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Is Newton's absolute space a priori synthetic knowledge and does this threaten Leibniz's critique on Newton's absolute space?

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Introduction

The concept of absolute space, introduced by Isaac Newton, has been a topic of philosophical debate for centuries. Absolute space is a metaphysical concept that describes three-dimensional, Euclidean, fixed entity that is a stationary reference point for all objects. Absolute space can be proven indirectly by observing absolute acceleration, however, absolute velocity and absolute position (which are consequences of absolute space), cannot be empirically observed and causes a lot of controversy.

In this essay, I will argue that Newton's absolute space is a priori synthetic knowledge, meaning that it is based on rational intuition and cannot be derived (or is necessary to derive) from experience alone. Moreover, I will examine whether this interpretation of absolute space undermines Leibniz's critique on Newton's theory. Specifically, I will investigate whether the a priori synthetic nature of absolute space is compatible with Leibniz's principle of the identity of Indiscernibles, which argues that no two objects in the universe can be exactly alike.

First, I will explain Newton's concept of absolute space in detail and why it would cause controversy. I will prove that the notion of absolute space is actually determined a priori rather than a metaphysical construct. I will further explain Leibniz's critique on absolute space and how absolute space being a prior threatens this critique. Lastly, I will expand on whether all consequences of absolute space (such as absolute position) are also a priori or not.

Content

When Newton developed his theory of motion, he coined the metaphysical concept of "absolute space" as a reference point for all motion. Absolute space is a hypothetic reference frame that is defined as being fixed at rest, relative to all objects in the universe. Reference frames are an important concept when discussing motion because without a proper frame of reference, it is impossible to tell which object is actually in motion relative to the other. For example, when you are sitting in a train where the window is blocked by another train right next to it and you start to see movement occurring, how do you know whether it is your train that is moving or the train next to you? It is common for people to initially mistake which one moves, usually the only way for them to rationalize which one is moving is by feeling the acceleration (or lack thereof) of the train they are in. If there were a more adequate reference frame visible that is known to be at a constant, fixed, state of rest, such as the ground of the Earth, then this mistake does not occur. This is why Newton introduced the concept of *absolute*

space. Absolute space is therefore the reference frame that is at a constant, fixed, state of rest relative to the whole universe – analogous to the ground of the Earth being a constant, fixed, state of rest relative to those that are mobile on the Earth. Absolute space is also understood to be an independent entity of all objects that it contains. Meaning that it exists independently whether or not there are objects contained in it. And the geometry of absolute space is three-dimensional and Euclidean and unchanging, as in, the geometry of space remains constant with or without objects.

Newton's notion of absolute space sparked some controversy because absolute space is a metaphysical concept that can't actually be directly observed. This is something that modern science strictly requires for a theory to be accepted, i.e. empirically backed evidence of the claim. Although absolute space can't be observed directly, what prompted this concept was the fact that it can be indirectly observed. To reference back to the train example, it is essentially impossible to tell which train is moving but what is known is that if the train that you were in was the one that started moving, you would feel the acceleration of the train. You would feel the force on your body as it is pushed forward. Therefore you can conclude with complete accuracy and with no fixed stationary reference frame that it is your train that is moving. Although Earth is often used as a convenient stationary reference frame, the Earth itself is not stationary on a cosmic scale; the Earth moves around the sun, which moves around the centre of the galaxy, which then also moves relative to other galaxies. Newton thought that, regardless of where you are in the universe, since it is always possible to detect which object is accelerating, even without any observable frame of reference (such as distant starts), that there must be an independent stationary frame of reference in space. This independent stationary reference frame was coined absolute space. The acceleration relative to that absolute space is called *absolute acceleration*. Since the position of space is fixed and at rest, that would also imply there is a thing such as *absolute position* and *absolute velocity*. As in, position relative to absolute space and velocity relative to absolute space. Unlike absolute acceleration, absolute velocity and absolute position aren't measurable. We can measure absolute acceleration because it is proportional to the amount of force that was inputted. This is Newtons first law of motion, force equals the mass multiplied by acceleration (F = ma). However, there is no such equation for velocity or position. For example, if you were travelling on a train, how could you measure your velocity without using Earth as a reference point? All velocities that are measured are measured relative to the stationary frame of the Earth. Without a stationary reference point, it is impossible to determine your velocity. In the same vein, there is no way to tell where you are unless you measure your position relative to something else. Although absolute space is

supposed to be the ultimate reference frame, the issue is that absolute space is empirically impossible to locate. Therefore, the notion of absolute space poses controversy in modern science because its direct consequences (absolute velocity and absolute position) are empirically impossible to determine.

One major critic of absolute space was Leibniz. Leibniz was a relationalist. Relationalists reject the notion of absolute space. According to relationalism, space does not exist independently of the objects that occupy it. Instead, the geometry of space is dependent on the objects inside it. For example, consider two objects in space, such as two planets. According to relationalism, the distance between the two planets is not an objective fact that exists independently of the planet themselves, which is what absolute space suggests. Rather, the distance is defined by the relationship and interactions between the two planets. The distance between the planets is not a fixed value but can change depending on the positions and movement of the planets relative to each other. This goes against the notion of absolute space because absolute space assumed that space is independent of the objects inside of it and the geometry of space is a fixed constant.

