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The 'Properties' of Leibnizian Space: Whither Relationism?

Edward Slowik

One of the nagging puzzles that vexes Leibniz scholars, whether from the space–time or Early Modern communities, is the problematic fit between relationism and his conception of space. Long ago, C.D. Broad hinted at the unsuitability of a spatial relationist interpretation, but the treatment of Leibniz's spatial hypotheses in many canonical texts (in the philosophy of space and time) has continued to portray Leibniz as having sanctioned a straightforwardly contemporary version of relationism.[1] One of these modern forms of relationism – that space is a mere relation among bodies, but that these relations may include within their scope possibilia or non-actual bodies – is still often defended,[2] while others promote the more traditional and restrictive conception of relationism, which insists that all spatial relations are directly grounded *within* material bodies, such that there are no spatial relations that are external to, or between, material bodies. Leibniz's denial of a vacuum (empty space) might lend support to this reductive relationist interpretation.[3] Yet, in this essay, not only will the majority of the relationisms typically offered as interpretations of Leibniz's theory be revealed as inadequate to the task, but the very viability of relationism will be called into question with respect to Leibnizian space. As will be demonstrated, the underlying metaphysics of Leibniz's theory requires a different set of conceptual resources, despite the obvious fact that the aftermath of the debates with the absolutists of his day (e.g. the Leibniz–Clarke correspondence) set in stone an idea of Leibnizian space that continues to mislead philosophers. While the conclusions of this essay may strike the reader as rather controversial, the preponderance of the evidence that we will present has played a major role in the metaphysical investigations of Leibniz for, roughly, the past 25 years. Unfortunately, the lessons to be gathered from this research have not been sufficiently assimilated by the space–time crowd in their analysis of the foundations of Leibnizian space, but neither have the subtleties

[1] C.D. Broad, 'Leibniz's Last Controversy with the Newtonians' in *Leibniz: Metaphysics and Philosophy of Science*, edited by R.S. Woolhouse (Oxford: Oxford University Press, 1981 [1946]), 157–174 (171–173); L. Sklar, *Space, Time, and Spacetime* (Berkeley, CA: University of California Press, 1974), 169; M. Friedman, *Foundations of Space-Time Theories* (Princeton, NJ: Princeton University Press, 1983), 219; see also S. Auyang, *How is Quantum Field Theory Possible?* (New York, NY: Oxford University Press, 1995), 247.

[2] E. Khamara, 'Leibniz's Theory of Space: A Reconstruction', *Philosophical Quarterly*, 43 (1993), 472–488 (478); G. Belot, *Geometric Possibility* (Oxford: Oxford University Press, 2011), 173–185.

[3] See, for example, M.J. Futch, *Leibniz's Metaphysics of Time and Space* (Berlin: Springer-Verlag, 2008), 48; and generally for relationists, C. Hooker, 'The Relational Doctrines of Space and Time', *British Journal for the Philosophy of Science*, 22 (1971), 97–130 (111).

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of Leibniz's concepts been properly factored into various metaphysical and historical appraisals. Part of the goal of this essay, in fact, is to remedy this unfortunate oversight.

In the first section, the various brands of relationism are compared and contrasted with Leibniz's spatial hypotheses, with the surprising result that most are either entirely inadequate, or, at best, only tangentially relevant to his deeper metaphysical design. In the second section, God's foundational role as the ontological basis of space will be revealed, along with an analysis of the substance/accident dichotomy, quantity and order of situations, and the holism or monism of both geometry and the material world's interconnections. In essence, a case will be made that the most plausible form of spatial theory consistent with Leibniz's spatial hypotheses is a unique form of property theory, albeit a property theory that resembles relationism on a few important issues.

Furthermore, throughout this essay, we will largely confine our analysis to the metaphysical level of material bodies, and substance/accident/relation metaphysics, since a thorough treatment of the intricacies of the monadic component of Leibniz's theory requires a separate investigation. Yet, various hints as to how the monadic realm connects with the material realm will be briefly considered in the concluding third section. This choice, to specifically focus upon the level of bodies, is in keeping with both the traditional substantival/relational dispute in ontology, and, more importantly, with the form of the debate as manifested in the Leibniz–Clarke correspondence, his most significant and detailed contribution to the philosophy of space. In short, the late correspondence with Clarke fails to bring into play the underlying monadic foundation of Leibniz's philosophy, thus partly justifying our exclusive investigation of the more commonplace ontological themes associated with material substances, accidents, and God. Nevertheless, a complete account of Leibniz's views on space must ultimately explicate the monadic basis, and thus the ensuing analysis is but the first half of this larger story.

RELATIONISM AND LEIBNIZIAN SPACE

In this section, which engages the commentary of a number of important contemporary studies (Arthur, Futch, Belot, De Risi, etc.), Leibniz's theory of space is weighed against various forms of relationism. The Leibnizian corpus relevant to our investigation will largely be drawn from 1700 onward, with special attention dedicated to the *New Essays* and the Leibniz–Clarke correspondence, although assorted works from earlier periods will also figure prominently.[4]

[4] Citations to original works will list the original source on its first appearance but not after, followed by an English language translation, when available. [C]: *Opuscules et fragments inédits de Leibniz*, edited by L. Couturat (Paris, 1903); [A]: *Sämtliche Schriften und Briefe*, edited by Akademie der Wissenschaften der DDR (Darmstadt and Berlin: Akademie-Verlag, 1923), cited with series, volume, and page; [GM]: *Leibnizens mathematische schriften*, edited by C.I. Gerhardt (Hildesheim: Olms, 1962), cited with volume and page; [G]: *Die philosophischen schriften von Leibniz*, edited by C.I. Gerhardt (C.I. Hildesheim: Olms, 1965), cited with volume and page; [L]: *Leibniz: philosophical letters and papers*, edited and translated by L.E. Loemker, second edition (Dordrecht: Kluwer, 1969); [AT]: R. Descartes, *Oeuvres de Descartes*, edited by C. Adams and P. Tannery (Paris: J. Vrin, 1976), cited with volume and page; [AG]: *Leibniz: philosophical essays*, edited and translated by R. Ariew and D. Garber (Indianapolis, IN: Hackett, 1989); [MP]: *Leibniz: Philosophical Writings*, edited and translated by M. Morris and G.H.R. Parkinson (Rutland, VT: C. Tuttle, 1995); [NE]: *New Essay on Human Understanding*, edited and translated by P. Remnant and J. Bennett (Cambridge: Cambridge University Press, 1996), cited with book, chapter, and section; [LC]: *Leibniz and Clarke Correspondence*, edited and translated by R. Ariew (Indianapolis, IN: Hackett, 2000), cited with author, [L] or [C], letter, and section; [LoC]: *The Labyrinth of the Continuum: Writings of 1672 to 1686*, edited and translated by R. Arthur (New Haven, CT: Yale University Press, 2001).

RELATIONISM AND UNIVERSAL PLACE

Providing a precise definition of substantivalism and relationism is a daunting task in its own right, but, for our purposes, we will deem substantivalism, or absolutism, as the view that space is an independently existing entity of some sort, such that the geometry of space is independent of bodies (e.g., distance relations are between the parts of space, with the distance relations among bodies supervening on these independent geometric facts). A central tenet of relationism is the rejection of substantivalism (or absolutism), thus, at least on this point, Leibniz's philosophical inclinations side with the relationists. In many writings, Leibniz clearly rejects the view that space is an entity that exists separate or apart from material things, but, unlike Descartes, he rejects the thesis that space is identical with matter: 'I do not say that matter and space are the same thing. I only say that there is no space where there is no matter and that space in itself is not an absolute reality'.[5]

Nevertheless, other approaches to space and time, such as the property theory, also deny the substantivalist creed (as will be explained below), so the rejection of substantivalism does not necessarily equate with relationism. Furthermore, relationism comes in many flavors, and so the question remains as to which type Leibniz subscribes, if any. One version is a strictly reductive, non-modal relationism, the main feature being the reduction of spatial facts to material facts and relations, whether those spatial facts possess a quantitative/geometric component or not. Another way to view this option is to claim that all spatial facts are necessarily obtained within matter, so that there can be no materially unsupported spatial facts that are external to the confines of corporeal existents, as in a vacuum. Descartes was the foremost proponent of this view, denying that a vacuum was possible whether internal or external to the terrestrial realm.[6] Yet, on several occasions, Leibniz insists that the vacuum is a possible, although not actual, state of affairs: 'I don't say that the vacuum, the atom, and other things of this sort are impossible, but only that they are not in agreement with divine wisdom'.[7] Nevertheless, in explaining away the possibility of a vacuum, Leibniz provides other, more potent, rationales, besides divine wisdom, to guarantee the fullness of space, the most important being that a vacuum would violate the principle of the identity of the indiscernibles (PII), because the empty parts of space would be intrinsically identical: 'Space being uniform, there can be neither any external nor internal reason by which to distinguish its parts and to make any choice among them'.[8] Yet, if one assumes that the structure of space is Euclidean, and hence infinite, as Leibniz presumably did (see footnote 70), then his admission that the material world could be finite if God had so desired raises obstacles for any non-vacuum version of reductive relationism, e.g. '[a]bsolutely speaking, it appears that God can make the material universe finite in extension […]'.[9] Likewise, the various hypothetical scenarios envisaged in the *New Essays*, which discuss indirect methods of measuring a vacuum within the material world (as opposed to outside the world; see, once again, footnote 70), would also seem to refute a non-vacuum reductive relationism.

