Against Generalism

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Forthcoming in the Australasian Journal of Philosophy

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Abstract

Relationism is the view that our best physical theories can dispense with spacetime. To show the feasibility of relationism, philosophers have suggested a whole range of approaches, from the postulation of a physical plenum to the use of modality. Shamik Dasgupta has recently suggested using his Generalism to develop a relationist account of spacetime. This paper argues that Dasgupta's Generalism offers no hope to the defenders of relationism. We first present Generalism in what we take to be its most perspicuous formulation. We then discuss a recent argument by Sider (2020) against Generalism and show how to defuse it. Finally, we present a novel argument against Generalism based on Barrett's criterion of parsimony (Barrett 2022).

Keywords: generalism, relationism, spacetime, theoretical equivalence

1 Introduction

According to Shamik Dasgupta (2015: 618), if one's aim is to reject the existence of spacetime points and advance a qualitativist account of spacetime 'the obvious starting point is to say that spacetime is not *fundamentally* an entity'. According to this qualitativist view of spacetime, instead of there being points and aggregates of points on which matter is located, fundamentally there are only geometric properties and relations. Dasgupta mentions in passing that one 'might try a kind of Generalism' (Dasgupta 2015: 618).[1] Generalism is a view put forward at the end of Dasgupta's influential essay *Individuals* (Dasgupta 2009). Its most perspicuous formulation has been a matter of dispute. What is clear is that it is intended as a metaphysics of properties, and an attempt to dispense with individuals, material individuals, or fundamental individuals in the foundations of physics. Much of the debate about formulating Generalism has revolved around the language and logic that are needed, as well as their costs and complexity.

According to Generalism, individuals do not exist. On this view, there are only properties and logical combinations of properties, some of which obtain while others do not. Since Generalism rejects individuals altogether, *a fortiori* it rejects spacetime points. So it seems to be at least *prima facie* a promising and attractive avenue for relationists if we conceive of relationism as the denial of spacetime points. Perhaps relationists are ready to sacrifice individuals (including material entities such as chairs and electrons) if by doing so they achieve a system free of space or spacetime.

In this paper, we explore whether this is a viable route to a relationist account of space. [2] We first discuss Dasgupta's claim that the most perspicuous way to represent the Generalist's metaphysical picture is by using a variant of Quine's predicate functor logic. We defend the view that Generalism is best formulated in first-order logic. By doing so, we will see how to salvage Generalism from Sider's recent argument that Generalism needs infinitary logic. Finally, we shall propose an argument against Generalism based on the fact that while the standard substantivalist theory T_S is interpretable in its generalist counterpart T_G, T_G is not interpretable in T_S. The argument has a logical structure akin to that of Dasgupta: it is an appeal to *theoretical virtues*. As we will see, Dasgupta's argument against individuals tries to establish that individuals are physically redundant in the same way in which, for example, the Lorentzian aether or absolute velocities are re-

[1]Dasgupta 2015 is mostly concerned with classical physics, but the qualitativist and anti-individualist character of Generalism makes it also an obvious candidate to resolve the Hole Argument in general relativity.

[2]Depending on how relationism is defined, one could regard the generalist approach as vindicating a substantivalist albeit qualitativist conception of spacetime. In the literature, it is customary to distinguish between two types of relationism: *reductionism* and *eliminativism* (see, for example, (Field 1984) and (Dasgupta 2015)). The former reduces facts about spacetime to facts about matter, while the latter does not posit the existence of spacetime altogether. The generalist approach is a form of *reductionist* relationism.

dundant and that therefore any generalist theory is more parsimonious than its counterpart with individuals. The argument presupposes an Ockhamist principle of parsimony about structure (see for example (North 2009) and (Sider 2013)).

Dasgupta (2009, 2015) has in mind a maxim to suppress undetectable entities and properties whenever possible. However, it seems to us that those cases can also be dealt with by the following principle:

Structural Parsimony All other things equal, we should prefer theories that posit less structure (Barrett 2022: 296).

If two physical theories are empirically equivalent and give good explanations of the phenomena, then the theory that posits more structure commits redundancy, or posits *superfluous* structure. This principle explains, for example, the fact that relativistic electrodynamics is preferable to Lorentz's aether theory. It also explains Dasgupta's very example of physically redundant entities, that is absolute velocities and the fact that Galilean spacetime is a better setting for Classical Mechanics than Newtonian spacetime. In Galilean spacetime, there is a fact of the matter whether a body is accelerating or not but there are no absolute facts about the velocity of bodies. On the contrary, the theory of Newtonian spacetime postulates a privileged standard of velocity. But absolute velocities are considered to be redundant pieces of structure. Hence the superiority of Galilean spacetime.

What does interpretability (or translatability) have to do with the principle of parsimony above? (Barrett 2022) has stated a *formal* criterion of structural parsimony, thereby making precise what it means for a theory to posit the same amount of structure as another. His original proposal is formulated in the language of category theory, but Barrett (2023) says that it is equivalent to a simpler, more natural one, based on the notion of an essentially surjective translation between theories (see (Barrett 2022: 310-11)):[3]

Equal Structure A theory T posits the same amount of structure as a theory T' if and only if there is an essentially surjective translation $f : T \mapsto T'$ *that preserves empirical content.*

[3]A translation $f\colon T \to T'$ is essentially surjective just in case for each sentence ψ of $L_{T'}$, there is a sentence ϕ of L_T such that $T' \vdash \psi \leftrightarrow f(\phi)$ (see (Halvorson 2019: 120)).

