STRUCTURAL HUMILITY

We can see our world (and possible worlds generally) as naturally dividing up into structure and contents. The contents of the world further divide into the properties and individuals which are instantiated at and exist in the considered world, respectively. On the other hand, the structure of the world provides the way that the contents are organized.

Call a thesis a 'Humility Thesis' if it amounts to claiming that there is some important part of the world that we are irremediably ignorant of. Humility Theses are claims of some systematic epistemic limitations we have. For example, David Lewis, in his "Ramseyan Humility" (2009), argues that we are irremediably ignorant of the identities of many properties of things.[1] We only come to know them as role-occupants (of dispositions or other roles). But given a contingent connection between roles and occupants, different properties can occupy the same role at different worlds. Thus, knowledge that the role is occupied is insufficient for identifying the property occupying that role. An analogous Humility Thesis arises in the case of individuals. Assume that we can know the qualitative character the individuals in our world. If individuals are only contingently connected with their qualitative properties (in the way role occupants were suggested to be connected with their roles), then different individuals could occupy the same qualitative characters in different worlds. If this is so, then knowledge that a particular qualitative character is had is likewise insufficient to know the identity of the individual which has that character.

The routes just sketched for these two Humility Theses bear a significant similarity. Both aforementioned Humility Theses involve claims about our epistemic limitations regarding our knowledge of the identities of *contents* of the world. The question I want to ask in this paper is whether or not there is reason to think that we may be irremediably ignorant of the *structure* of the world. Spatiotemporal structures provide common examples of world structures. As such I will limit the following discussion to whether or not we should accept a Humility Thesis about the world's spatiotemporal structure.[2] In particular, I argue that we remain irremediably ignorant of whether we are in a world with distinct regions which are topologically indistinguishable from one another.

[1] I discuss Lewis' arguments in §1.

[2] In what follows I ignore current discussion about whether or not our world isn't fundamentally spatiotemporal, though I believe that my discussion will generalize to other types of world structures.

I begin by briefly reviewing Lewis's argument for Humility about the intrinsic properties of things ('Ramseyan Humility' henceforth). I then discuss whether we should endorse a corresponding Humility Thesis about the worlds' spatiotemporal structure ('Structural Humility' henceforth). I argue that the standard metaphysics of spacetime fall prey to Structural Humility. This is significant because avoiding concerns of Humility is touted as a reason for adopting a particular metaphysic of spacetime. I conclude with a brief discussion of the implications of Structural Humility for this view.

1. Ramseyan Humility

Lewis's argument for Humility regarding our knowledge of properties begins with two arguments for Humility about *fundamental* properties.[3] Fundamental properties can come in a variety of categories as well. They can be all-or-nothing properties of various adicities, or come in varying degrees such as scalar and vector magnitudes, and so on.

Advances in scientific theorizing and the discovery of fundamental properties stand in a mutual relationship. So much so that a true and complete final theory, $\mathscr{T}$, will provide us with a complete inventory of the fundamental properties at work in nature. The final theory, $\mathscr{T}$, however, will leave out properties which are instantiated but play no role in nature ('idlers'), and those fundamental properties which aren't instantiated in our world ('aliens').[4]

The argument for Ramseyan humility can be seen as proceeding in two steps. First, the argument shows that any evidence for our fundamental theory $\mathscr{T}$, is just evidence for what is called the *Ramsey sentence* of $\mathscr{T}$. Second, it is argued that the Ramsey sentence of $\mathscr{T}$ admits of multiple realizations. Since all evidence for $\mathscr{T}$ is only evidence for the Ramsey sentence of $\mathscr{T}$ and the Ramsey sentence of $\mathscr{T}$ isn't uniquely realizable, we have no more evidence for $\mathscr{T}$ than any other possible realizer of the Ramsey sentence of $\mathscr{T}$. Allow me to unpack.