Given the existence of these texts, it is thus not surprising that the type of relationism often associated with Leibniz takes a modal form, thereby equipping space with a full panoply of

[5] G.VII.345–440; LC: L.V.62.
[6] For example, Descartes, *Principles of Philosophy*, II.16; AT VIIIA 49.
[7] To J. Bernoulli, January 1699, GM.III.565; AG 170.
[8] LC: L.IV.17.
[9] LC: L.V.30.

relations, despite the (possible) presence of matter-less regions. Earman's well-known characterization of spatial relationism, dubbed (R2), can be interpreted as consistent with modal relationism, as long as the spatial relations involving 'potential bodies', as we may call them, are grounded upon existing bodies and their spatial relations.

> (R2): spatial relations among bodies are direct; that is, they are not parasitic on relations among a substratum of space points/places that underlie bodies; but, (i) these spatial relations need not be confined internally to bodies/fields, and (ii) the spatial relations that incorporate potential bodies are based on, and derived from, the relations among actual bodies.[10]

Nevertheless, a close inspection of Leibniz's writings casts doubt on the viability of even this relationist construal, although spelling out the problems will take a considerable degree of elaboration.

Consider the following description of 'place' from the *New Essays*, delivered by Leibniz' spokesman, Theophilus:

> [(a)] 'Place' is either *particular*, as considered in relation to this or that body, or *universal*; the latter is related to everything, and in terms of it all changes of every body whatsoever are taken into account. If there were nothing fixed in the universe, the place of each thing would still be determined by reasoning, if there were a means of keeping a record of all the changes or if the memory of a created being were adequate to retain them—as the Arabs are said to play chess on horseback by memory. However, what we cannot grasp is nevertheless determinate in the truth of things.[11]

While it may seem innocent enough at first glance, passage (a) plays havoc with the prospects of a clear-cut, *body-centered* version of (R2) relationism as regards Leibniz's theory of space (where '*space* is that which results from places taken together'[12]). In the discussion that directly precedes (a), Philalethes, Locke's representative, contends that 'same place' is relative to different contexts, and can thus be applied, for instance, to a chess board in a ship: 'The chess-board, we also say, is in the *same place* […] if it remains in the same part of the cabin, though, perhaps, the ship which it is in [has set sail …]'.[13] Leibniz responds, in (a), by referring to Philalethes' genuinely body-based relational conception as 'particular' place, 'in relation to this or that body', and goes on to contrast this idea with a 'universal' notion of place, such that it 'is related to everything, and in terms of it all changes of every body whatsoever are taken into account'. Leibniz's claim that 'if there were nothing fixed in the universe, the place of each thing would still be determined by reasoning' is deeply antithetical to relationism, needless to say, and mimics Newton's absolutist conception of place in the *Principia*.[14] Put simply, a straightforward relationist must define the notion of, say, 'same place' with respect to a material reference frame: they cannot, as does Leibniz, countenance the possibility that there may be no fixed material frames at all, yet insist that the same place is still 'determinate in the truth of things' – determinate with respect to what? Leibniz's claim, therefore, implies that there is something

[10] This definition is paraphrased, for our purposes, from J. Earman, *World Enough and Space-Time* (Cambridge, MA: MIT Press, 1989), 12.
[11] G.V.39–509; NE: II.xiii.8.
[12] LC: L.V.47.
[13] NE: II.xiii.8.
[14] I. Newton, *Philosophical Writings*, translated and edited by A. Janiak and C. Johnson (Cambridge: Cambridge University Press, 2004), 66.

else besides material existents, his universal place, which records all bodily changes of place, and this runs counter to all but the most liberal brands of relationism (see the following sections). Of course, Leibniz would deny that this framework, universal place, is an independent entity that can exist apart from matter; rather, it is simply an internal feature of some sort in bodies (or monads) that, presumably, allows a reconstruction of the prior places that bodies had occupied. Yet, while this last inference is correct, it still falls afoul of relationist doctrine, since any record or memory of a universal place within matter, a record by means of which 'all changes of every body whatsoever are taken into account', is, once again, akin to absolute place – although it is absolute space reinterpreted as an internal feature of each body.

Before proceeding further, it is worth pointing out that the more elaborate and better-known arguments concerning space in the Leibniz–Clarke correspondence do not undermine the concept of universal place put forth in the *New Essays*. In fact, his analysis of 'fixed existents', as well as other passages, would seem to confirm the continuing applicability of universal place. After defining place via the relation of a body to 'other existents which are supposed to continue fixed' over a period of time, Leibniz states that '*fixed existents* are those in which there has been no cause of any change of the order of their existence with others, or (which is the same thing) in which has there has been no motion'.[15] Leibniz's various references to 'suppose to continue fixed' could thus be taken as signifying a body-centered framework for determining place, which allows Galilean transformations to all equivalent, inertially-related frameworks (i.e. 'suppose' means that the ensemble may be itself moving uniformly or at rest, relative to other ensembles).[16] Yet, Leibniz explains the meaning of this supposition in his fifth letter:

> And supposing or feigning that among those coexistents there is a sufficient number of them which have undergone no change, then we may say that those which have such a relation to those fixed existents as others had to them before, have now the *same place* which those others had.[17]

In other words, the supposition is that there are any fixed existents at all, which is verified by his reference to 'a sufficient number of them [unchanged bodies]' needed to establish 'same place', as well as by his later defense of the validity of rest: 'It is true that, exactly speaking, there is not any one body that is perfectly and entirely at rest, but we frame an abstract notion of rest by considering the thing mathematically'.[18] This last description parallels the assertion from the *New Essays*,

[15] LC: L.V.47.

[16] The following characterization of 'same place' by R. Arthur, on the other hand, seems entirely appropriate, and does not bring into play Galilean transformations: 'Thus the hypothesis of fixed existents allows us to define *place* in terms of an equivalence: it is the equivalence class of all things that bear the same situation to our (fictitious) fixed existents. And when we take all possible situations relative to these fixed existents, we have a manifold of places, or abstract space', R.T.W. Arthur, 'Space and Relativity in Newton and Leibniz', *British Journal for the Philosophy of Science*, 45 (1994), 219–240 (237). On a similar note, it should be mentioned that the findings in above present obstacles to line of thought present in several contemporary assessments of Leibniz's theory, i.e. that Leibniz's space is relational, or quasi-relational, but that his treatment of motion is absolute; see, e.g., J.W. Cook, 'A Reappraisal of Leibniz's Views on Space, Time, and Motion', *Philosophical Investigations*, 2 (1979), 22–63; J.T. Roberts, 'Leibniz on force and absolute motion', *Philosophy of Science*, 70 (2003), 553–573. A full assessment of relational motion as regards Leibniz is beyond the bounds of this essay, but, for a careful analysis, see P. Lodge, 'Leibniz on Relativity and the Motion of Bodies', *Philosophical Topics*, 31 (2003), 277–308. On the whole, De Risi and Arthur have contributed greatly to the cause of disassociating Leibniz from the traditional, reductive, and external relationism that most modern philosophers of space and time have tended to read into his philosophy.

[17] LC: L.V.46.

[18] LC: L.V.49.

examined above, which upholds universal place: 'if there were nothing fixed in the universe, the place of each thing would still be determined by reasoning'. Finally, and more importantly, the explication of particular place in the *New Essays* brings into play inertially related frames, e.g. the stationary chess board on the moving ship, but he proceeds to contrast this bodily-centered notion of place with universal place. In summary, there is no evidence in the correspondence with Clarke to read 'fixed existents' as denoting a (Galilean) system of inertial reference frames, nor to overturn the concept of universal place.

UNIVERSAL PLACE AND THE PROPERTY THEORY

One way to grasp how a body-centered (R2) relationism conflicts with Leibniz's theory is to focus on the fact that universal place allows bodies to occupy different positions/places, despite the fact that these bodies could bear the same relations of co-existence among existing (and potentially existing) bodies (with 'co-existence' being Leibniz's preferred manner of describing bodies that exist at the same time[19]). That is, the 'directness' of the spatial relations mandated by (R2) relationism is violated, *even granting* the modality involved with potentially co-existing bodies. For example, suppose a body, A, stands one meter to the right of bodies C, E, F, G, and that these five bodies alone comprise the material universe. If A_0, E_0, C_0, F_0, and G_0 symbolize this initial configuration, and A is moved one meter further to the right, to new position A_1, after which E_0, C_0, F_0, and G_0 are moved one meter to the right as well, to new positions E_1, C_1, F_1, and G_1, then the initial and final states of this relative configuration are identical for a traditional body-centered (R2) relationist: that is, A_0, E_0, C_0, F_0, $G_0 = A_1$, E_1, C_1, F_1, G_1; and this identity also holds for all of the potential bodily positions defined relative to A, E, C, F and G. But, Leibniz's insistence in (a), 'that the place of each thing would still be determined by reasoning, if there were a means of keeping a record of all the changes', means that the initial and final relative configurations *do* indeed occupy different positions in universal place, since these changes are capable of being recorded via the distinct motions/forces applied to the bodies (first to A, and then to the others). Thus, A_0, E_0, C_0, F_0, $G_0 \neq A_1$, E_1, C_1, F_1, G_1, which implies that there is an aspect of spatiality – 'determinate in the truth of things', as noted in (a) – that is *not* a direct relation among bodies (and potential bodies), due to the fact that a body's position bears a truth value, so to speak, *relative* to universal place ('in terms of it all changes of every body whatsoever are taken into account'). Nevertheless, as mentioned above, since Leibniz appeals to the 'truth of things', the truths of universal place are apparently retained by the bodies themselves, and so it would not be correct to infer that universal place amounts to an independent entity that exists apart from material existents.