What we actually need, however, is a similar criterion for when a theory T posits *less structure* than another theory T'. It is natural to assume that this is the case if there is a translation f from T to T' but no essentially surjective one. This suggests the following criterion (see Lemma 1 in (Barrett and Halvorson 2022: 8) as well as (Babic and Cocco, 2024)):

Less Structure A theory T posits less structure than a theory T' if and only if there is an interpretation $f : T \mapsto T'$ but there is no interpretation $g : T' \mapsto T$.

The principle has the following intuitive justification. If there is an interpretation, or translation f from T into T' that preserves logical structure, then for every assertion ϕ in T, there is an assertion $f(\phi')$ in T' that has the same logical relations to observation reports, and therefore intuitively the same degree of confirmation. However, if there is no reverse translation, one can prove that the theory T' contains additional theoretical statements that have no counterpart in T (they are not $f(\phi)$ for some statement ϕ in T). This extra content adds to the risk of T' being false without purchasing any extra explanatory gain. The principle has also the merit of matching the two cases cited above. In Newton's formulation of his mechanics, one can formulate propositions such as 'the Earth is at absolute rest' that have no counterpart in Newtonian mechanics in Galilean spacetime. In the case of the Lorentz's aether theory, one can formulate statements such as 'the Earth is at rest relative to aether', that again correspond to nothing in Einstein's electrodynamics.

Barrett 2021 has applied this principle to the choice between nominalistic and platonistic physical theories. According to him, the requirement of Putnam 1971 that a nominalistic physical theory interpret standard platonistic theories is unreasonable, since it commits the nominalist to just as much structure

We want to show that, in stark contrast to the case of aether and absolute velocities, the two maxims diverge in the case of individuals. The maxim of suppressing undetectable entities favors Generalism. But the maxim of favoring overall simplicity favores individualism.

1.1 Intepretation

We have not defined what we mean by an interpretation of a first order theory into another. We propose to use a very minimal notion:

Definition 1 Let T_1 and T_2 be two theories in predicate logic. A function $f : L_1 \mapsto L_2$ from formulae of one language to formulae of the other language is an interpretation if (1), for any formulae ψ_1, ψ_2, $T_1 + \psi_1 \models \psi_2$ if and only if $T_2 + f(\psi) \models f(\psi_2)$, and moreover, for any observation sentence ψ_1, the translation $f(\psi_1)$ is an observation sentences confirmed and disconfirmed by roughly the same empirical evidence as ψ_1.

Think of the metaphor of Quine (1950) of our theory of the world as a web of logical relations, connecting with experience only at the edges. We want to map one web of belief into the other web, preserving inferential connections, and preserving the relations with experience at the edges. The notion of confirming and disconfirming evidence can be captured by the notion of meaning stimulus (see (Quine 1960: ch.2) or possibly a more mentalistic modern analog. (The notion of observation sentence raises worries about the theory ladeness of observations and the like that we recognize are important, but that cannot be addressed in this applied paper).

2 Which logic for the generalist?

The world, according to Generalism, consists of a countable set of attributes or universals, some of which obtain while others do not. At the bottom level, there is a stock of simple and fundamental properties. These properties can then combine to form more logically complex properties. The ways in which the basic properties combine correspond to the Boolean operations and the complexity of a property mimics the logical complexity of their names. Given two properties, say redness and roundness, there exists, for example, the conjunctive property of redness-and-roundness. But there are also quantificational properties: given the property of redness, there exists the property of there-being-redness. That's the structure of the world for the generalists: a countable structure, some composition operations, and some special paint thrown on what obtains.

Dasgupta has argued that a perspicuous way to formalize Generalism is by using a variant of Quine's predicate functor logic. Quine's goal was to show how to eliminate variables from first order logic without altering its expressive power. To do so he devised a language whose vocabulary consists of predicates and predicate functors. The notation adopted by Quine 1960 includes used six predicate functors: Der, Inv, inv, Ref, Neg and $\times$. Formulae are obtained by applying the predicate functors to predicates. The cartesian product $\times$, for example, applies to two formulae to form the conjunction of the two. The language was designed by Quine in such a way as to allow us to associate each formula of the language of his predicate functor logic with a first order formula built out of the same predicates. For example, $(InvP)$ is satisfied by n-tuples obtained by permuting cyclically to the left an n-tuple satisfying the predicate $P(x, ..., y, z)$. $(DerQ)$ is satisfied by the $n-1$ tuples that we get by cutting the last term from an n-tuple satisfying Q (this is also sometimes called the crop functor). The translation works in both directions. We can take predicate functor logic as primitive and introduce by definition the usual notation '$\exists$', '$\neg$', 'x' etc. of predicate logic. Quine has proved that whenever a sentence ϕ is deducible by a theory T, its translation $f(\phi)$ will be implied by the translation $f(T)$ of T.

Now, it is crucial to say that Dasgupta does not use Quine's predicate functor logic. The language of functorese is fundamentally readapted and reinterpreted in Dasgupta 2009 to serve as a vehicle for Generalism. The predicates of the theory are turned into constants – names of universals and properties – and the logical connectives become logical functors, forming *terms* and not *sentences*. The sole predicate of the theory is 'Obtains x'. In fact, what for Quine is a formula of predicate functor logic is for Dasgupta the name of a property. In Dasgupta's variant of predicate functor logic, the vocabulary contains, first of all, names that designate simple universals: $P, P', P'', ...$ We can also have names for relational universals, like 'Biting'. In addition to the basic terms, we want to form terms for more complex properties. To do so, Dasgupta introduces the same functors of Quine; except that this time they are function symbols that apply to names to form other, more logically complex, names of properties. For instance, if we apply the negation functor Neg to a name of a property, P, we get its corresponding negative property. If we apply the $\times$ functor to P and P' we get a term $P \times P'$ for their corresponding conjunctive property. If we apply Der to a name of a relational universal, say, 'Biting', we form another name, 'Der Biting', that stands for, intuitively, the property of biting something. And so on and so forth. The predicate of obtaining, Obtains x, allows us to form sentences. An example should make this clear. Suppose that we combine redness and roundness into a one-place conjunctive property:

$$\text{Red} \times \text{Round} \tag{1}$$

We can form the name of the zero-place property (or state of affairs) of there being something red and round by using the *Der* functor:

$$Der(\text{Red} \times \text{Round}) \tag{2}$$

Finally, we can say of that property that it obtains:

$$\text{Obtains } Der(\text{Red} \times \text{Round}) \tag{3}$$

The formula in (3) is an example of a well-formed atomic formula of Dasgupta's language.