Recall $\mathscr{T}$ is our final and complete theory at the limit of empirical enquiry. The language of $\mathscr{T}$ contains *$\mathscr{T}$- terms* which are the theoretical terms implicitly defined by $\mathscr{T}$. Then there is the rest of our language which Lewis calls *$\mathscr{O}$-language* for 'old language'. $\mathscr{O}$ -

[3] Lewis (2009, pp. 204-5) tells us that the fundamental properties are those that ground objective similarity and difference, they provide a minimal base for the rest of the world's qualitative features. For more in-depth treatments of fundamental properties see Lewis (1983) and Lewis (1986, pp. 59-63).
[4] Lewis (2009, p. 205).

language is what is available to us without the term introducing theory $\mathscr{T}$. The $\mathscr{O}$-language is rich enough to describe all possible observations.[5]

Recall that all fundamental properties except aliens and idlers will be listed in $\mathscr{T}$'s inventory. Importantly, all of the fundamental properties mentioned in $\mathscr{T}$ are named by the $\mathscr{T}$- terms.[6] Now the theory $\mathscr{T}$ consists in all of the logical consequences of a sentence called the *postulate* of $\mathscr{T}$. We can write the postulate as $\mathscr{T}(t_1, \ldots, t_n)$ where $t_1, \ldots, t_n$ are the theoretical terms introduced by $\mathscr{T}$ and all of the rest of the language in the postulate is $\mathscr{O}$- language. When we replace all of the $\mathscr{T}$- terms with variables, we get $\mathscr{T}(x_1, \ldots, x_n)$. An *n*-tuple that satisfies $\mathscr{T}$ with respect to the actual world is called an *actual realization* of $\mathscr{T}$ whereas one that can satisfy $\mathscr{T}$ with respect to some possible world is a *possible realization* of $\mathscr{T}$. We then get the R*amsey sentence* of $\mathscr{T}$ when we prefix $\mathscr{T}(x_1, \ldots, x_n)$ with existential quantifiers: $\exists x_1, \ldots, \exists x_n, (x_1, \ldots, x_n)$.[7] Significantly, the Ramsey sentence of $\mathscr{T}$ implies exactly those $\mathscr{O}$- language sentences which are implied by the postulate of $\mathscr{T}$.[8] Because the $\mathscr{O}$- language is rich enough to describe all possible experiences, the predictive success of $\mathscr{T}$ will be the same as the Ramsey sentence of $\mathscr{T}$. This means that if there are multiple possible realizations of the Ramsey sentence of $\mathscr{T}$, no possible observation can tell us which one is the actual realization. This is because, no matter which one is the actual realization, the Ramsey sentence will be true and our observational evidence only gives us evidence for the truth of the Ramsey sentence.[9]

What is left to be shown is that there are in fact multiple realizations of the Ramsey sentence of $\mathscr{T}$. Lewis offers two arguments for this conclusion: the *permutation argument* and the *replacement argument*. Both rely on Lewis's acceptant of a principle of recombination. Namely, that we can take apart distinct elements of a possibility and rearrange them, we can remove some of the distinct elements, we can reduplicate some of them, and we can replace elements of some possibility with elements of others and get a new possibility.[10] It is

[5] *Ibid.* pp. 205-6.
[6] *Ibid.* p. 206.
[7] *Ibid.* p. 207.
[8] *Ibid.* p. 207, n. 6.
[9] *Ibid.* p. 207.
[10] *Ibid.* pp. 207-8. For an in-depth discussion into formulating a principle of recombination and other principles of plenitude see Bricker (MS b).

important to note that distinct elements cannot be recombined in any way possible, but that they have to be recombined in a category-preserving way.

The permutation argument starts with the assumption that we have the actual realization of $\mathscr{T}$. Then we find the members of the *n*-tuple that satisfies $\mathscr{T}$ that are fundamental and belong to multi-membered categories. Then we permute these within their categories to get a new *n*-tuple that satisfies $\mathscr{T}$. The principle of recombination is what allows us to permute these properties to get a possibility. *Quidditism*, the view that two worlds can differ merely by permutation of fundamental properties, gets us that the resulting possibility is distinct from the original possibility. Note that the argument from permutation only gets us humility insofar as there are actual fundamental properties of multi-membered categories that can be swapped. If there are only a small number of categories of fundamental properties in $\mathscr{T}$ that are multi-membered, this does not guarantee a sweeping Humility Thesis.[11] The replacement argument is designed to provide a more sweeping conclusion.