The ramifications of universal place in (a) are quite profound when assessing the content of Leibniz's theory. In short, our conclusion that A_0, E_0, C_0, F_0, $G_0 \neq A_1$, E_1, C_1, F_1, G_1 entails that the following (paraphrased) relationist thesis must be rejected:

> (R3): No irreducible, individual bodily spatiotemporal properties, like "is located at spatial point *p*", appear in a correct analysis of the spatiotemporal idiom.[20]

[19] For example, LC: L.V.47.
[20] Earman, *World Enough and Space-Time*, 13.

Because $A_0 \neq A_1$, etc., irreducible spatial locations do figure into Leibniz's account; hence, Leibniz appears to endorse ~(R3), contra relationism and Earman's interpretation of Leibniz.[21] As a last ditch maneuver, the relationist can accept a minimalist interpretation of (R2), which we will dub (R2*), which simply rejects the independent existence of space apart from all matter; i.e. without requiring that all spatial relations and facts are obtained *directly* within or among bodies (thus the existence of, say, one minuscule body, is enough to ground all spatial relations, even if infinite in scope). In other words, a universal frame of some sort can now be associated with material existents, and bodies can now occupy places relative to this framework in accordance with ~(R3). Thus, even universal place, (a), is consistent with (R2*), and, by this means, modal relationism can be secured.[22] Yet, this strategy prompts the question of whether or not (R2*) is really a relational view, since it is consistent with ~(R3). (Whether or not (R2*) is consistent with relationism is beyond the bounds of this essay, however.) As will be seen in the following section, there are alternative conceptual resources that more closely fit the peculiarities of Leibniz's approach to space, and his version of ~(R3), regardless of the general applicability of the far too loose and hazy (R2*) classification. (Hint: Earman considers ~(R3) to be a major component of a property theory of space.[23])

Nevertheless, it is important to add that Leibniz's alleged endorsement of ~(R3) is limited in various ways (as will be discussed later in this paper), and so Leibniz's sanction of ~(R3) is only partial and confined to certain cases. Specifically, a new position in space that preserves the relative configuration of all bodies (static shift), or adding a uniform velocity to all bodies (kinematic shift), would result in all bodies having a different position in space. Hence, a true property theory of space would side with the absolutist, in claiming that the outcome of a static or kinematic shift is a different state of affairs; namely, each body now occupies a different place. Yet, Leibniz denies this inference,[24] and, in fact, uses it as a means to attack absolute space. Consequently, Leibniz's sanction of ~(R3) does not include the shift scenarios, and so his conception is only partially consistent with a property theory.

RELATIONAL MOTION TO THE RESCUE?

If a variety of Leibnizian hypotheses on space appear hostile to relationism, a natural defense is to invoke his allegedly relationally pure theory of motion, and thereby indirectly defend relational space (since motion is change of place, and hence relational motion requires relational place). Leibniz contends that

> [i]f we consider only what motion contains precisely and formally, that is, change of place, motion is not something entirely real, and when several bodies change position among themselves, it is not possible to determine, merely from a consideration of these changes, to which body we should attribute motion or rest […].[25]

[21] Earman, *World Enough and Space-Time*, 14.

[22] This minimalist interpretation, (R2*), is presumed in and all earlier works by the author, but included within the general (R2) category. For instance, E.Slowik, 'The "Dynamics" of Leibnizian Relationism: Reference Frames and Force in Leibniz's Plenum', *Studies in History and Philosophy of Modern Physics*, 37 (2006), 617–634.

[23] Earman, *World Enough and Space-Time*, 14–15.

[24] LC: L.III.5.

[25] Leibniz, *Discourse on Metaphysics*, 18; G.IV.427–63; AG 51.

Consequently, a central tenet of Leibniz's conception of motion is relational. Nevertheless, his puzzling conviction that considerations of force, or cause of motion, break the symmetry of a kinematically-conceived relational transfer, so that the bodies can be assigned individual speeds relative to a specific hypothesis (e.g. conservation of mv^2), does not inspire much confidence in this latest gambit to salvage relational space (nor does his insistence that all motion is rectilinear, or that mv^2 is conserved[26]):

> I grant there is a difference between an absolute true motion of a body and a mere relative change of its situation with respect to another body. For when the immediate cause of the change is in the body, that body is truly in motion, and then the situation of other bodies, with respect to it will be changed consequently, though the cause of that change is not in them.[27]

Leibnizian dynamics, as the analysis of motion under the action of forces, is thus as relationally problematic as Leibniz's universal place. Although these issues are not the focus of this essay, the 'reality' of force, or cause of change, resides in substances/monads, with the reality of motion reducible to force. In the mid 1690s, he writes that 'if motion, or rather the motive force of bodies, is something real […] it would need to have a subject'.[28] What has not been previously noted, however, is that passage (a), which posits universal place, would seem to represent the spatial framework relative to which the 'true motion' of a body can be measured, that is, once the true cause of the motion is determined. After claiming that 'change of place, [or] motion is not something entirely real', Leibniz adds: '[b]ut the force or proximate cause of these changes is something more real, and there is sufficient basis to attribute it to one body more than another'.[29] Hence, the need to attribute a concept of 'absolute speed' to Leibniz,[30] besides contradicting the texts (e.g. 'motion is not something absolute, but consists in a relation'[31]), is entirely unnecessary, since universal place has the capacity to determine these motions once a knowledge of the underlying forces is furnished.

THE METAPHYSICAL FOUNDATION OF LEIBNIZIAN SPACE

In this section, we will explore the ontological basis of Leibniz's theory of space, and, by this means, the non-relational features latent in his natural philosophy work will be explained.

THE IMMENSUM

Among the many historical items brought to light in Richard Arthur's revelatory study (LoC), one of the most intriguing is that Leibniz's early work on space, circa 1670s, was predisposed towards a view resembling Spinozism in some ways, or even neo-Platonism, in that God serves directly as the underlying ontology of space. Material bodies form the geometric contours of space, as in standard Cartesianism, with the continuous flux of the matter in the plenum resulting in

[26] For example, Leibniz, *Specimen Dynamicum*; GM.VI.234-254; AG 135.
[27] LC: L.V.53; also AG 51.
[28] To Huygens, June 1694, GM.II.185; AG 308.
[29] AG 51.
[30] For example, Roberts, 'Leibniz on force and absolute motion'.
[31] C 590–593; AG 92.

space's constant change. Yet, the ontological foundation of space, termed the 'immensum', does not change, unlike its body-dependent individuation into diverse shapes: 'But there is something in space which remains through the changes, and this is eternal: it is nothing other than the immensity of God, namely an attribute that is one and indivisible, and at the same time immense'.[32] In a slightly later work, he adds:

> [(b)] Space, by the very fact that it is dissected into parts, is changeable, and variously dissected; indeed, it is continuously one thing after another. But the basis of space, the extended per se, is indivisible, and remains during changes; it does not change, since it pervades everything. Therefore place is not its part, but a modification of it arising from the addition of matter […] [I]t is the immensum which persists during continuous change of space […] [T]he immensum is not an interval, nor is it a place, nor is it changeable; its modification occur not by any change in it, but by the superaddition of something else, namely of bulk, i.e., mass; from the addition of bulk and mass there result spaces, places, and intervals, whose aggregates give Universal Space. But this universal space is an entity by aggregation, and is continuously variable; in other words, it is a composite of space empty and full, like a net, and this net continuously receives another form, and thus changes; but what persists through this change is the immensum itself. But the immensum itself is God insofar as he is thought to be everywhere […][33]

It is important to note that Leibniz's tendency to view God as the foundation of space persists even as late as the mid-1680s, despite the rise of both his force-based notion of matter (e.g. endeavor or appetite) and the categorization of space as a 'real relation':

> [(c)] Time and place, or duration and space, are real relations, i.e. orders of existing. Their foundation in reality is divine magnitude, to wit, eternity and immensity. For if to space or magnitude is added appetite, or, what comes to the same thing, endeavor, and consequently action too, already something substantial is introduced, which is in nothing other than God or the primary unity. That is to say, real space in itself is something that is one, indivisible, immutable; and it contains not only existences but also possibilities, since in itself, with appetite removed, it is indifferent to different ways of being dissected. But if appetite is added to space, it makes existing substances, and thus matter, i.e., the aggregate of infinite unities.[34]

In the transition from (b) to (c), bodies no longer 'dissect' the one, indivisible, and immutable 'real space' (which is associated with 'divine magnitude') into its changeable, aggregate structure; rather, endeavors now fill this role, with bodies and their 'real relations' (space, time, etc.) as further derived results.