It is not difficult to realize that the logical apparatus of Dasgupta 2009 turns out to be a *fragment* of a first-order theory: the vocabulary that remains after quantifiers, variables and sentential connectives are thrown out. It is that fragment of first-order logic that contains just predicates (in this case only one, the predicate of obtaining), names (which in this case denote properties rather than individuals) and function symbols that apply to names. What this means is that the metaphysical picture of Dasgupta 2009 can be explained within the framework of first-order logic, on a par with other first-order systems of universals like Eberle's formalizations of the Russellian 'bundle theory' (see (Eberle 1970)). There is no need to make reference to predicate functor logic to give an accurate exposition of what the theory tells us about the world. The mention of functorese and its notation can be even misleading.[4]

The most natural formalization of Generalism is actually in full first-order logic, not just in the truncated fragment of Dasgupta. We can add to Dasgupta's theory the logical connectives: for it seems very natural for a generalist to wish to express sentences like 'If Redness×Roundness obtains then Redness obtains'. We can add variables ranging over properties as well as quantifiers for such variables. After all, generalists presumably want to express a sentence like 'Some properties obtain while others do not'. A formalized theory T_G can be obtained from an informal exposition of the

[4]Reference to functorese is relevant only in so far as the official language of generalism can be seen as piggybacking on functorese, by turning Quine's predicate functors into function symbols.

metaphysical picture of Generalism by a straightforward process of regimentation of ordinary language. The analogy with the Russellian bundle theory is exploited again to resist Dasgupta's argument that the existential and universal quantifiers require a domain of individuals over which to range. The quantifiers of his theory range over universals, and not individuals.

If Dasgupta insists that Generalism is most perspicuously represented within the fragment of first-order logic without variables, quantifiers and logical connectives, we can give two arguments to favor the system T_G as the official formulation of Generalism.

Argument 1: The first is that the relative costs of adopting an ontology of universals à la Dasgupta – rather than an ontology of material objects – are better assessed by confronting theories *with equal logics.* To suppress the quantifiers, variables, and connectives is only a way to artificially reduce the expressive power afforded by a luxurious ontology. The maneuver is dual to a common maneuver in metaphysics, whereby a strengthening of the logic - with modal, temporal, or ancestral operators - is assumed to remedy the absence of instants of time, or sets, in the ontology. In the terminology of Quine 1978, the weaker logical apparatus obstructs ontological comparisons:

> Admission of additional linguistic elements can upset this ontological standard [the criterion of ontological commitment]. Thus suppose someone adopts outright an operator for forming the closed iterated of predicates, instead of defining it with the help of an ontology of sets. Are we to say that he has saved on ontology? I say rather that he has shelved the ontological question by switching to a language that is not explicit on ontology. His ontology is indeterminate, except relative to some agreed translation of this notation into our regimented one. (Quine 1978: 161)

Argument 2: The second argument is that the quantifiers are needed, moreover, to express certain basic metaphysical claims made in (Dasgupta 2009). The main exhibit is sentence (4) below (see (Babic and Cocco 2019)):

(4) There are no (fundamental) individuals

3 Sider's Argument for Infinitary Logic

In his recent book, Ted Sider (2020) has argued that Generalism needs to be formulated with an *infinitary logic* or needs to embrace some generalist analogue of second order quantifiers, and suggests that this may offset its supposed ontological economy. The structure of Sider's argument against Generalism is identical to that of Sider and Hawthorne's modal argument against the bundle theory of universals. He describes a number of *distinct* situations in terms of individuals. In these situations, individuals are arranged in certain structures that are not isomorphic, but give rise to qualitatively identical patterns. He then shows that a description à la Dasgupta collapses all of these possible scenarios.

The first scenario he considers is a world that consists only of the positive integers related by the successor relation, addition, and multiplication. This world is described by the theory of first-order Peano Arithmetic. Peano Arithmetic (PA) can be presented using only predicates (see (Cohen 2008: 6-7) and (Quine 1986: n.25)). Its vocabulary includes a binary predicate for the successor relation Sxy ('y is the successor of x'), a ternary predicate for the addition relation $x + y = z$ ('z is the sum of x and y') and a ternary predicate for the multiplication relation $x \cdot y = z$ ('z is the product of x and y'). Function symbols for the addition, multiplication, and successor operations can be defined in terms of the addition, multiplication, and successor predicates. The individual constant '0' can also be defined in terms of the predicates.