The replacement argument gets us Humility through replacing the fundamental properties in $\mathscr{T}$ with fundamental alien and idling properties of the same category. If there are alien or idling properties that fall into the same categories as the fundamental properties mentioned in $\mathscr{T}$, then recombination entails that there are distinct possibilities where some or all of the fundamental properties in $\mathscr{T}$ have been replaced with aliens or idlers of the same category. Lewis offers a few reasons to think that there will be enough alien properties to replace at least a large majority of the fundamental properties in the actual realization of $\mathscr{T}$. The reason I find the most powerful begins by noting that it is a contingent matter what fundamental properties are instantiated. And once we've appreciated this fact we should think that there is a world where more fundamental properties are instantiated than are instantiated at this world. And there is a further world with more properties instantiated at it than the second one and so on. It's implausible to think that amongst these worlds with more fundamental properties than ours that there won't be alien properties that are members of most, if not all, of the categories in the fundamental properties mentioned in $\mathscr{T}$. Thus, we have good reason to think that there are sufficiently enough alien properties

[11] Lewis (2009, 208-12).

for the replacement argument to go through. This argument gives us an argument for a much more sweeping Humility Thesis than the permutation argument.[12]

2. HUMILITY ABOUT SPATIOTEMPORAL STRUCTURE

We've seen how Lewis argues for a Humility Thesis about our knowledge of the properties our world instantiates in his arguments for Ramseyan Humility. To get to Structural Humility we need to proceed differently. One important reason for thinking this has to do with the inapplicability of recombination to structure. Lewis's arguments for Ramseyan Humility made use of recombination to swap properties around from within a world or swap properties from a different world into the structure of the old one in order to get new possibilities. We can't swap around parts of structures in the same way. Trying to use recombination to fill out the possible world structures runs into serious problems. Further, the recombination principle that Lewis uses presupposes that there is a structure to recombine the elements into. Instead, we need a different principle of plenitude for structures. I believe if we accept a plausible principle of plenitude for world structures *and* we accept some plausible views about the nature of the worlds' geometric structure, then we remain irremediably ignorant of important aspects of the worlds' geometric structure. Namely, whether the world we live in contains distinct topologically indistinguishable points and how the distinct indistinguishable points are distributed.[13]

2.1. Metric and Merely Pseudo-Metric Spaces

First, let's take a look at two different classes of geometric structures. *Metric spaces* are spaces whose topology is solely determind by a distance function that meets the following definition:

D1 $d(x,y) = 0 \Leftrightarrow x = y$	(Identity of Indiscernables)
D2 $d(x,y) = d(y,x)$	(Symmetry)
D3 $d(x,y) + d(y,z) \geq d(x,z)$	(Triangle Inequality)

3D-Euclidean spaces count as an examples of a metric space. The metric spaces are part of the larger class of *pseudo-metric spaces*. That is all metric spaces are pseudo-metric spaces but not all pseudo-metric spaces are metric spaces. The class of pseudo-metric spaces is the class of spaces whose topology is defined by a distance function that replaces D1 with:

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[12] *Ibid.* 212-4.

[13] Any distinct points, p and p^*, are *topologically indistinguishable* just in case for any open set, S, p belongs to S just in case p^* belongs to S.

D1* $x = y \Rightarrow d(x,y) = 0$ (Indiscernibility of Identicals)

In other words pseudo-metric spaces include geometric structures which have distinct points at zero-distance from one another. Call the pseudo-metric spaces which have distinct points at zero-distance from one another *merely pseudo-metric spaces*. The metric spaces and the merely pseudo-metric spaces are mutually exclusive and exhaust the class of pseudo-metric spaces. Metric spaces and merely pseudo-metric spaces only differ over whether they have *topologically indistinguishable* points or not. In metric spaces the open sets that fix the topology also uniquely determine the points in that space, in merely pseudo-metric spaces this is not the case. Moreover, in merely pseudo-metric spaces there will also be distinct topologically indistinguishable regions besides the point-sized ones. For any two distinct topologically indistinguishable regions, R and R^*, there are some distinct topologically indistinguishable points, p and p^*, such that p is in both R and R^* yet p^* is in R but not R^* (or *vice versa*).

