too.

(D5) is false. Devitt's *PIBE* thesis implies that the answer to the Taxon question is partly intrinsic. But the BSC and the ESC both imply that the answer to the Category

question is fully extrinsic, for on both of these species concepts, the R_{SP} relation supervenes on purely extrinsic properties of organisms. ("Belongs to the same group of interbreeding populations as" and "occupies the same ecological niche as" are both fully extrinsic.) However, by the fundamental fact, the answer to the Taxon question is partly intrinsic if and only if the answer to the Category question is also partly intrinsic. Hence the *PIBE* thesis is incompatible with both the BSC and ESC.

(D6) is trickier to assess. Devitt points out, correctly, that the PSC is often taken to imply that a new species can only be formed by cladogenesis, i.e. the splitting of an existing species lineage into two.[19] This means that evolutionary transformation of a single lineage, however extensive, can never give rise to a new species, hence "anagenetic speciation" is impossible. Devitt accepts that this version of the PSC is incompatible with his *PIBE* thesis – since if a single species lineage can in principle undergo unlimited evolutionary change while remaining numerically the same, it cannot have a partly intrinsic essence. This is correct. However, Devitt argues that the "speciation requires splitting" idea is undesirable and suggests that the PSC can be divested of it (and of the related idea that a species lineage ceases to exist when it splits). When these unwanted ideas are dropped from the PSC, it can be reconciled with his *PIBE* thesis, he claims.

Whether this claim (and thus D6) is true depends on how exactly the resulting PSC is spelled out, which Devitt does not explain. But we can say the following. Since the *PIBE* thesis implies that the Taxon question has a partly intrinsic answer, *PIBE* is only compatible with answers to the Category question that are also partly intrinsic, by the fundamental fact. So for (D6) to be true, it would have to be true that the PSC, when divested of the speciation-requires-splitting idea, yields a partly intrinsic answer to the Category question, i.e. makes the R_{SP} relation come out partly intrinsic. (For example, the R_{SP} relation could be something like "is descended from the same ancestral population as *and* is genetically similar to in certain respects"; this relation's supervenience base includes both intrinsic and extrinsic properties of the organisms it relates). Whether there is a viable version of the PSC along these lines is hard to tell without further details.

[19] This was the view of Hennig (1966), the founder of phylogenetic systematics. It is defended by Ridley (1989) (under the label "cladistic species concept"), among others.

(D7) is false. Certainly, many authors have taken the Con-Specificity question to provide a bridge between the Category and Taxon questions. But *pace* (D7), this is not a mistake, as our proof of the fundamental fact illustrates. In that proof, we showed that answers to the Category and Taxon questions go hand in hand, in respect of being intrinsic / partly intrinsic / fully extrinsic, precisely by using the Con-Specificity question as a bridge. For we observed that answers to the Category and Con-Specificity questions must go hand in hand due to the necessary co-extensiveness of R_{SP} and R_{con}; we then proved that answers to the Con-Specificity and Taxon questions go hand in hand (a point that Devitt accepts), and concluded that answers to the Category and Taxon questions go hand in hand. This is not a mistake but a valid chain of reasoning.

(D8) is true: an extrinsic answer to the Con-Specificity question does indeed imply an extrinsic answer to the Taxon question. That is, if the R_{con} relation is fully extrinsic, then the essence E_S of each species taxon *S* must be fully extrinsic; and similarly if we replace fully extrinsic with partly intrinsic. We showed this formally in our proof of the fundamental fact.

(D9) is strictly speaking true, but "very nearly" false. An answer to the Category question tells us what the *SP* property is, while an answer to the Con-Specificity question tells us what the R_{con} relation is. These are not the same pieces of information. However, as we have seen, a logically adequate answer to the Category question must characterize the *SP* property in terms of the R_{SP} relation; this comes very close to telling us what the R_{con} relation is, given that the R_{con} and R_{SP} relations are necessarily co-extensive.

It is instructive to examine Devitt's reasoning on this point. He illustrates (D9) using the biological species concept (BSC). He notes, rightly, that the BSC is an answer to the Category question in the first instance. Devitt then admits that the BSC does tell us *something* about con-specificity but insists that it falls short of supplying an answer to the Con-Specificity question. Devitt says that the BSC's category answer "tells us that con-specific organisms are members of an interbreeding group", but he argues that this doesn't tells us anything about what *makes* the organisms conspecific (2023 p.21). Therefore, he continues, the BSC "is compatible with the view that organisms are con-specific in virtue of sharing a certain intrinsic underlying property and, perhaps, a history" (ibid p.21).

The first of these statements is highly misleading and the second is false. The BSC implies not merely that con-specific organisms do in fact belong to a single interbreeding group (of populations), but that *necessarily*, con-specific organisms belong to a single interbreeding group. In our terms, Devitt concedes that the R_{con} and R_{SP} relations are co-extensive, whereas in fact they are necessarily co-extensive. This means that Devitt's second statement is false. The BSC would only be compatible with the view that organisms are conspecific "in virtue of sharing a certain intrinsic underlying property and, perhaps, a history", if it were the case that two organisms' belonging to a single interbreeding group was necessarily co-extensive with their "sharing a certain intrinsic underlying property and, perhaps, a history". But this is not so. It is perfectly possible that two organisms could belong to a single interbreeding group of populations despite one of them lacking any chosen intrinsic property (e.g. because of mutation).

(D10) is false. Since the main species concepts found in biology give a (fully) extrinsic answer to the Category question, it follows, by the fundamental fact, that they imply a fully extrinsic answer to the Con-Specificity question.

This completes our assessment of Devitt's ten claims. What explains the discrepancy between our own conclusions and Devitt's? There are three factors. Firstly, Devitt does not fully appreciate the logical constraints on joint answers to the three questions that he rightly distinguishes. As a result, his claim that answers to the Category question are "silent" about the Taxon question is untenable. Secondly, Devitt does not appreciate that logically adequate answers to the Category question must characterize the *SP* property by means of the R_{SP} relation. As a result, Devitt fails to realize that answers to the Category and Con-Specificity are intimately linked, and thus strongly constrain each other. Thirdly, Devitt operates with a flawed conception of what makes an answer to the Category question intrinsic or extrinsic, which further obscures the connection between the Category and Con-Specificity questions.

6. Conclusion

Orthodoxies in philosophy deserve to be challenged, and Devitt has done a valuable service by directing his critical eye on the anti-essentialist consensus in the philosophy of biology.

644 Devitt's distinction between his three questions is certainly important. Devitt is right that
645 the species concepts in biology are attempts to answer the Category question in the first
646 instance; and that the issue of essentialism concerns the Taxon question. However, there
647 turn out to be tight logical constraints on joint answers to Devitt's three questions. These
648 constraints imply the fundamental fact, namely that answers to the Taxon, Category and
649 Con-Specificity questions go hand in hand in respect of being intrinsic, partly intrinsic, or
650 fully extrinsic. This in turn means that Devitt's *PIBE* thesis, though addressed to the Taxon
651 question, does in fact conflict with the answers to the Category question found in modern
652 biology. The anti-essentialist orthodoxy therefore survives Devitt's critique. As Maynard
653 Smith (1976) reminded us, "it does not follow that, because a position is orthodox, it is
654 wrong" (p.277).

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