It is crucial to note that the axioms of PA can be formulated without using names. This means that any formula of Peano Arithmetic can be translated in the language of Dasgupta's Generalism by using (a variant of) Quine's translating scheme between predicate functor logic and first-order logic (see the appendix **§A**). For example, Peano Arithmetic entails that everything has a successor. We can translate this statement as follows:

$$\forall x \exists y\, Syx \mapsto_f \text{ Obtains } \; Neg\, Der\, Neg\, Der\, S$$

The standard, intended model of Peano arithmetic is the structure $\mathfrak{N} = \langle \mathbb{N}, +, \times, 0, S\rangle$ where $\mathbb{N}$ is the set of natural numbers, $\{0, 1, 2, 3, 4....\}$. However, Peano arithmetic also has so-called non-standard models, on which the literature abounds. Just to give an intuition, the order type of a non-standard model is obtained by adding to the domain of the intended structure $\mathbb{N}$ $\mathbb{Q}$-

copies of $\mathbb{Z}$. We can define then a structure with this domain, which is a model of Peano Arithmetic. Let us call it $\mathfrak{M}$. We can imagine two possible worlds w and w', in which certain particles or individuals are ordered on a sequence (such as a queue to vote or to the post office), according to $\mathfrak{N}$ and in one according to $\mathfrak{M}$. Let us assume that the particles that exist in the standard world w exists also in the nonstandard world w', and occupy the very same positions in the sequence. Can the individualists distinguish two such models or worlds? Sider thinks that they can. He says:

> The believer in individuals can distinguish the worlds; they have non-isomorphic collections of fundamental facts about particular entities. (Sider 2020: 100)

We have said that $\mathfrak{N}$ and $\mathfrak{M}$ are two models of the same theory, that is Peano arithmetic, but they are not isomorphic. The individualist can switch to a variant of the language of Peano arithmetic where *names* for particular individuals are introduced. The individualist can then express in this new language facts that hold in one world but not in the other. For example, the individualist could introduce three names, c_1, c_2 and c_3 that denote three particles in w' that stand in the position of non-standard numbers, and say that in w it is true that $c_1 + c_2 = c_3$, whereas in w' the same sentence is not true, since there are no such particles in the sequence. Sider then argues that, since Generalism cannot distinguish these two situations, Generalism must be false. More explicitly, the argument goes like this:

P_1 : The two worlds are distinct ($w \neq w'$)
P_2 : Generalism collapses them (*i.e,* implies that $w = w'$
C : Generalism is false

According to Sider, a generalist like Dasgupta might respond by introducing a more powerful logical ideology into the language used to state the fundamental facts. For example, if Generalists adopt second order quantifiers, then Peano arithmetic can be turned into second order arithmetic. And the models of second order arithmetic are all isomorphic. So no problem arises there. Another solution is to admit in the language of Generalism infinite conjunctions. The generalist can express facts about nonstandard models of arithmetic that do not hold in the standard model. For example, in a nonstandard model of arithmetic (but not in the standard model), this infinite conjunction holds:

$$\exists x \bigwedge_{n \in \mathbb{N}} x \neq c_n$$

However, the argument that Generalism needs either infinitary logic or second order quantifiers begs the question against Generalism. In particular, it is not clear how we pass from the description of certain scenarios in terms of individuals, arranged in a certain structure, such as a nonstandard model of arithmetic, to a conclusion about the limitations of the expressive power of Generalism. In a sense, it is obvious that the generalist cannot distinguish the two worlds. The worlds w and w' are worlds with individuals in them. These are worlds in which Generalism is *false*. Therefore, it is not a problem that Generalism fails to capture all the facts in those two worlds, because ought to capture none at all. It seems that Sider is asking us to make two inconsistent assumptions: (a) that the individualist and the generalist theories are descriptions of exactly the same world but (b) that the worlds are different (since one is a world of individuals and one is a world of universals). But a serious generalist ought clearly to assert (b) and deny (a).

A more charitable characterisation of the premises of the argument might be that to a given world of individuals corresponds a matching world of universals. To two non isomorphic models of true arithmetic, there must correspond two non isomorphic models of functorese arithmetic. More precisely, one could assume the two following principles:

(A) To every possible world with individuals w there corresponds a unique generalist counterpart w' that is intuitively how the world w would be if only Generalism were true.

(B) Two worlds with individuals are mapped onto the same generalist world w' if and only if they are equivalent up to a permutation of the individuals (up to the "identity of the individuals").

By assuming that Generalism could give us counterpart worlds with the same qualitative pattern exhibited in these two scenarios we can modify Sider's argument in the following fashion:

P1: $\mathfrak{N}$ is not qualitatively identical to $\mathfrak{M}$

P2: If Generalism captures the qualitative structure of two worlds, then its counterparts must be numerically distinct (*i.e,* $\mathfrak{N}' \neq \mathfrak{M}'$).

P3: $\mathfrak{N}'$ is identical to $\mathfrak{M}'$

C: Generalism does not capture the qualitative structure of worlds $\mathfrak{N}$ and $\mathfrak{M}$

The problem with this reconstruction of Sider's argument is that no defense is given of principles (A) and (B). They are not self-evident or an obvious requirement for a generalist metaphysics. In fact (A) and (B) appear to us to be obviously false under Generalism. Generalism stands on its own and is an empirically adequate, self-consistent story about how the world is and does not need to reproduce the models of an individualist's metaphysics.[5]

To summarize, the arguments of Sider (2020) for an infinitary logic are fallacious. More precisely, they beg the question against Generalism. Sider describes a number of *distinct* situations in terms of individuals. He describes individuals arranged in certain structures that are not isomorphic, but which give rise to qualitatively identical patterns, such as two continua of colored spacetime points, Democritean atoms, and a nonstandard model of arithmetic. He proves that a description à la Dasgupta collapses all of these possible scenarios. In other words, there is no one-to-one map between the models of system T_G and models of a theory of individuals T_{FOL} up to isomorphism. This can be remedied somewhat by assuming an infinitary logic. Unfortunately, no good reason is given to expect such a one-to-one mapping. What can be requested at most, if Generalism is to be empirically adequate, is that each model of T_{FOL} can be associated with an empirically indistinguishable model of T_G.[6]

[5] Sider considers also more complicated scenarios than arithmetical worlds, the Democritean worlds, in which there are uncountably many spacetime points, each being either "on" or "off" (see (Sider 2020: 119)). The argument he builds on them, and thus our response to it, is perfectly analogous to the argument from the arithmetical worlds.