2.2. The Possibility of Merely Pseudo-Metric Spaces

We are accustomed to thinking in terms of spaces that are metric spaces. In fact, I'd imagine most think it is constitutive of being a point that it is uniquely identified by its place in the worlds' geometric structure. The possibility of merely pseudo-metric spaces flouts this intuition. So there needs to be good reason to think that merely pseudo-metric spatial structures are possible. The best way to go about this requires providing a principled way to determine what structures are possible and which ones aren't. In "Plenitude of Possible Structures" (MSa) Bricker provides what I take to be the best method for determining the possibility of a class of world structures.

The method can be summed up as follows: First, we need to determine what structures have played an explanatory role in our theorizing about the world.[14] Here, playing an explanatory role isn't understood in sociological, but objective terms – the structures must have genuine explanatory power.[15] Determining these structures provides the base of logically possible structures from which we can generalize to other possible structures. Next, we need to determine which classes of structures are natural classes. The members of

[14] In particular Bricker tells us "[w]e have warranted belief that a structure is logically possible if that structure plays, or has played, an explanatory role in our theorizing about the actual world." (MSa, p. 5). This just gives us a base set of structures from which we will determine the who class or classes of possible structures from.
[15] Bricker (MSa, p. 6).

natural classes of structures objectively resemble each other in ways that members of classes that aren't natural don't. We determine the natural classes of structures by seeing whether or not each of them serve as a principle object of study in some major area of study in mathematics – the ones that do are the natural classes.[16] This gives us candidate natural classes of structures to generalize to as logically possible ones. Finally, not just any generalization from the base classes of structures to a natural class will count as a good generalization. Only those natural classes that are *natural generalizations* of the structures in our base count as logically possible structures.[17] Here, again, we defer to mathematicians to see what classes of structures are natural ganeralizations of others. This method gives us the following principle of plenitude:

> PRINCIPLE OF PLENITUDE OF STRUCTURES
> Suppose S is a class of logically possible structures. Any structure belonging to any natural generalization of S is logically possible.[18]

The argument for the possibility of merely pseudo-metric structures is straightforward. First, the class of Euclidean spaces, $\mathscr{E}$, is a prime example of a class of structures that have played a role in our theorizing about the actual world. So $\mathscr{E}$ is a class of logically possible structures. The class of metric spaces, $\mathscr{M}$, is a natural generalization of $\mathscr{E}$, so this means any structure in $\mathscr{M}$ is logically possible. This is the same as saying that $\mathscr{M}$ is a class of logically possible structures. Finally, the class of pseudo-metric spaces, $\mathscr{P}$, is a natural generalization of $\mathscr{M}$. Because $\mathscr{M}$ is a class of logically possible structures, and $\mathscr{P}$ is a natural generalization of $\mathscr{M}$, any structure in $\mathscr{P}$ is logically possible. All of the structures of pseudo-metric spaces are in $\mathscr{P}$. This includes all of the merely pseudo-metric spaces. So, merely pseudo-metric spaces are logically possible. Moreover, *any* merely pseudo-metric spatial structure is a logically possible one.

2.3. Undetectible Differences

Recall that Lewis's argument for Ramseyan Humility is intended to show that although we can come to know the properties of things as role-occupants this is insufficient to identify

[16] Bricker (MSa, pp. 9-10). Though, they aren't natural *because* they are the principle objects of study some major area in mathematics. Instead, they are the principle objects of study in some major area in mathematics *because* they are natural.
[17] Bricker (MSa, p. 19).
[18] Bricker (MSa, p. 19).

the role-occupier. The points, specifically, and regions, generally, in a geometric structure can likewise be thought of as role-occupants of that particular geometric structure. I would like to suggest that we can think of the difference between merely pseudo-metric and metric spaces in a similar way. The rough thought is that the distinct but topologically indistinguishable points in merely pseudo-metric spaces play the same role as the unique topologically distinguishable points in metric spaces. To put the idea slightly differently, we can't tell how complex the occupants of the point-roles in the worlds' geometric structure are. This isn't quite right, but provides us with a useful, albeit imperfect, way of drawing out the similarity between Ramseyan Humility and Structural Humility.