One might think that these Spinozistic tendencies would have been long since abandoned by the time of Leibniz's mature monadic writings (post mid-1690s), but there are a number of discussions in this period that are strongly reminiscent of the immensum. In what follows, we will largely confine our examination to the *New Essays*, given the importance of universal place in (a), throughout our discussion. After commenting that space's 'truth and reality are grounded in God, like all eternal truths', Leibniz responds to the query whether 'space is God or that it is only an order or relation' by having his mouth-piece, Theophilus, state: 'the best way of putting it is that space is an order but that God is the source'.[35] At greater length, he argues:

[32] A.VI.iii.391; LoC 55.
[33] A.VI.iii.519; LoC 119–121.
[34] A.VI.iv.1641; LoC 335.
[35] NE: II.xiii.17.

> [(d)] If God were extended he would have parts. But duration confers parts only on his operations. Where space is in question, we must attribute immensity to God, and this also gives parts and order to his immediate operations. He is the source of possibilities and of existents alike, the one by his essence and the other by his will. So that space like time derives its reality only from him, and he can fill up the void whenever he pleases. It is in this way that he is omnipresent.[36]

The upshot of this illuminating quote is that space (and time) obtain their 'reality only from [God]', that God's 'essence' is responsible for the *possibility* of any existing thing in space (more on this below), and that his will can fill up any void. A bit later, he adds that 'absolutes are nothing but the attributes of God', and that the 'idea of the absolute, with reference to space, is just the idea of the immensity of God and thus of other things';[37] with 'absolute' defined as 'an attribute with no limits'. In addition, it is God's 'immediate operations' that can be assigned spatial parts, and not God's immensity per se. Leibniz goes on to characterize this divine omnipresence, and link it to continuous conservation, using the Scholastic terminology of '*ubeity*, or ways of being somewhere': 'The third kind of ubeity is *repletive.* God is said to have it, because he fills the entire universe in a more perfect way than minds fill bodies for he operates immediately on all created things, continually producing them […]'.[38]

Leibniz contrasts his favored way of God's 'being somewhere' with two other views: first, circumscriptive ubeity, which he defines as a 'point for point' matching that 'depends upon being able to specify points in the located thing corresponding to points in space'; and, second, definitive ubeity, where the 'located thing lies within a given space without being able to specify exact points or places'.[39] Without digressing into a lengthy analysis, it should be noted that the first form of ubeity is central to the thought of the Cambridge neo-Platonists, such as More, Raphson, and almost certainly Newton (at least in his early *De gravitatione*),[40] since God and other incorporeal substances are held to be extended in the same way as corporeal substance (but without being divisible, impenetrable, etc., like matter). Other philosophers, such as the Gassendist, Walter Charleton, had argued that lesser spirits were in space only within definite regions, which he correlates with definitive ubeity.[41] In the correspondence,[42] Leibniz also rejects the 'whole being in every part of space' doctrine, popular among the Gassendists and various Scholastics in relating incorporeal beings to space, a view dubbed 'holenmerism' by More.[43] In contrast, Leibniz prefers the Cartesian view that only God's powers can be regarded as being in space, so that spatial parts can be assigned to these actions alone, i.e. as in (d), space 'gives parts and order to his immediate operations'. Likewise, in the correspondence, he claims that 'God is not present to things by situation but by essence; his presence is manifested by his immediate operation'.[44] He also invokes a number of arguments against Clarke's attempts to directly equate space with either a substance or attribute of God, which Leibniz perceives as lessening God's independence: '[t]he immensity of God is independent

[36] NE: II.xv.2.
[37] NE: II.xvii.3.
[38] NE: II.xxiii.21.
[39] NE: II.xxiii.21.
[40] See E. Slowik, 'Newton's Neo-Platonic Ontology of Space' (2008), philsci-archive.pitt.edu/id/eprint/4184.
[41] W. Charleton, *Physiologia Epicuro-Gassendo-Charletoniana* (London, 1654), 70.
[42] LC: L.III.12.
[43] H. More, *Henry More's Manual of Metaphysics: A Translation of the* Enchiridium Metaphysicum *(1679)*, Parts I and II [*Enchiridium*], translated by A. Jacob (Hildesheim: Olms, 1995), 98–148.
[44] LC: L.III.12.

of space as his eternity is independent of time', and '[t]he immensity and eternity of God are things more transcendent than the duration and extension of creatures […]'. Nevertheless, '[t]hose divine attributes do not imply the supposition of things extrinsic to God, such as are actual places and times'.[45] In deeming God an *intelligentia supramundana*, he adds that '[t]o say that God is above the world is not denying that he is in the world',[46] and, in criticizing Clarke's notion that space is God's place, he reasons that '[o]therwise there would be a thing [space] coeternal with God and *independent* of him'.[47] Therefore, God is independent of space, but space is not independent of God.

What lessons can be extracted from the evolution of Leibniz's conception of God's immensity as regards space? While some aspects will be examined further below, the most prominent change is the avoidance of language that refers to the immensum as 'the extended per se' in (b), or 'divine magnitude' in (c). Likewise, there are no longer any references that spatialize God as a form of container of body/force properties, such as 'adding' mass to the immensum in (b), or that endeavors are 'in nothing other than God' in (c). Whatever his relationship with Spinozism, it is likely that the continuing disputes with the neo-Platonist crowd in England had an effect on Leibniz's more careful, and more Cartesian, disavowal of attributing spatial features directly to God (with the exception of God's powers, of course). On most other issues, however, immensum-like thought persists in Leibniz's mature natural philosophy, from 1676 (b), through the *New Essays* and the Clarke correspondence. First, God's immensity remains the *ontological* basis of space; second, in (d), God's 'essence' grounds the 'possibilities' that are so often implicated in his later analysis of space,[48] just as God's immensity is the unchanging basis of all *possible* changes in space, brought about by either bodies or endeavors. Hence, the contemporary neglect of the importance of the immensum, i.e. as less central to his mature thought, simply does not do justice to its continuing relevance throughout the Leibnizian corpus. In short, a more Cartesian version of the immensum is a central feature of his late natural philosophy of space as well.

To return to the central topic of this essay, our detailed examination of God's relationship to space in Leibnizian thought thus has truly damaging ramifications for a relationist interpretation. As we have seen, Leibniz holds that space is dependent on God, and that God's essence grounds the capacity of an empty space to receive bodies. Interestingly, there was another natural philosopher, also associated with Newton and More, who held almost identical views to Leibniz on space, namely Isaac Barrow! Like Leibniz, Barrow regards space as dependent on God,[49] although he is not very forthcoming on details, e.g. 'there was Space before the World was created, and […] there is now an Extramundane, infinite Space, (where God is present) […]'.[50] This last quote would appear to suggest that space does exist prior to bodies, contra Leibniz's view; but, Barrow's explanation of space's 'existence' is put entirely in terms of the possibility of existing bodies, since he judges that space is the mere capacity to receive bodies (which follows a long Scholastic tradition associated with 'imaginary'

[45] LC: L.V.106.
[46] LC: L.IV.15.
[47] LC: L.V.79, emphasis added.
[48] For example LC: L.V.104.
[49] I. Barrow, *The Mathematical Works of Isaac Barrow D.D.* [*Works*], edited by W. Whewell (Cambridge: Cambridge University Press, 1860), 154.
[50] I. Barrow, *Lectiones Geometricae*, translated by M. Capek, in *The Concepts of Space and Time: Their Structure and Development* [*Lectiones*], edited by M. Čapek (Dordrecht: Reidel, 1976), 203.

space[51]): 'Time therefore does not imply an actual existence, but only the Capacity or Possibility of the Continuance of Existence; just as space expresses the Capacity of a Magnitude contain'd in it'.[52] That is, Barrow's nominalist tendency in geometry denies that space has quantity or magnitude; rather, only bodies possess magnitude. Space, which is not an actual entity, is 'nothing else than a simple pure potency, mere capacity […] of some magnitude'.[53] Barrow's spatial theory is, accordingly, nearly identical to Leibniz's, in that space merely signifies a capacity for material quantities, although Leibniz is perhaps more absolutist in that he may ascribe a quantity, even if indirectly, to some empty places (see footnotes 3 and 4). One should not be misled, as is De Risi,[54] by Barrow's claim that 'space' exists prior to bodies, since his intended meaning is that there exists a (God-based) possibility for bodies to fill a vacuum, just as Leibniz holds. Nevertheless, unlike Leibniz, Barrow is often grouped with the absolutists: Barrow's 'space exactly anticipates Newton's conception of absolute space […]'.[55] In all likelihood it is the unlucky conjunction of Leibniz's relational theory of motion and the contemporary absolutist–relationist controversy that have continued to distract commentators from the very close similarities between Barrow's and Leibniz's natural philosophies of space (although their overall natural philosophies differ on many other points, of course).

