Is matter necessary for the existence of space and time? Discuss with reference to two or more thinkers.

1   Introduction

In this essay, I will argue that matter is necessary for the existence of space and time. I will do so with reference and through the point of view of the Leibniz-Clarke-Newton debate about the nature of space and time. My essay is structured as follows:

(P1) If space is relational, then matter is necessary (and sufficient) for the existence of space.

(P2) If space is substantival, then it is absolute.

(P3) Space is not absolute.

(C1) Space is not substantival, or in other words, it is relational.

(C2) Matter is necessary for the existence of space.

Taking each premises in turn, I will demonstrate their veracity, and proceed to demonstrate if all the premises are true and the argument is valid, then the argument is sound and therefore the conclusions logically follows.

2   Premise 1

I shall argue that if space is a relational entity, and not a substantival one, then space necessarily depends on matter for its existence. That is to say, a system of material bodies with spatial relation, or "successions of situation", is sufficient and necessary in defining space as a relational entity.

Before starting, I would like to assume the naive substantial distinction between the physical and the mental. The reason being if the latter collapses into the former, then my premise is true by definition. As a caveat, I shall not

attempt here to demonstrate why the former cannot collapse into the latter, but I can claim such a view ultimately defeats the point of answering this question.

First, if space, as abstracted from everything, is a relational entity, then the propositional properties derived from a set of sentences describing a system of bodies in space would be relational properties. If "I am next to the computer" is such a system of bodies, then "being next to" is the relational property derived from the system. Now, if I remove the subject and object particles from the sentence, and replace them with X and Y respectively, then we have the sentence "X is next to Y". If I attempt to substitute X and Y with something, then I *prima facie* do so with physical objects—those comprises of matter. I claim that such an action is ostensible proof that only objects of matter can substitute X or Y in this sentence. While such a claim appear terse, consider the opposing case using mental images. If I now sit in park and think of an image of myself being next to my computer, then while I can utter the sentence "I am next to the computer", such a sentence will make no sense unless I clarify that "the concept of myself is next to the concept of a computer". But even then, such a sentence is meaningless. If two concepts can be said to be next to one another, then they can also be said to be on top, under, in front, etc., without any means to differentiate between them— they are mere utterances. Therefore, while it might be painfully trivial, if spatial relations can be ascribed to both physical or mental bodies, only the first will have any worthwhile propositional content. This proves my first premise (P1).

3   Premise 2

To clarify, by "substantival", I mean a classification of space which considers it as a substance, or in other words, that which exists on its own. Being substantival necessarily entails that matter is independent from space, by definition. If space is not a substance, then it is relational in nature.

A second classification involves absolutism. If space is absolute, and let us take Euclidean three-dimensional geometrical infinite space as a representation, then there exists an immovable and distinct reference point ($x = 0, y = 0, z = 0$) which determines the origin of all future translated Euclidean space. All points are therefore relative to this origin. This point is immutable and therefore defines the absoluteness of space.

Substantival space is absolute. If space is a substance, then it cannot be determined by other entities, including its origin. However, the reverse does not hold—space can be absolute yet not a substance. For example, Newton (whose theory I will discuss in Section 4) brought in the role of God, and likened absolute space to God's Sensorium[1],[2] along with God's attributes. Hence, space cannot be

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[1]Jammer 1954, p. 115.
[2]Barbour 1989, p. 629.

a substance if its existence depends on at least one other entity (a Deity). This proves my second premise (P2).

4 Premise 3

I shall now take on the task of evaluating Leibniz's use of the Principle of Identity of the Indiscernibles (PII onwards) against absolute space can subsequently. I will claim his attempt as ultimately successful.

PII, in the strong form, which I will utilise, holds that no two indiscernible entities can share all their intrinsic properties.[3] An intrinsic property is one in which entities can have in virtue of they way they are, and not in relation (or lack thereof) to other entities.[4] For PII, the "stronger" its formulation is, the stricter the conditions become for entities to be considered distinct. If A and B share non-identical sets of non-intrinsic properties $N_1 \neq N_2$, but identical sets of intrinsic properties $I_1 = I_2$, no matter how small the intrinsic sets or how large the non-intrinsic sets are, if this latter condition holds, then A and B are indiscernible, hence it follows from PII that a universe with both A and B are not logically possible.

Newton, in his *Scholium* found at the start of the *Principia*, espoused for a theory where space is "absolute and immutable"[5] out of "logical and ontological necessity".[6] PII was established and used by Leibniz to demonstrate against the logical necessity of Newtonian absolute space, I will set aside ontological necessity. Newtonian space was put forth in response to problems found in Descartes' relative space. Rest and uniform motion were both defined with circular reasoning in Descartes' definition of motion, so either they have to be treated as two distinct concepts (from which Newton picked up) or the Cartesian principle of inertia, in which the rest and uniform motion cannot be distinguished, has to be rejected (Leibniz's move in order to defend relative space). For Leibniz, treatment of space and matter cannot be separated because space for him was compared to a genealogical tree,[7] and the action of abstraction to space presupposes a system of material bodies.[8] In setting up the scene, Leibniz's proposed two *reductio ad absurdum* to refute absolute space.

Consider that space is absolute, and a possible world U1 with finite or infinite material bodies, and possible world U2 with the same finite or infinite material bodies. U2 is numerically distinct from U1, even if all the bodies are relation-

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[3]Khamara 1988, p. 146.
[4]Ibid., p. 144.
[5]Jammer 1954, p. 101.
[6]Cushing 1998, p. 157.
[7]Jammer 1954, p. 118.
[8]Cushing 1998, p. 159.

ally identical. Then from PII, U2 is indiscernible from U1. But this leads to a contradiction. Therefore, we must forgo absolute space.