An important feature of merely pseudo-metric spaces is that there is a way to "convert" them into metric spaces. Recall that the only difference between a particular metric spatial structure and its equivalent merely pseudo-metric structures is that they disagree on whether or not there are distinct topologically indistinguishable points. Different merely pseudo-metric structures that are otherwise structurally the same as a given metric space will only differ on how many distinct indistinguishable points there are and the distribution of the distinct topologically distinguishable points. This could be as minimal of a difference from the corresponding metric space as there being exactly two points in a merely pseudo-metric structure that are topologically indistinguishable to all of the points being topologically indistinguishable from some other distinct points. Some pseudo-metric spaces may uniformly increase the topologically indistinguishable points, so that for each distinguishable point in the metric space, there are 2, or 3, or 4, … indistinguishable points in the merely pseudo-metric space. Or, the increase could be non-uniform. Nevertheless, each of these merely pseudo-metric spaces can be converted into metric spaces by treating the pluralities, or fusions, or sets of distinct topologically indistinguishable points in a merely pseudo-metric space as single points in a metric space.

To see this, let X be a merely pseudo-metric space. Let $x \sim y$ just in case $d(x, y) = 0$ (*i.e.* just in case x and y are topologically indistinguishable in X). So any points stand in the equivalence relation '$\sim$' if they are zero distance from each other according to the distance function, d, defined on X. We can then define a new space X^* where $X^* = X/\sim$. In the new space, X^*, each of the points are equivalence classes of points in X, represented as $[x]$, $[y]$. We define a distance function d^*: $X/\sim \times X/\sim \to \mathbb{R}_+$ such that $d^*([x], [y]) = d(x, y)$. We can see that d^* is a metric and X^* is a metric space. For, we already know that d^* will satisfy D1*, D2 and D3 of the definition of a metric above, and, further, because $x \sim y$ if and only if $d(x, y) = 0$, then $d^*([x], [y]) = 0$ if and only if $[x] = [y]$. So D1 will be satisfied. The space X^* is called the *metric identification* of X.[19]

Through metric identification, it seems like *any* theory that is cast in terms of a metric structure could be cast in terms of a merely pseudo-metric structure. Where the metric theory has simple, singular, and distinguishable points filling the roles of the point-sized regions, the merely-pseudo-metric theory will have pluralities of distinct indistinguishable points or their fusions filling these roles. Further, no matter which way the world turned out it seems we would be none the wiser. The pluralities of distinct indistinguishable points in the pseudo-metric version of the theory will do the same work in the theory's predictions as will the single distinguishable points in the metric version of the theory. Same predictive work, same amount of confirmation. If this is right, then there is an important part of the worlds' geometric structure we will remain forever ignorant of.

Now, I'd imagine that one might want to object that we would *have no reason* to posit the extra indistinguishable points that the pseudo-metric version of the theory does. This is because simplicity dictates that we should accept the simpler of the two versions of the theory. Because the pseudo-metric version of the theory makes unnecessary posits, then we should prefer the metric version of the theory. I do not find this objection compelling. We are interested in what we can know. If the sense of 'prefer' here has to do with knowledge, then the objector has to tell us how we could know that the world is simpler in this way. But, this is *just what I've argued we couldn't do.* Perhaps they might say that we could, in principle, build some detection device that could detect whether or not indistinguishable points or regions were present. Assume that one could build such a device. This device would have to operate based off of some sort of *causal connection* with the distinct indistinguishable regions that allowed it to detect when multiple regions take the same position in spacetime. Even if this were possible, this would still leave undetermined important facts about the worlds geometric structure. Any theory, T, by which our detection device would work, would have to spell out what the causal conditions were whereby it would be able to detect the presence of multiple indistinguishable points. Note that theory T will only distinguish topologically distinguishable points by the causal role that they play. So we only come to know and identify the points by the causal role they play. Now, imagine a different theory, T^*, which is identical to T *except* that whenever the causal roles are filled that allows us to detect the presence of distinct topologically

[19] For a more thoroughly spelled out version of this proof see Simon (2015, pp. 3-4).

indistinguishable points, according to T, in T^* that role is filled by pairs of topologically indistinguishable points. Our detection device would operate in much the same way, and would be able to detect some instances of distinct topologically indistinguishable regions, but it would be none the wiser as to whether it was in a T world or a T^* world. The thrust of the idea here is that if we have a theory that makes some claim about the points and how they are distinguished, we can replace it with a theory where pluralities or complexes of points of whatever number are playing those exact same roles. Because of this we will forever remain unable to know important features of our worlds' geometric structure.