SUBSTANCE, ACCIDENT, AND RELATIONS

Needless to say, one of the principal reasons for assuming that Leibniz's theory of space is relational is that he often uses the term 'relation' (*relatio*) to characterize space. Nevertheless, this terminological usage is deceptive, for Leibniz's ontological categorization of space stems from a different source than the default body-based relationism often ascribed to his natural philosophy. It is certainly true that a number of passages seem to endorse relationism, e.g. '[e]xtension or space, and the surfaces, lines and points one can conceive in it are only relations of order or relations of coexistence, both for the actually existing thing and for the possible thing one can put in its place'.[56] As regards the substance/accident dichotomy, he denies that space is a substance for one of the same reasons that Newton gives in the *De gravitatione*, specifically that

[51] See E. Grant, *Much Ado About Nothing: Theories of Space and Vacuum from the Middle Ages to the Scientific Revolution* (Cambridge: Cambridge University Press, 1981), chapter 6.
[52] Barrow, *Lectiones*, 204.
[53] Barrow, *Works*, 158.
[54] V. De Risi, *Geometry and Monadology: Leibniz's* Analysis Situs *and Philosophy of Space* (Basel: Birkhäuser, 2007), 564.
[55] A.R. Hall, *Henry More and the Scientific Revolution* (Cambridge: Cambridge University Press, 1990), 210. Yet, as Futch explains (Futch, *Leibniz's Metaphysics of Time and Space*, chapter 2), many aspects of Barrow's treatment of time are closer to the absolutists; in particular, he separates time from bodily change, much like Newton, whereas Leibniz remains somewhat wedded to the older Scholastic tradition. Nevertheless, on the issue of space, Barrow and Leibniz are nearly identical, save for Leibniz's possibly having attributed quantity to empty spaces that are bounded by matter or at least measurable (NE: II.xiii.22), but, since God's essence grounds the possibility of a body occupying that space, it is thus not true to say that it constitutes an ontologically unsupported spatial extension (see 'Substance, Accident, and Relations'). Likewise, Barrow claims that 'space', i.e. as a capacity, exists prior to bodies, but, as argued above, Leibniz holds the very same view, although he does not refer to this sheer possibility using the term 'space' (rather, space only co-exists with bodies). As regards our later analysis in 'Holism: Physical and Geometrical', it is interesting to note that Barrow claims that numbers, like points, have position, since position requires a multiplicity (Barrow, *Works*, 62), which is, undoubtedly, very reminiscent of Leibniz's approach.
[56] Notes on Foucher's Objections, G.IV.491–2; AG 146.

space cannot act on things.[57] Space is not a property (accident, affection) that inheres in *individual* beings in the traditional Scholastic sense. Furthermore, since 'the same space will be sometimes the affection of one body, sometimes of another body, sometimes of an immaterial substance […] [b]ut this is a strange property or affection, which passes from one subject to another'.[58] Conversely, he supports a key element of substance/accident metaphysics, namely that there can be no *ontologically unsupported* spatial properties: 'if [a] space is empty, it will be an attribute without a subject, an extension without anything extended'.[59] Hence, space or place cannot be an individual property that flits from one substance to another in violation of the Scholastic understanding of substances/accidents, but he leaves room for place (pardon the joke) to be a property of a different sort. Besides Leibniz's claim, examined above, that ties God's essence to empty spaces (and his frequent assertions that space is not independent of God), a similar property-oriented demand for an ontological grounding for space is also confirmed in the remainder of the section just quoted from the Clarke correspondence: 'Thus, by making space a property, the author falls in with my opinion, which makes it an order of things and not anything absolute'.[60]

In a famous passage from the fifth letter, the ideality of place and space, as opposed to the property-like nature of 'relation of situation', provides more details on the relevance of individual properties in Leibniz's theory:

> And here it may not be amiss to consider the difference between place and the relation of situation which is in the body that fills up the place. For the place of A and B is the same, whereas the relation of A to fixed bodies is not precisely and individually the same as the relation which B (that comes into its place) will have to the same fixed bodies; but these relations agree only. For two different subjects, such as A and B, cannot have precisely the same individual affection, since it is impossible that the same individual accident should be in two subjects or pass from one subject to another. But the mind, not contented with an agreement, looks for an identity, for something that should be truly the same, and conceives it as being extrinsic to the subjects; and this is what we call *place* and *space.* But this can only be an ideal thing, containing a certain order, in which the mind conceives the application of relations.[61]

Accordingly, because the 'relation of situation' is 'in the body that fills in the place', it would seem to follow that 'relation of situation' is an internal property of bodies. But how can that be? How can situation be both an internal attribute of bodies and also a relation, which seemingly implicates other bodies? Leibniz's metaphysics of individual bodies/substances is clearly in play here, although a long aside on the 'complete concept' notion is beyond the bounds of this essay.[62] In brief, the spatial relations among all bodies are packed into the complete concept of each individual, thereby validating Leibniz's numerous claims that each body/substance/monad 'mirrors the world'.[63]

In a tract entitled 'On the Principle of Indiscernibles' (c. 1696), he invokes the famous statement that 'there are no purely extrinsic denominations', and that we erroneously 'conceive

[57] NE II.xiii.17; Newton, *Philosophical Writings*, 21.
[58] LC: L.V.39.
[59] LC: L.IV.9.
[60] LC: L.IV.9.
[61] LC: L.V.47.
[62] See, for example, B. Mates, *The Philosophy of Leibniz: Metaphysics and Language* (New York, NY: Oxford University Press, 1986), 58–69, for more details.
[63] See, for example, Leibniz, *Discourse*, 9; AG 42.

position as something extrinsic, which adds nothing to the thing posited, whereas in fact it adds the way in which that thing is affected by other things'.[64] More carefully, he argues:

> [(e)] To be in a place seems, abstractly at any rate, to imply nothing but position. But in actuality, that which has a place must express place in itself; so that distance and the degree of distance involves also a degree of expressing in the thing itself a remote thing, either of affecting it or receiving an affection from it. So, in fact, situation really involves a degree of expressions.[65]

We will examine the implications of (e) for Leibniz's dynamics in later sections. Returning to the fifth letter to Clarke, this same tendency to view place, position, etc. as akin to an internal property is evident in the well-known example that involves ratios of lines:

> I shall adduce another example to show how the mind uses, on occasion of accidents which are in subjects, to fancy to itself something answerable to those accidents out of the subjects. The ratio or proportion between two lines L and M may be conceived three several ways: as a ratio of the greater L to the lesser M; as a ratio of the lesser M to the greater L; and lastly as something abstracted from both, that is, as the ratio between L and M without considering which is the antecedent or which is the consequent, which is the subject and which is the object […] In the first way of considering them, L the greater, in the second, M the lesser, is the subject of that accident which philosophers call relation. But which of them will be subject in the third way of considering them? It cannot be said that both of them, L and M together, are the subject of such an accident; for if so, we should have an accident in two subjects, with one leg in one and the other in the other, which is contrary to the notion of accidents. Therefore we must say that this relation, in this third way of considering it, is indeed out of the subjects; but being neither a substance nor an accident, it must be a mere ideal thing, the consideration of which is nevertheless useful.[66]

Given that this passage follows the previous citation from LC:L.V.47 on the concepts of place and space, the conclusion to be drawn is that the relations of place and situation function in much the same manner as an internal property, a point that has been raised by previous commentators, such as Auyang.[67] Not only are relations likened to internal 'accidents' of subjects L and M, on the first two ways of considering this relation, but these subject-based accidents are, somehow, relations *between* the two objects, with space (the third way) being a mere ideal notion, abstracted from the two ways that the accident figures in each subject's set of predicates, either from L or M's perspective.[68] The abstracted third way of considering the relation, more importantly, is not put forward as negating the first and second interpretations; rather, it is just a different manner of understanding the relation.

Relationists often attempt to read an 'externalist', reductive construal of spatial relations into the many passages like LC:L.V.47, where Leibniz employs 'relation' and 'abstraction' terminology; that is, they strive to abstract space from the extension of each individual body, which in an infinite plenum gives an infinite space when the bodily boundaries have been subtracted; all of this is in keeping with a relationist orthodoxy that denies any reality to space apart from the non-reducible extension possessed by each body. But, as we have seen, the actual relations

[64] MP 133–134.
[65] MP 133.
[66] LC: L.V.47.
[67] Auyang, *How is Quantum Field Theory Possible?*, 247–251.
[68] On Leibniz on relations, see M. Mugnai, *Leibniz' Theory Of Relations* (Stuttgart: Verlag, 1992).

with other bodies are included within a body's accidents, alongside bodily extension. This alone indicates that Leibniz cannot be reconciled to contemporary spatial relationism, and that he is working with a different 'model', as it were, of how space is linked to bodies and, ultimately, individual substances/monads. Hence, Leibniz does not use the term 'relation' in the modern relationist sense, and thus it cannot serve as a basis to tag his natural philosophy of space as relationist.

Other problems for an externalist, reductive interpretation of relations lie in Leibniz's comments on the intricate interrelationship between bodily extension and space. On a straightforward interpretation of reductive relationism, the extension within bodies and the relative configuration of the bodies can remain invariant, whereas the actual distance relations among bodies (i.e. the geometry) can vary significantly. Likewise, one could employ the observations of various rigid body motions as a means of determining the geometrical structure of space as a whole, e.g. Sklar's relational method for explicating the orientation (handedness) property of space–time.[69] Yet, in contrast, there are a number of discussions in Leibniz's late corpus that single out (infinite) Euclidean geometry as the only possible spatial structure.[70] Moreover, Leibniz adds that 'although it is true that in conceiving body one conceives something in addition to space, it does not follow that there are two extensions, that of space and body'.[71] He continues:

> [T]here is no need to postulate two extensions, one abstract (for space) and the other concrete (for body). For the concrete one is at it is only by virtue of the abstract one: just as bodies pass from one position in space to another, i.e. change how they are ordered in relation to one another, so things pass also from one position to another within an ordering or enumeration—as when the first becomes the second, the second becomes the third, etc. In fact, time and place are only kinds of order; and an empty place within one of these orders (called 'vacuum' in the case of space), if it occurred, would indicate the mere possibility of the missing item and how it relates to the actual.[72]

The same theme is proclaimed in a famous passage from the Clarke correspondence:

[69] L. Sklar, *Philosophy and Spacetime Physics* (Berkeley, CA: University of California Press, 1985), 234–248.