[6] We can note that the attack of Sider 2019 on Generalism is analogous to the proof of the impossibility of nominalism of Putnam 1971 (and criticised by Barrett 2022). Both Sider 2019 and Putnam 1971 insist as a condition of satisfaction on nominalism and Generalism that they recover all the fine distinctions formulable under platonism or individualism, whereas it is precisely *the point* of these philosophies to collapse as much of the distinct but empirically indistinguishable possibilities that the former posit.

4 Against Generalism

In this final section of the paper, we will formulate a critique of Generalism. Our claim is that a generalist theory of the world scores lower than a rival individualist theory on one important theoretical virtue: total simplicity or parsimony. However, what to infer from the inferiority of Generalism in this respect depends on our general attitude to extraempirical virtues.

4.1 Theory Choice

In his argument against individuals, Dasgupta 2009 works with the epistemic notion of detectability rather than with simplicity as we characterize it. He argues that theories that do away with individuals should be preferred because they dispense with undetectable entities, not because they are simpler. Individuals, according to Dasgupta 2009, are undetectable: one cannot detect any difference between two possible worlds that exhibit the same distribution of properties and differ only with respect to which individuals inhabit them (see (Dasgupta, 2009: 40-43) for a detailed discussion).

However, Dasgupta 2015 later made it clear that the norm against undetectability presupposes a *ceteris paribus* condition:

> If we can show that the feature is undetectable, then we will have shown that we do not (and cannot) have empirical evidence in the form of observations or measurements of it. It remains possible that dispensing with the feature yields a theory that has too many other vices to warrant belief, such as being too inelegant or complex. (Dasgupta 2015: 854)

In the second scenario, Dasgupta 2015 concedes that we might have evidence 'of sorts' for the undetectable feature of the world, because the overall better confirmed theory implies its reality (see (Dasgupta 2015: 854)).

We agree with Dasgupta on this. The point of our paper is that we are not in the presence of an "all else equal" situation. In fact, we want to show that by eliminating a feature of the theory, that is individuals, we end up with a more complex, and therefore less parsimonious, theory. It may very well be that Dasgupta's Generalism scores better with respect to undetectability (we do not want to question the notion of undetectability here[7]), but our point is that individualism is the simpler theory. One could

[7] See (Martens 2021) for a discussion of undetectability as a criterion of theory choice.

question whether simplicity trumps detectability: this remains to be seen.

4.2 The Argument

Dasgupta (2009) shows how, starting from an arbitrary individualist theory T_{ind} couched in the idiom of first-order logic, it is possible to construct a generalist theory T_{gen} and interpret T_{ind} inside T_{gen}. Our claim is:

Claim 1 For any physical theory T_{ind}, T_{ind} is simpler than T_{gen}.

We have discussed earlier our criterion for total simplicity, which we have adapted from the criterion of equality of structure of Thomas Barrett (2020). According to the parsimony criterion, we have to show that there is an interpretation of the individualist theory inside the generalist theory that preserves empirical content, but there is no interpretation of the generalist theory in the individualist theory that similarly preserves the predictions.

For our purposes, it will suffice to show that the canonical interpretation f_{can} of individualist talk in generalist terms, mentioned by Dasgupta (2019, Appendix) has no *inverse*. In other words, we show that there is no interpretation g of the generalist theory T_{gen} inside the individualist theory T_{ind} that counts as an inverse to f_{can}, that is $g = f_{can}^{-1}$), in the following sense: such a g cannot always send the translation $f_{can}(\phi)$ of an individualist sentence ϕ back to a sentence equivalent to the original sentence ϕ:

$$T_{ind} \models g(f_{can}(\phi)) \leftrightarrow \phi$$

Note that it is not simply a matter of ϕ and $g(f_{can}(\phi))$ being logically inequivalent. We will show that, if there is a deviant interpretation g at all, its translation $g(f_{can}(\phi))$ will *not* in general be equivalent to ϕ *even relative to theory* T_{ind}. According to T_{ind}, ϕ could be true and $g(f(\phi))$ false, or vice versa. Since T_{ind} is arbitrary, g cannot preserve empirical content. The proof that this is the case is given in the appendix.

No matter what T_{ind} is, T_{ind} and $f^{-1}(T_{gen})$ will be confirmed by different evidence. An example may bring out the significance of our claim. Suppose that our individualist physical theory says that there are electrons

$$\exists x \text{ Electron } x, \tag{4}$$

There is a canonical way to interpret this claim in generalist terms: It is the claim (5) that the derelativisation of electronhood obtains.

$$\text{Der Electron} \tag{5}$$

Suppose we now want to translate back generalist claims into individualist terms. We would like to translate the claim (5) that the derelativisation of electronhood obtains as the claim (4) that electrons exist, or something equivalent *by the lights of our individualist theory.* However, we will see that no matter what our theory T_{ind} is, doing that for all such claims is impossible.

It seems to us likely that, at least for sufficiently complex theories, there is not even a deviant interpretation of T_{gen} inside of T_{ind}. However, all the proof ideas we have require heavier machinery that we cannot develop in this space, such as arithmetisation. We will first set up the canonical translation in our notation. Then, we show that it is not invertible in this sense.