One argument that Leibniz came up with to refute the notion of absolute space is the Principle of the Identity of Indiscernibles (PII) which essentially states that if two things behave *exactly* the same way, then they must be the same thing. An example of where this principle is useful is the following: people are able to determine what the Earth's core is made of by analysing indirect properties that this material exerts. It was found that the Earth's core has *identical* properties to iron. It can be argued that the core isn't made of iron but rather a special composite that happens to exert the same properties as iron. This is a fair proposition since the Earth's core has never actually been directly observed. However, it's been empirically supported that it really is impossible for a certain material to exert identical properties as another material and it *not* be the same material. Therefore, the Earth's core *must* be iron. This is what the PII concurs. If the properties are identical; it's the same thing. Leibniz uses this argument against the notion of absolute space. He gives two examples that, according to Newton, must be different. Leibniz imagines a universe that is at rest, and one that is going at a constant velocity of 10 m/s. If absolute space is real, then clearly they must be different since one is moving relative to absolute space and the other is stationary relative to absolute space. Leibniz argues, however, that it is impossible to detect any differences between these universes, as they exert the exact same identical properties, and therefore according to PII they must be the same thing. If those universes are the same thing, then absolute space cannot exist, because absolute space would require that the universes are different. I want to now argue that absolute

space shouldn't be written off as an unempirical metaphysical concept that can't be proven and show that it may be a logical necessity when it comes to motion.

Absolute space doesn't have to be seen as an abstract concept. Newton defined the motion of an object to be the rate of change of position, 'x', over time, 't', ($\frac{dx}{dt}$). From the definition of motion it can be directly inferred that, relative to the object in motion, there is a state of rest. Otherwise, there would not be a change in position over time. All objects in motion, therefore, have this relative state of rest directly deduced from the definition of motion. For any motion to occur, Newtons first law of motion states that an input of force is required. It can be reasoned that before something was set in motion by a force, it must have originally been at rest. This applies to all objects in the universe. Although there are many objects going at varying velocities, they all must have a common state of rest, because that state of rest is a logical prerequisite before any of the objects are able to have motion.

Therefore, the relative state of rest of all objects in motion is a priori synthetic knowledge. That is, this fact does not require empirical evidence to prove (because it is logically deduced) and the knowledge obtained is not trivial (because it is not directly in the definition but a logical consequence of it). This relative state of rest that all objects in motion must have can be interpreted to represent Newton's absolute space. Absolute space is the state of rest that all objects in motion are moving relative to. This time not as an abstract concept but a logical necessary one. From this reasoning absolute space doesn't have to be an independent concept that Newtons laws of motions are built upon, but rather the logical consequence from the empirical fact that there is any motion at all. From this point of view, Newton's absolute space does not require empirical proof and may save him from the critique that his concept is too metaphysical and empirically nonsensical.

How does the notion of a priori stationary reference state affect Leibniz's critique with the universe at rest and the universe in motion? According to Leibniz, these universes must be the same and therefore absolute space does not exist. With our new concept of a priori stationary reference, the universe in motion, must by inference have a relative state of rest, and therefore there is a stationary reference frame that the former universe has that is the same as the latter universe. Leibniz's argument isn't able to disprove that this logical consequence isn't true. Although his argument PII is empirically convincing in most cases, it is not enough to refute a priori synthetic knowledge and can therefore be rejected on those grounds.

A relationalist like Leibniz may argue that there is more to Newtons conception of absolute space than a simple stationary reference frame that is determined a priori. The three

logical consequences of absolute space are absolute acceleration, absolute velocity, and absolute position. Absolute acceleration can be indirectly observed, which was explained prior. Absolute velocity can't be observed (directly or indirectly) however, based on previous arguments it was reasoned that all objects in motion (going at a certain velocity) have a common stationary reference state, in other words, all objects in motion is in motion relative to absolute space, therefore absolute velocity is a logical consequence of motion. However, what about absolute position?

The argument provided earlier may work with proving absolute velocity exists, however, it does not work with absolute position. The concept of absolute velocity worked because all object in the universe must, at some point, started from a common state of rest. However, this isn't the case for absolute position. Not all objects in the universe must have started from the same point in space and have all moved relative from that point. This is something that absolute space requires because it is a reference point where position, velocity, and acceleration can be measured against. Since it cannot be logically deduced that position must also have a common reference point, that means that absolute position isn't a priori synthetic knowledge. Relationalists could use this fact to support their concept of space, where objects in space can only be described as points relative to each other, rather than relative to absolute space. Even though their arguments fall for absolute acceleration and absolute velocity, they still have a case for absolute position. So, on these grounds the relationalist could argue that the notion of absolute velocity being a priori synthetic knowledge does not prove that absolute space is a priori synthetic knowledge, because absolute position (which is a conceptual consequence of absolute space) remains empirically unproven *and* logically unproven.

In this essay, I analysed whether Newton's absolute space was a priori synthetic knowledge and how that would threaten Leibniz's critique on Newton's absolute space. Absolute acceleration, absolute velocity, and absolute position are all conceptual consequences of absolute space. The ability to directly observe absolute acceleration has been support for the notion of absolute space. The lack of observability of absolute velocity and absolute position has been the source of controversy of absolute space. In this essay I have shown that absolute velocity can be determined a priori. From the definition of motion ($\frac{dx}{dt}$), which states that velocity is the rate of change of position over time, implies that when an object moves, there must be a state of rest it is moving relative to. All objects in the universe must have a common state of rest because for any motion to have occurred at all, it first have an input of force. This

notion refutes Leibniz's example against absolute space because Leibniz argues that a stationary universe and a universe in motion must be the same according to his principle of the identity of indiscernibles. Understanding that absolute velocity is a priori synthetic knowledge, this argument no longer holds any weight. This concept, however, makes no case for absolute position. The existence of absolute position is therefore still up to debate and Newton's notion of absolute space isn't completely defended from relationalist attacks.

References

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