[70] On the many ways that the world could be filled with matter, Leibniz comments that 'there would be as much as there possibly can be, given the capacity of time and space (that is, the capacity of the order of possible existence); in a word, it is just like tiles laid down so as to contain as many as possible in a given area'. (G.VII.304, On the Ultimate Origination of Things, 1697; AG 151). This suggests, in keeping with the analysis above, that spatial structure is not determined by matter, contra modern reductive relationism (instead, the spatial structure determines the possible material configurations). Furthermore, Euclidean geometry appears to be that determinate structure. After defining 'distance' as 'the size of the shortest possible line that can be drawn from one [point or extended object] to another', he comments that '[t]his distance can be taken either absolutely or relative to some figure which contains the two distant things', but adds that 'a straight line is absolutely the distance between two points' (as opposed to the arc of a great circle on a spherical surface; NE: II.xii.3). By defining a straight line as 'absolute distance', in contrast to 'relative distance' – i.e. *relative* to the various figures or surfaces that can be delineated *within* Euclidean (three dimensional) geometry – this implies that the overall determinative structure of space is Euclidean. Interestingly, it would seem to follow that a limited material world with, say, a spherical shape would have a non-Euclidean metric on that surface, given his notion of relative distance. On the larger issue of 'compossibility', see D. Rutherford, *Leibniz and the Rational Order of Nature* (Cambridge: Cambridge University Press, 1995); and Futch, *Leibniz' Metaphysics of Time and Space*. Finally, Leibniz's complex analysis of infinity is also beyond the bounds of this essay, but see, e.g., R. Arthur, 'Leibniz's Theory of Space', *Foundations of Science* (2011, forthcoming); and S. Levey, 'Leibniz on Mathematics and the Actually Infinite Division of Matter', *The Philosophical Review*, 107 (1998), 49–96.

[71] NE: II.iv.5.

[72] NE: II.iv.5.

> I do not say, therefore, that space is an order or situation, but an order of situations, or (an order) according to which situations are disposed, and that abstract space is that order of situations when they are conceived as being possible. Space is therefore something merely ideal.[73]

On an externalist construal of relations, on the contrary, there are two extensions of sorts that can vary independently of one another: on the one hand, space or extension as a quantitative measure, i.e. distance; and on the other hand, the extension within bodies as well as their relative configuration (or, if unextended point masses or events are utilized, then it is simply their relative configuration). Leibniz's view differs quite substantially from this externalist relational approach, needless to say. First, he collapses the difference in externalist relationism between relative order and space in favor of the former notion, order of situations, which he declares has quantity/distance. Second, as disclosed previously, he then treats that quantity, order of situations, as an internal property of each body, which, when idealized apart from bodies, becomes space. Third, the statement that bodily extension 'is at it is only by virtue of the abstract one [space]' signifies that even bodily extension cannot be separated from the order of situations (space), both being internal to each body. All of this, of course, runs counter to the priority assigned to bodily extension and the relative configuration of bodies, in opposition to space (distance, geometry), in a truly reductivist relational theory. Incidentally, we have seen an analogous misreading of Leibniz's view in Clarke's contention that the order of bodies can remain the same despite a difference in the quantity of space between the bodies. Leibniz responds: 'As for the objection that space and time are quantities, or rather things endowed with quantity, and that situation or order are not so, I answer that order also has its quantity: there is in it that which goes before and that which follows; there is distance or interval'.[74] Once again, space cannot vary independently of bodily extension and relative order, contra a reductivist, external relationism; what this suggests, apparently, is that these three concepts (bodily extension, relative bodily order or situation, and the quantity, space) come as a kind of package deal, and this further implies something like a property theory of space, or, to be more precise, ~ (R3), regardless of how one parses its ontological implications.[75]

But it is a strange property view, indeed, since a body's extension and its relative order with other bodies functions like internal properties of each body, with space comprising a mere idealization of these two. Apparently, this is Leibniz's method of overcoming the problem of migrating spatial properties (such as place), and is likewise an expression of the complete concept notion and the prohibition on extrinsic denominations, etc. More precisely, if you build the entire order of situations into each body, then the Scholastic ban on accidents existing outside substances is upheld, as when we erroneously presume 'same place' transfers from body A to body B.[76] Yet, as all Leibniz enthusiasts know, the price to be paid for such a scheme is astonishingly high: it *apparently* renders the whole of space internal to each body/substance, with phenomenalist (or idealist)

[73] LC: L.V.104.
[74] LC: L.V.54.
[75] In the work previously quoted from 1676, Leibniz comments that 'Space is only a consequence of [the Immensum], as a property is of an essence'. (LoC 55). Compare with: 'Thus, by making space a property, the author falls in with my opinion, which makes it an order of things and not anything absolute' (LC: L.IV.9). Of course, Leibniz does not sanction the ontology of a straightforward property theory of space in the way that, say, More's late *Enchiridium* seems to espouse (see More, *Enchiridium*, 56–57, where space becomes God's internal property). Yet, as argued above, ~ (R3) is viewed as a key requirement for a property view, and thus it is imperative that we investigate the manner by which Leibniz's theory resembles a property theory on this point, indeed, as argued in this essay, Leibniz's theory of space more accurately reflects a property theory orientation than modern relationism.
[76] See LC: L.V.47.

consequences difficult to evade, e.g. 'situation really involves a degree of expressions' in (e) (more on this below). This predicament can be seen as the spatial incarnation of the old adage that Leibniz replaced Spinoza's single substance (space) with an infinity of isolated, non-interacting substances (spaces) in pre-established harmony with one another. Likewise, it provides a unique twist on the holenmerism prevalent in his day (see above). Although, rather than make God whole in every part of space, as holenmerists such as Gassendi or Charleton support, Leibniz makes space whole in every body/substance (of which there are an infinite number), all founded upon God's immensity.

HOLISM: PHYSICAL AND GEOMETRICAL

However, if we persevere in our commitment to refrain from a purely phenomenalist interpretation of Leibniz's spatial theory, such as defended by Furth[77] – and thereby limit our investigation to ontological concerns relevant to both a corporeal substance/accident metaphysics and the modern substantival/relationism dispute – then a species of material world 'holism' is the only plausible conclusion that can be drawn from the inclusion of external bodily relations within each body. That is, the corporeal manifestation of Leibniz's claims that the order of situation is an internal property, or is 'expressed' by each body, is just the interconnectedness of all material bodies. This exact point is made in quotation (e) and its accompanying passages, where the PII is utilized to deny the relevance of spatial locality: 'there are no purely extrinsic denominations, *because* of the interconnection of things', and, 'if place does not itself make a change [i.e. no external denominations], it follows that there can be no change which is merely local'.[78] The interconnection of the material universe is a dominant theme in Leibniz's work, of course: 'each corpuscle is acted on by all the bodies in the universe, and is variously affected by them'.[79] Even so, the link between the PII, space and time, and the world's bodily interconnection has been more often overshadowed by a phenomenalist reading of the internal (force-based) denominations that usually take center stage in Leibniz discussions.

But, in a very instructive early passage, Leibniz explains that the term 'expression' (*exprimere/expressiones*), which has phenomenalist overtones, signifies a structural identity between any two things (in the modern parlance, a partial isomorphism): 'That is said to express a thing in which there are relations which correspond to the relations of the thing expressed'.[80] While this work does not offer examples of perceptions 'expressing' material bodies, that term is often used in a perceptual context in Leibniz's output, e.g. 'it is very true that the perceptions or expressions of all substances mutually correspond in such a way that each one […] coincides with others', and although all substances 'express the same phenomena, it does not follow that there expressions are perfectly similar; it is sufficient that they are proportional'.[81] In 'What is an Idea?', a number of non-phenomenalist examples are given, however, such as models/machines, linear projections/solids: 'What is common to all these expressions is that we can pass from a consideration of the relations in the expression to a knowledge of the corresponding properties of the thing expressed. Hence it is clearly not necessary for that which expresses to be similar to the thing expressed, if only a certain

[77] M. Furth, 'Monadology', *Philosophical Review*, 76 (1967), 169–200.
[78] MP 133, emphasis added.
[79] 'Metaphysical Consequences of the Principle of Reason', c.1712, MP 176; also, *The Monadology*, 61; AG 221.
[80] What is an Idea?, G.VII.263–264; L 207.
[81] Leibniz, *Discourse*, 14; AG 47.

analogy is maintained between the relations'.[82] If we take 'expression', therefore, as a structural relationship between any two things, and *not* just between perceptions and the material world, then the holistic interconnectedness of Leibniz's material world begins to emerge: 'that which has a place must express place in itself; so that distance and the degree of distance involves also a degree of expressing in the thing itself a remote thing, either of affecting it or receiving an affection from it'.[83] Not surprisingly, each body/substance, taken 'in the thing itself', expresses distance relations to 'remote things' by means of dynamic change, 'affecting it or receiving an affection from it'. Consequently, the holistic interconnection of the material world is both dynamical and spatial.