Note that, independently of simplicity, the result shows that the generalist theory and the individualist theory are not *formally equivalent* relative to modest standards of formal equivalence. The theorem in the appendix **§A** shows that they are not theoretically equivalent either, and so the debate cannot be dismissed in a deflationary manner as a verbal dispute, in which the two sides are saying the same things in different idioms.

4.3 Alternative Notions Of Translation

The proof in the appendix **§A** shows that the canonical translation of a theory of individuals into a theory of universals that Dasgupta 2009 proposes is not *surjective.* This means that certain sentences, such as (6):

$$\forall x(Obtains\ x \rightarrow \neg\, Obtains\ Neg\ x) \tag{6}$$

are not logically equivalent to the translation of a sentence in the mouth of the individualist. We have interpreted this fact according to our criterion, as a sign that the generalist theory contains *extra structure.*

However, one may wonder whether this result is not merely an artifact of our formal methods, namely, our much too restrictive notion of translation. Translation and interpretation in logic and in the literature on formal methods in philosophy are construed as mappings of sentences into sentences (see (Halvorson 2019) for a survey). However, could we not think that sentences such as (6) are simply ways to compress a *collection* of sentences in the individualist theory? To use an analogy with truth, the assumptions of attributes or universals may function as a device to express generality.

For example, consider the collection of sentences of the form:

$$\phi \rightarrow \neg\neg\phi \tag{7}$$

Does the set S of all the instances of schema (7) correspond to the single generalist claim (1)? If that is the case, then it seems that the relevant structure is right there in the individualist theory, although distributed across an infinity of sentences, rather than expressed by a single claim.[8]

However, it seems to us that there are good reasons to deny that the schema (7) captures the content of (6). If we translate them individually, all the instances of (7) in S already correspond to the class of generalist sentences S', expressed by a schema with the form of (8) below:

$$\textit{Obtains} - - - \phi - -- \tag{8}$$

in which the dots are replaced by some term in which the logical particles have been replaced with operators. We omit the details because the formula is ugly when we rewrite the conditional only with '$\times$' and 'Neg'.

But note that the universal generalization of (8) has the form

$$\forall x \; \textit{Obtains} \; - - - x - -- \tag{9}$$

with the dummy term ϕ, standing for terms denoting a fact, replaced by the variable 'x'. Sentence (9) has a strong claim to condense schema (8), since it implies all the instances of schema (8), and is true in all and only the possible worlds in which all the instances of schema (8) are true. But schema (8) captures the same content as (7), of which it is a translation; nearly equivalently, the generalist sentences in S' represent the same structure as the sentences in S of which they are the translation. But if (9) compresses (8), then it captures the content of S', and therefore, if the translation is accurate, the same amount of structure as does S in the individualist theory.

However, to conclude this argument, note that sentence (9) is not by any means equivalent to our initial sentence (6) that is not in the range of translation. The first, namely (9), says that all logically complex facts of a certain sort obtain. The second, sentence (6), states a generalization about facts, namely, that a fact and its 'negative fact' cannot both obtain. But a

[8]Dasgupta has suggested to us to look into this proposal, and mentioned (7).

crazy generalist could without logical inconsistency assert that all the facts mentioned in (9) obtain, but *also all their 'negative facts'*. To rule this out, we need a further law of metaphysics such as (6) (a substantial commitment).

This is merely an example, but it seems to generalize easily to other similar cases. One may insist that (6) corresponds to a collection of sentences that is not expressed by a schema, to block the argument. But without a concrete proposal, and a compelling motivation for it, the chances of locating the extra structure in the individualist theory seem to us to be slim.

5 Conclusion

According to Dasgupta, if one wants to eliminate individuals from the book of the world, then one might try to rewrite it in a "feature-placing" language, that is a language which, unlike first-order logic, does not contain any device, like names and variables, to refer to individuals. Quine's predicate functor logic is one such language. Virtually everyone in the literature seems to assume that Dasgupta is operating with Quine's predicate functor logic or a variant thereof - even Dasgupta himself. But one of the main messages of this paper is that, actually, Dasgupta's Generalism is *not* formulated in Quine's PFL. It is literally formulated in the fragment of first-order logic which contains no quantifiers. Ironically, the logical form of the basic sentences of Generalism, sentences of the form 'property P obtains', can be broken into the subject/predicate form. Does that mean that Generalism is somehow committed to the existence of individuals? Not at all. On the contrary, we argued that Dasgupta not only can but should embrace the full power of first-order logic to formulate Generalism and introduce the quantifiers in the language of Generalism. Generalism is best construed, or so we argued, as a theory of universals couched in a fully-fledged first-order language with variables ranging over properties, function symbols to form singular terms standing for complex properties and one predicate of 'obtaining'. Our construal of Generalism has the advantage of making clear what goes wrong in Sider's recent argument against Generalism. However, it paves the way, in our opinion, for a compelling argument against Generalist theories. For, in general, a standard physical theory with individuals can be translated into the idiom of Generalese but a generalist rewriting of the same physical theory cannot be translated back into a theory of individuals. This suggests that, as far as simplicity is concerned, Individualism does better than Generalism.

It remains to be seen whether the simplicity of Individualism trumps the key benefit of Generalism: its reduction in the undetectable entities we assume.

Acknowledgements

We would like to thank Prof. Shamik Dasgupta and an anonymous referee for valuable comments on this paper.

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Appendix A

A.1 The canonical translation

Quine (1960, 1976) has described an algorithm that associates every closed formula ϕ of predicate logic (PL) to a predicate of predicate functor logic (PFL). This algorithm, which results in what we may call the *auxiliary function* f_{aux}, can be described in the following fashion (a more formal version but with a different notation can be found in (Kuhn 1983: 235)):

Definition 2 Let ϕ be a formula of predicate logic. The auxiliary function $f_{aux} : PL \mapsto PFL$ is given by the following procedure:

1. Translate every universal quantifier $\forall$ occurring inside ϕ into existential quantification and negation.

2. Translate the scope of each innermost existential quantifier into disjunctive normal form.

3. Distribute every existential quantifier over the disjunctions using the rule of passage. (At this point the scope of every innermost quantifier is either an atomic formula with or without negation, or a conjunction thereof).