It is important to notice that this argument takes seriously the idea that the spatiotemporal structure of the world includes something like points. How seriously must we take the existence of points to get Structural Humility off of the ground? Not very, I think. There are three major contenders in the debate over the nature of spacetime: substantivalism, ontic-structural realism ('structuralism' henceforth), and relationalism. None escape Structural Humility. Let me briefly explain why. Substantivalists of all stripes take the worlds' spacetime to be fundamental, independent thing. This means the substantivalist takes regions and the spacetime structure as fundamental. Substantivalists will agree that spacetime is made up of points connected in a structure of spatiotemporal relations. Since points are genuine objects according to the spacetime substantivalist, the world structures that are strictly pseudo-metric will be understood in terms of real, physical, distinct topologically indistinguishable points and the threat of Structural Humility will loom. Structuralists, on the other hand, don't take points very seriously at all. For them, the spatiotemporal structure is fundamental, and the points are, at best, placeholders in the structure lacking intrinsic natures, and, at worst, just places or intersections in the series of relations that constitute the worlds' spatiotemporal structure.[20] However, structuralists still have to worry about Structural Humility. Roughly, the structuralist maintains the relational structure posited by the substantivalist but loses the points.[21] So a world with a pseudo-metric structure, for the structuralist, will have distinct indistinguishable places within its structure. How many of these there are, or how they're distributed will remain forever unknown to us. Finally, the relationalist takes the worlds' spatiotemporal structure to be dependent upon the material objects and the fundamental spatiotemporal relations they

[20] See Esfeld and Lam (2007) for an overview about ontic structural realism and a defense of a moderate structuralism about spaceime.

[21] For example, see Esfeld and Lam (2008, pp.42-3).

stand in. For the relationist the problem arises when we have co-located material objects that are constantly adjoined throughout their existence.

3. Concluding Thoughts: Structuralism and Humility

So far we've reviewed how Lewis argued for our irremediable ignorance of the identities of many of the properties in the world and I've argued that a similar Humility Thesis about the geometric structure of the world can be seen to follow from some important ontologies of spacetime. The worry was that we are irremediably ignorant of the existence and distribution of indistinguishable regions. This kind of Humility afflicted both substantivalists and structuralists about spacetime but not relationalists. Before closing the paper I would like to briefly note how Structural Humility relates to a kind of strategy that has been used to motivate structuralism.

Structuralism about spacetime is of a piece with a broader ontic structural realist project which seeks to downplay the importance of objects and inflate the importance of structure. Structure is generally treated as being fundamental and objects are taken to be eliminated, reduced to, grounded in, or dependent upon fundamental structure.[22] One important motivation for structuralism is the following kind of consideration:

> **Epistemelogical-Ontological Coherence (EOC)**
> Our metaphysics should be coherent with our epistemology. Metaphysics that posit entities that lead to unknowable gaps between our metaphysics and epistemology should be done away with. We shouldn't deny ourselves in principle epistemic access portions of (physical) reality. Only structuralism avoids a metaphysics which entails epistemic gaps.[23]

Other motivations for structuralisms in various areas of ontology exploit similar considerations.[24] Motivations, like EOC, can just be seen as denials of a particular Humility Thesis. In the case of EOC the denial of Humility is broad and global. So, if this kind of motivation for structuralism holds water, then structuralism better be able to avoid Humility Theses of any variety. However, if what I've said above is right, then structuralism

[22] See Frigg and Votsis (2011) for a wonderful overview of the varieties of ontic structural realism. Ladyman (1998) and French (1998), depending on how they are read, can be seen as advocating either an eliminative or reductionist approach. MacKenzie (2018) provides a grounding based understanding of ontic structural realism. And Esfeld and Lam (2008) and Mackenzie (2013) offer versions of structuralism where the relation between objects and structures should be understood in terms of dependence that isn't grounding.

[23] This formulation roughly follows Esfeld and Lam (2008, p. 30). See also Esfeld (2004, pp. 614-6),

[24] See for example, Jantzen's (2011, pp. 435-9) discussion of how standard or naïve realism falls prey to worries about making our physical theories incomplete while structuralism avoids this problem.

cannot avoid Humility across the board – it runs into Structural Humility. As such, considerations about of Structural Humility undercut one important motivation for the ontic structural realist project.

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