The holistic interconnection of the physical world is matched, furthermore, by the holism of Leibniz's classical conception of geometry, which conceives geometric elements or structures as equally interconnected in various ways: for example, the situations that form the basic component of his novel geometric theory, *analysis situs*, are determined by the space's distance relations, which thus demonstrates that the modern division between the topological and metrical aspects of geometry is not applicable to his overall conception.[84] On a similar theme, the most classical feature of his geometric approach is his stance on points, which 'strictly speaking, are extremities of extension, and not in any way, the constitutive parts of things; geometry shows this sufficiently'.[85] For instance, points are merely the boundaries of lines, and so cannot exist apart from as lines (just as situation is inseparable from the quantitative distance relations). All of these notions, which are enduring features of his oeuvre, are consistent with an approach that views the whole of space/geometry, which is ideal, as prior to its parts; this contrasts with real entities, where the part precedes the whole:

> For, while space is an ideal continuum, Mass is discrete, that is, an actual multiplicity, or a being through aggregation of infinite unities [simple substances/monads]. In actuals, simples are anterior to aggregates; in ideals the whole is prior to the part.[86]

In a Rationalist critique that even Descartes would likely have admired, Leibniz uses a similar line of reasoning to argue, contra Locke, that space and time cannot be grasped by a process of imaginative construction from particular discrete entities: 'Ultimately one can say that the idea of the *absolute* is, in the nature of things, prior to that of the *limits* which we contribute, but we come to notice the former only by starting from whatever is limited and strikes our senses'.[87] As attributes without limits, the absolute 'precedes all composition and is not formed by the addition of parts',[88] 'is internal to us', and 'these absolutes [i.e. space and time] are nothing but the attributes of God; and they may be said to be as much the source of ideas as God himself is the principle of beings'.[89]

[82] L 207.
[83] MP 133.
[84] See, De Risi, *Geometry and Monadology*, 176, for the metrical basis of Leibniz's theory.
[85] To Masson, 1716, G.VI.624–629; AG 228.
[86] To Des Bosses, July 31, 1709, G.II.379; translated by De Risi, *Geometry and Monadology*, 567–568.
[87] NE: II.xiv.27.
[88] NE: II.xvii.1.
[89] NE: II.xvii.5.

WRAPPING UP

We are finally in a position to provide a synthesis of the many separate themes in our analysis, all centered on the evolution of Leibniz's spatial ontology and the corresponding viability of a relationist interpretation. Throughout Leibniz's writings, God's immensity is directly linked to the unity, oneness, and indivisibility of space, i.e. the holism or monism of space. For instance space and time, which are the holistically-conceived 'absolutes' put forward in the *New Essays* (as above), 'are nothing but the attributes of God'. Nevertheless, in the work up through the 1680s, such as in (b) and (c), bodies or endeavors are directly *added* to the divine unity, thereby resulting in the discrete, aggregate structure that we actually experience. By the time of his later output, though, God's earlier quasi-Spinozistic or neo-Platonic role as the holistic ontological platform of space, to which endeavors and bodies are added, has been drastically altered, leaving only the holistic, ideal conception of space that is *posterior* to our experience of the material world of discrete, bodily phenomena. God's immensity remains as the foundation of space, of course, but in a more transcendent, more Cartesian manner, such that only God's operations can be straightforwardly given a spatiotemporal predication. Put differently, with God now transferred to the transcendent realm, the whole, dynamically interconnected world now directly provides the foundation for his holistically conceived space.

Nevertheless, how can a world composed of discrete, individual bodies, no matter how interconnected dynamically, serve as the ontological platform for a spatial or geometric 'property' that is holistic and non-discrete? In answering this question, it is best to keep in mind the very important provisos disclosed above: bodily extension 'is at it is only by virtue of the abstract one [space]';[90] space is 'an order of situations […] according to which [bodily] situations are disposed';[91] and 'the absolute is in the nature of things'[92] etc. Therefore, given these frequently asserted provisions, as well as our analysis of 'expression' in (e), the inevitable inference to be drawn here is that the *dynamically* interconnected world of discrete bodies *instantiate*, *exemplify*, etc., the *truths* of the ideal holistic structure of space and geometry, a nominalist perspective that is predicated on God's role as the transcendent source of both actual and possible existents. Put differently, the truths of geometry are obtained by the world's dynamic material interconnections, with God grounding the possibility of these (yet to be obtained) truths. In this context, the 'instantiation of geometric truths' simply means that the behavior and analysis of material bodies and their interactions upholds or follows the truths of (Euclidean) geometry, a conclusion that is perfectly in accordance with a geometric nominalism that rejects the Platonic existence of geometric truths in the absence of matter. While often declaring that space is not an 'absolute reality', or, as he more carefully puts it, 'an absolute being',[93] it still expresses 'real truths'[94] and so on: 'Time and space are of the nature of eternal truths, which equally concern the possible and the actual'.[95] Overall, such sentiments best fit our formulation that space is a unique sort of property, *both* of God and the material world, albeit in different ways. As eternal truths, space and time concern the possible via God's essence, such that there can be no space and time apart from God's essence, and an essence is a necessary property (or attribute) of a being, thereby explicating his assertion

[90] NE: II.iv.5.
[91] LC: L.V.104.
[92] NE: II.xiv.27.
[93] LC: L.III.5.
[94] LC: L.V.47.
[95] NE: II.xiv.26.

that space and time 'are nothing but the attributes of God'.[96] But, space and time also concern the actual, via the material world's instantiation of these spatial truths, specifically, since space is an ideal whole, whereas bodies are discrete, the 'instantiation' of space thus amounts to the instantiation of the geometric *truths* associated with Euclidean space, such that the behavior of bodies is governed by those truths. More carefully, whereas a straightforward nominalism would seem to dictate that only the whole interconnected dynamic world can properly instantiate the holism of geometric truths, Leibniz's unique approach circumvents this limitation, since his conception of relations entails that each individual body/substance 'knows about', *expresses*, the dynamic interconnections of the world, and thus each body/substance has access to the holism of geometric truths via the dynamic/spatial correlation surveyed in 'Holism: Physical and Geometrical', above.[97] In evading the problem of migrating places (see 'Substance, Accident, and Relations'), which undermines a traditional property theory of space as regards material bodies, it would thus seem that Leibniz's response is to render absolute space, i.e. universal place in (a), a truth that is instantiated by the world's holistic interconnections. Accordingly, while space is not a material property in the ontological, substance/accident sense of the term, it still nonetheless fits a crucial criterion of both a property theory and nominalism: it is instantiated by matter, such that it is only an idea if not otherwise instantiated. Of course, relationists would claim that space is also instantiated by matter under their theory; but, as argued above, the many non-relational features of Leibniz's spatial hypotheses undercut the case for a relationist interpretation (e.g. $\sim$ (R3), and the fact that bodily extension, relative bodily situation, and the quantity, space, cannot vary independently of one another).

In summary, the material world's function as the instantiating basis of ideal, holistic space thus explains many of the distinctive features of Leibniz's theory, namely 'that there is no space where there is no matter and that space in itself is not an absolute reality' (i.e. matter instantiates space but space does not exist apart from that instantiation),[98] and 'if there were no creatures, space and time would be only in the ideas of God' (i.e. pre-instantiation, space is merely a possibility guaranteed by God's essence).[99] The universal place in quotation (a), which presents such a serious obstacle to relationism by diverging from bodily-defined place, is hence akin to both his holistic notion of space/geometry and his dynamical, holistic understanding of material world change: universal place is 'determined by reasoning' (i.e. it is an ideal abstraction from discrete bodily behavior) and 'is related to everything, and in terms of it all changes of every body whatsoever are taken into account' (i.e. the dynamics of bodily interactions instantiate spatial geometry). In addition, this conception of how geometry relates to bodies contrasts sharply with Newton's stance, which reified the holistic structure of spatial geometry in a very literal Platonic sense (independent of matter): 'For the delineation of any material figure is not a new production of that figure with respect to space, but only a corporeal representation of it, so that what was formerly

[96] NE: II.xvii.5.

[97] See, especially, the quotes from MP 133. The use of such terms as, 'instantiate', 'exemplify', etc., is drawn from structuralist conceptions of mathematics: see, S. Shapiro, *Philosophy of Mathematics: Structure and Ontology* (Oxford: Oxford University Press, 1997). Given God's role as the basis of these eternal (geometric) truths, the non-reductive, *in re* (nominalist) version of mathematical structuralism would seem to best fit Leibniz's conception, although more traditional (non-reductionist, non-fictionalist) strands of nominalism would also be applicable (and hence our analysis does not rely on a structuralist reading). For more on these issues, see E. Slowik, 'Spacetime, Ontology, and Structural Realism', *International Studies in the Philosophy of Science*, 19 (2005), 147–166.

[98] LC: L.V.62.