4. Replace every negation symbol inside the scope with the functor Neg.

5. Merge every conjunction into a single predication by using the functor $\times$ and concatenate its variables on the right. For example,

   $Neg\, Px_2x_3 \wedge Fx_2 \wedge Neg\, Qx_1$

   becomes:

   $(Neg\, P \times F \times Neg\, Q)x_2x_3x_3x_1$

6. Bring the quantified variable of each innermost quantifier on the left by using the functors Inv and inv. For example, if the quantified variable is x_2 as in the following string:

   $\exists x_2\, (Neg\, P \times F \times Neg\, Q)x_2x_3x_3x_1$

   then we move all the occurrences of x_2 on the left side of the sequence of variables by applying first a major inversion Inv (which brings the last variable at the beginning of the sequence), then a minor inversion inv, and then another major inversion Inv:

$\exists x_2\, Inv\, inv\, Inv\, (Neg\, P \times F \times Neg\, Q)x_2x_2x_1x_3$

7. Use the functor Ref to eliminate all the occurrences of the quantified variable except for one. In our previous example, the result would be the following:

   $\exists x_2\, Ref\, Inv\, inv\, Inv\, (Neg\, P \times F \times Neg\, Q)x_2x_1x_3$

8. Use the derelativization functor Der to eliminate the existential quantifier. Again, in our example this results in the following:

   $Der\, Ref\, Inv\, inv\, Inv\, (Neg\, P \times F \times Neg\, Q)x_1x_3$

9. Repeat the previous steps (4-9) for each innermost existential quantifier so as to eliminate every remaining variable and quantifier.

From the point of view of the generalist, the auxiliary function f_{aux} can be seen as a function that maps every sentence of the individualist language into a *term* of the generalist language. We can then define the canonical translation f_{can} from the individualist language to the generalist one by capitalizing on the existence of f_{aux}. An individualist sentence ϕ will be translated as the claim that the fact denoted by $f_{aux}(\phi)$ obtains.

Definition 3 Let ϕ be a sentence of the individualist language. Then f_{can} is defined as follows:

$$f_{can}(\phi) = Obtains\ f_{aux}(\phi)$$

A.2 The theory T_{gen}

Dasgupta suggests identifying the generalist theory T_{gen} to the collection of translations of individualist sentences:

$$T_{gen} = f_{can}(T_{ind})$$

However, there is a small subtlety when we move from predicate functor logic to ordinary quantification theory. In predicate functor logic, there are various rules of inference such as modus ponens. From the premises

$$\phi \tag{10}$$
$$Neg\ (\phi \times Neg\ \Psi) \tag{11}$$

one is allowed to infer the conclusion that

$$\Psi. \tag{12}$$

However, when we move to predicate logic, the sentences:

$$Obtains\ \phi \tag{13}$$
$$Obtains\ (Neg\ (\phi \times Neg\ \Psi)) \tag{14}$$

are atomic formulae. Therefore, they do not imply the sentence:

$$Obtains\ \Phi \tag{15}$$

since atomic formulae are logically independent. However, we want to maintain the same inferential connections between sentences as in predicate functor logic. If that is not the case, then f_{can} is not an interpretation at all.

To remedy this deficiency, there are two options: adding more primitive inference rules to the predicate logic or extralogical postulates to T_{gen}. We suggest the second option, so as to stay squarely within ordinary quantification theory. Let us call C_{logic} the collection of conditionals

$$Obtains\ \phi_1\ \wedge ... \wedge\ Obtains\ \phi_n \rightarrow Obtains\ \Psi \tag{16}$$

such that the terms $\phi_1, ..., \phi_n$, when construed as sentences, imply in the predicate functor logic the term Ψ construed as a sentence. By adding an instance of (16) as a premise, and using conjunction introduction and modus ponens, we will be able to infer (15) from (13),(14), and that instance of (16). The fact that f_{can} is an interpretation into T_{gen} so construed should therefore be obvious enough, although we omit the formal verification:

Lemma 1 f_{can} is an interpretation of T_{ind} into T_{gen}.

A.3 A Further Extension of T_{gen}

For purely technical reasons, let us consider another motivated extension $T_{gen} \subset T^+_{gen}$ of T_{gen} that the generalist may be tempted to commit to. We need it as a tool in the proof. We do not assume that the generalist commits to it. The idea is to add to the postulates all the instances of the schema:

$$Obtains\ t \leftrightarrow \neg Obtains\ Neg\ t \tag{17}$$

in which the dummy term 't' is substituted by a term of the generalist language of the form $f_{aux}(\psi)$ for $\psi \in L_{ind}$ an individualist sentence. The schema tells us, for every state of affairs named by a term of the generalist language, that if it obtains, its negative state of affairs does not obtain.

Although it plays no role in the proof, it is tempting to add also another set of postulates corresponding to a schema for conjunction:

$$Obtains\ t \times t' \leftrightarrow Obtains\ t \wedge Obtains\ t'. \tag{18}$$

This says that if the conjunction of states of affairs obtain, then each state of affairs obtains. Let us call C'_{logic} the set of instances of (17) and (18). Let us then define the extended theory:

$$T^+_{gen} = T_{gen} + C'_{logic}.$$

We get the following lemma about f_{can} and the powerful theory T^+_{gen}.