The above argument comes from translating space (like adding a constant amount to the origin), so numerical distinctness but no relational differentiation results. In two-dimensional Euclidean space, consider a triangle with base and height both of length 1, with coordinates (0,0), (0,1) and (1,1). If I now translate the origin of this space from (0,0) to (2,2), then the triangle now has coordinates (2,2), (2,3) and (3,3). The numerical relation between the vertices remain unchanged, so are the base and height. Thus, the intrinsic property, a unit right-angled triangle arranged like so, is invariant.

The second argument follows the exact same logical structure, but translation has been replaced by reflection along the vertical. The argument is simple, if the entire universe at present is flipped (the universe in the mirror), then would I observe any intra-world difference? Leibniz argued from PII for both translation and reflection that absolute space must be refuted.

With the presence of some bodies then, space is non-absolute. What about the case in which a possible world devoid of matter is considered instead? Here, Leibniz would argue that because absolute space can be divided into arbitrarily small parts, each part identical to one another, then from PII there is only one such arbitrarily small part. So the entire universe is one such small part. From this absurd consequence, Leibniz rejected absolute space. Khamara argued here that the use of PII in this scenario is intra-world (parts of a world) and not inter-world (between worlds, like the two arguments above), and since abusing PII intra-world leads to inconsistencies, Khamara dismissed the validity of this argument.[9]

However, if we consider (P3) of the thesis, then notice that by considering a universe devoid of any matter, we already presuppose it is substantivalist, and hence by *modus tollens* it is absolute. Hence, trying to prove relative space in the case where absolute space is true is a logical contradiction (since the two are mutually incompatible), so the argument as a whole is unnecessary. The two arguments from translation and reflection are sufficient for the refutation. That is to say, to retain the efficacy of this argument, we would have to refute (P3). I cannot see a way to do so. Space as a substance cannot move into any other "space", thus it is immovable and that is the definition of absolute space.

But if we do not retreat the argument, then it is possible to argue the following. Using PII intra-world leads to absurd consequences, such as the case where a system of N intrinsically identical spheres placed in arbitrary locations is the same as a system of $N + 1$ also identical spheres (and identical to the first system) placed in another arbitrary set of locations. While this may suggest this flavour of PII is too strict—we want *prima facie* a principle capable of capturing the most intrinsic information and PII does not suit this role, it may also suggest that PII

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[9]Khamara 1988, p. 153.

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happens to *describe* the physical world, where no such ideal system can exist where multiple bodies are considered intrinsically identical (assumed with the hindsight of modern physics). This leads to a discussion on using physically impossible thought experiments to test logic, I will not discuss this further. My point remains that absolute space is sufficiently refuted from the two arguments from translation and reflection alone. Thus, this proves my third premise (P3).

5   Arriving at the conclusion

From here, it is a matter of logical syllogism; space is not absolute, then space is not substantival (from (P2) and (P3) using the principle of *modus tollens*). If space is not substantival then it is relational, and if it is relational, then applying *modus ponens* on (P1), we can henceforth argue that matter is necessary for the existence of space, or that (P3) is true.

6   What about time?

In the same sense, arguments for time run parallel to the ones for space. Though we might want to appreciate first the differences between time and space, at least in the mathematical sense which Newton has constructed, I cannot do so here, and I claim that if we humbly hold Newton's primal, "bare" view of time[10] which is embedded into his mathematical Euclidean space, then time exhibits no hierarchy in its direction of evolution, so temporal distance and betweenness can be likened to space. Hence, the argument from temporal translation and temporal reversal (akin to spatial reflection) can be made using PII faultlessly. For the third case where the universe is inhabited, I reject the usefulness of such an argument in the same manner as I did for the spatial case. Therefore, following an identical steps in reasoning from 5, with 'time' replacing 'space', I can argue that matter is also necessary for the existence of time.

7   Loose ends

Here are two things I cannot expand on but are worth a cursory notice. In my negative refutation of absolute space, I have not considered positive arguments for absolute space. Leibniz's argument involves PII as its main logical device; in itself this only concerned the kinematics (motions only) of bodies, such as the act of translation and reflection. Newton provided a separate dynamical (the forces which cause motions) arguments for the existence of absolute 'true' motion which

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[10]Khamara 1988, p. 158.

demonstrate the existence of absolute space (the rotating water bucket thought experiment). While Leibniz seemed victorious in kinematics, his concede to Newtonian dynamics[11] might seem to endanger my argument. However, while this might posit absolute space, to avoid erring by affirming the consequent of (P2), it does not necessarily entail substantivalism.

In contrast, the relational nature of space and hence its ontological dependence on matter can also be arrived at positively through other Leibnizian arguments from economy. He argued matter is sufficient for a relational space time, and hence no sufficient reason to make the abstraction of spatial relations a real, separate substance (hypostatisation). This can directly prove (P3) and alongside (P1), prove (P3). Since both of these points do not weaken my argument, I thereby uphold the truth of my thesis.

8 Conclusion

Having argued for the truth of my premises, the validity and soundness of my argument pronounce that matter is necessary in the existence of space and time. I have also pointed out further related arguments, none of which posed a threat to my thesis, and hence I hope to have proven my case successfully.

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[11]Jammer 1954, p. 119.