[99] LC: L.V.41.

insensible in space now appears before the senses'.[100] Leibniz's nominalist conception of geometry, on the other hand, only regards spatial geometry as the property of the whole world of bodies, such that God's essence secures this nominalism, and which includes the possibility of bodies existing in a vacuum (assuming there are empty spaces), much like Barrow. Therefore, the universal place in (a), although not an absolute being, is an eternal truth grounded in the material world as a whole (by way of God); this entire conception and approach, it should be noted again, bears little resemblance to a modern relationist theory of space.

By way of conclusion, it is worth pointing out how the preceding discussion also helps to shed light on the nature of Leibniz's espousal of ~ (R3), first advanced above. As well as the shift arguments that first appear in the Leibniz–Clarke correspondence. As previously discussed, Leibniz would deny that the material world could either occupy a different position in absolute space (static shift) or have a different uniform velocity in absolute space (kinematic shift), although this contradicts ~ (R3). Does this fact undermine the claim that Leibniz's conception resembles a property theory of space, which we have identified with ~ (R3)?

While the shift scenarios prove that Leibniz does not endorse a full property theory, there are reasons for his exclusion of the shift cases that correlate with other his other conceptual priorities, namely his nominalism and his force-based conception of matter. As demonstrated in 'Substance, Accident, and Relations', relative bodily configuration and extension cannot vary independently of space, whereas the shift arguments assume this independence. For these reasons alone, Leibniz's theory of space is not susceptible to the shift arguments, but the dynamical character of his overall theory adds a new facet to this assessment. Given that Leibniz, in (e), regards space (distance) as instantiated by the dynamical interactions among bodies, the hypothetical scenarios presented by Clarke that involve different non-dynamical relationships between the entire world and space – position (static shift), velocity (kinematic shift) – are simply inapplicable given Leibniz's conception. Indeed, as demonstrated in the various passages associated with (e), the PII is actually employed to argue for the irrelevance of extrinsic denominations, and in support of a dynamic material holism as the grounds of space. Accordingly, the many arguments in the correspondence against absolute space (as a being entirely independent of body) that use the PII are totally in keeping with our analysis, although Leibniz frames his use of the PII in ways that differ from (e). For example, if space 'is nothing at all without bodies but the possibility of placing them, then those two states, the one such as it is now, the other supposed to be the quite contrary way [static shift], would not at all differ from one another'.[101] More precisely, since space is merely an idea in God's mind prior to the material world's instantiation of space – i.e. 'the possibility of placing them', secured via God's essence – then stipulating that the world's inhabitants could have possessed different spatial locations in a uniform way (e.g. each body's location having been three feet to the left) is to make the claim that space could have been instantiated by the material world in a different fashion. That is, space would have to be independent of any material instantiation of space if it were possible for the world to have a different location, and this independence is exactly what Leibniz's nominalism denies. Hence, a uniform and unobservable static shift would amount to nothing more than a relabeling of the places already instantiated by the material world; that is, it is a mere difference in scale or gauge, which is no difference at all, as Leibniz insists. The same holds true for a kinematic shift, since any uniform addition or subtraction of speed or difference in direction as regards all bodies does not affect the dynamical

[100] Newton, *Philosophical Writings*, 22.
[101] LC: L.III.5.

interconnections among those bodies.[102] Indeed, any uniform addition or subtraction of speed only changes the overall total numerical value of the conserved quantity, mv^2, and thus represents another difference in scale factor alone. Obviously, a relationist would resist the shift arguments in an analogous fashion, but that simple fact does not render Leibniz's nominalism, or unique brand of property theory, identical to modern relationism, since they differ on many other issues, as has been often noted above.

A MONADIC CONCLUSION

A few words are in order regarding how the monadic realm in Leibniz's theory connects with the main conclusions of this essay. First, the world's dynamic interconnections are, ultimately, founded upon monads:

> And since everything is connected because of the plenitude of the world, and since each body acts on every other body, more or less, in proportion to its distance, and is itself affected by the other through reaction, it follows that each monad is a living mirror or a mirror endowed with internal action, which represents the universe from its own point of view and is as ordered as the universe itself.[103]

Second, monads ultimately depend upon God: 'And a monad, like a soul, is, as it were, a certain world of its own, having no connections of dependency except with God'.[104] Hence, two of the main themes in our investigation, the dependence of space upon both God and the world's dynamic interconnections, find a correlate at the level of monads. In the notes Leibniz prepared for this letter, he offers one of his favorite metaphors for the different way that things 'appear', whether as judged from bodies/monads or God:

> If bodies are phenomena and judged in accordance with how they appear to us, they will not be real since they will appear differently to different people. And so the reality of bodies, of space, of motion, and of time seem to consist in the fact that they are phenomena of God, that is, the object of his knowledge by intuition. And the distinction between the appearance bodies have with respect to us and with respect to God is, in a certain way, like that between a drawing in perspective and a ground plan. For there are different drawings in perspective, depending upon the position of the viewer, while a ground plan or geometrical representation is unique. Indeed, God sees things exactly as they are in accordance with geometrical truth, although he also knows how everything appears to everything else, and so he eminently contains in himself all other appearances.[105]

[102] The static and kinematic shift arguments also explain why Leibniz's theory does not exactly correlate with a strict or thorough property theory, ~(R3). On a strict property theory, a static or kinematic shift of the world would allow new positions of the world's shifted bodies to be obtained, just as they do as regards passage (a), where the individual dynamic changes of bodies relative to one another brings about new spatial positions in universal place. However, since Leibniz sees space as arising from the dynamic interconnections of the whole world, this fact limits the spatial locations, and thus the changes of spatial location, to changes in location *among* individual bodies. Hence, Leibniz's dynamic holism provides a conclusion that is quite similar to traditional relationism on this issue alone. But, as argued above, this aspect of his natural philosophy stems from a commitment to his blend of nominalism and dynamic holism, which is quite different from a body-centered (R2) relationism (but not the sophisticated (R2*) variety).

[103] Leibniz, *Principles of Nature and Grace*, 1714, G.VI.598–606; AG 207.

[104] To Des Bosses, 5 February 1712, G.II.435–436; AG 199.

[105] G.II.438–439; AG 199.

The claim that God sees things 'in accordance with geometric truth', as opposed to the perspectival view of bodies/monads, would seem indicative of the difference between the whole of Euclidean space, and a perspective from a single location within Euclidean space (or from a location within a finite material world with a non-Euclidean metric; see footnote 70). Indeed, this distinction is captured in Leibniz's analogy between a ground plan and a perspective drawing, since the ground plan, presumably, contains all of the different perspectives. Moreover, the ground plan is both 'unique' and the 'phenomena of God', thus it is not surprising that geometric *truth* is linked with this assessment (as argued above in 'Wrapping up'), although God 'eminently contains' the perspectival appearances as well.[106]

Briefly put, monads share a feature with Leibniz's God, which helps to explain their distinct role within the metaphysical scheme surveyed in this essay. Like God, monads are not in space (and time) per se: '[f]or monads, in and of themselves, have no position with respect to one another, that is, no real position which extends beyond the order of phenomena'.[107] Yet, they have a sort of derivative location, via bodies: '[f]or even if they are not extended, monads have a certain kind of situation in extension, that is, they have a certain ordered relation of coexistence to other things, namely, through the machine in which they are present'.[108] While outside the scope of this essay, these passages have fueled speculation on whether or not monads are really in space.[109] Outside the Early Modern community, however, the implications of these aspects of Leibniz's deep metaphysics of space have largely eluded those scholars who have been overly preoccupied with the substantival/relational dispute. To put it bluntly, monads are the link between God and the material realm: monads, like God, are not in space per se, but they are the means by which God 'brings about' matter, and hence, when idealized, space. As Leibniz puts it: 'properly speaking, matter is not composed of constitutive unities [monads], but results from them'.[110] Consequently, if one truly desires a modern analogue of Leibniz's theory within contemporary research in the philosophy of space and time, then the details of his monadological thesis seem much more closely allied with the many recent attempts to explain how the macroscopic level of reality, i.e. material bodies and the large scale structure of space, arises from a manifestly different, and more fundamental, level of reality, e.g. the search for a theory of Quantum Gravity. Much like these contemporary theories in physics, Leibniz's monadology is concerned with the creation of matter, and the space associated with matter, at the macroscopic scale, such that this higher scale of reality 'results from' a quite different realm of being altogether (as in 'emerges', to use a modern locution).[111] The continuing preoccupation with relationism, accordingly, has only had the unfortunate effect of distracting philosophers from this more fruitful line investigation.

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[106] Compare with Newton, *Philosophical Writings*, 22–30.
[107] To Des Bosses, 26 May 1712, G.II.444; AG 201.
[108] To De Volder, 30 June 1704; G.II.248–253; AG 178.
[109] See, e.g., J. Cover and G. Hartz, 'Are Leibnizian Monads Spatial?', *History of Philosophy Quarterly*, 11 (1994), 295–316.
[110] AG 179; see, e.g., Rutherford, *Leibniz and the Rational Order of Nature*, for an extended analysis.
[111] See D. Garber, *Leibniz: Body, Substance, Monad* (Oxford: Oxford University Press, 2009), 383–384, who briefly suggests a similar interpretation of the goals of Leibniz's monadic metaphysics.