Lemma 2 For any formula $\psi \in L_{ind}$, we have the following:

- $T^+_{gen} \models f_{can}(\neg\psi) \leftrightarrow \neg f_{can}(\psi)$
- $T^+_{gen} \models f_{can}(\psi \wedge \psi') \leftrightarrow f_{can}(\psi) \wedge f_{can}(\psi')$

Proof. Obvious.

A.4 Theorems

We want to show that there is no interpretation g of T_{gen} into T_{ind} that acts as an inverse to f_{can}. The proof will go as follows. We will first prove that f_{can} is not *essentially surjective*: there is a formula of the generalist language ϕ_{neg} that is not equivalent to $f_{can}(\psi)$ for any $\psi \in L_{ind}$ even relative to T^+_{gen}. We will then show that there is no way to translate this formula ϕ_{neg} into the individualist language as $g(\phi)$ while inverting the translation f_{can} on the other formulae. The formula ϕ_{neg} that we will use is the following:

$$\forall\, x(\mathit{Obtains}\ x \rightarrow \neg \mathit{Obtains}\ \mathit{Neg}\ x) \tag{19}$$

that says that if a fact obtains, then the negation of that fact does not obtain. We want to see that it is not settled by any version of the theory T^{+}_{gen}.

Lemma 3 Let T_{ind} be any consistent individualist theory and $T_{ind} \subset T'_{ind}$ a complete and consistent extension of T_{ind}. Let $T'^{+}_{gen} = f_{can}(T'_{ind}) + C_{logic} + C'_{logic}$ be defined as above. Then $T'^{+}_{gen} \nvdash \phi_{neg}$ and $T'^{+}_{gen} \nvdash \neg\phi_{neg}$.

Proof. We show that there are two models $\mathcal{M}$ and $\mathcal{M}'$ of T'^{+}_{gen} such that ϕ_{neg} is true in $\mathcal{M}$ and ϕ_{neg} is false in $\mathcal{M}'$. The universe $\mathfrak{U}(\mathcal{M})$ of properties and facts of $\mathcal{M}$ can be taken to be the terms of L_{gen}. These are all terms of the form $f_{aux}(\psi)$ for some individualist formula $\psi \in L_{ind}$. We then take the extension of the unary predicate of obtaining in $\mathcal{M}$ to be like in the Henkin model: the terms that give a theorem when substituted for the free variable

$$\mathcal{M}(\mathit{Obtains}) = \{t \in \mathfrak{U}(\mathcal{M}) \mid T_{gen} \models \mathit{Obtains}\ t\}$$

and similarly for the function symbols. It is then easy to show that, for any assignment τ, $\tau(x) \in \mathfrak{U}(\mathcal{M})$ is identical to the extension $\mathcal{M}(t)$ of some term t and moreover that $t = f_{aux}(\psi)$ for some $\psi \in L_{ind}$. But then

$$\mathcal{M} \models \mathit{Obtains}\ t \rightarrow \neg \mathit{Obtains}\ \mathit{Neg}\ t$$

because, if $t \in \mathcal{M}(\mathit{Obtains})$, then we have that $T'_{ind} \models \psi$ by definition of T'_{gen}. But then $T'_{ind} \nvDash \neg\psi$ by consistency. This means that:

$$T_{gen} \nvDash \mathit{Obtains}\ \mathit{Neg}\ t \ \ (= f_{can}(\neg\psi))$$

by definition of T_{gen}. This means that

$$\mathcal{M} \models \neg \mathit{Obtains}\ \mathit{Neg}\ t$$

as we wanted. However, note that we can construct a model $\mathcal{M}'$ with the same universe but adding an alien term p and all the terms obtainable from p and previous terms by logical operations T_p:

$$\mathfrak{U}(\mathcal{M}') = \mathfrak{U}(\mathcal{M}) \cup T_p$$

We can add both p and its negative 'state of affairs' Neg p to the extension of the unary predicate of obtaining:

$$\mathcal{M}'(Obtains) = \mathcal{M}(Obtains) \cup \{Neg\ p\} \cup \{p\}$$

and we still have a model of T_{gen}. For each atomic formula in $f_{can}(T_{ind})$, it is still satisfied. Every sentence in C_{logic} and C'_{logic} is also satisfied as in $\mathcal{M}$.

Let us now state formally what we mean when we say that an interpretation g is an inverse to the interpretation f:

Definition 4 If $f : T \to T'$ is a translation and $g : T' \to T$ is a translation, then g is an inverse of f iff for every closed formula ϕ of L_T and for every closed formula of $L_{T'}$ we have that $T \vdash \phi \leftrightarrow g(f(\phi))$ and $T' \vdash \psi \leftrightarrow f(g(\psi))$.

Corollary There is no interpretation f^{-1} that is an inverse to f_{can}.

Proof. Assume an inverse f^{-1} exists. Let ϕ_{neg} be as in **Lemma 3**. Then $T'_{gen} \vdash f_{can}(f^{-1}(f(\phi)_{neg}) \leftrightarrow \phi_{neg}$. Since T'_{ind} is complete, we have either $T'_{ind} \models f^{-1}(\phi_{neg})$ or $T'_{ind} \models \neg f^{-1}(\phi_{neg})$. But then, since f_{can} is a *translation* of T'_{ind} into T'^{+}_{gen}, by **Lemma 1** and **Lemma 2** we have that $T'^{+}_{gen} \models f_{can}(f^{-1}(\phi_{neg}))$ or $T'^{+}_{gen} \models \neg f_{can}(f^{-1}(\phi_{neg}))$. Therefore, T'^{+}_{gen} decides ϕ_{neg}. Contradiction.