432018 PHILOSOPHY OF PHYSICS (Spring 2002)

Lecture 12: Arguments for the 'absolutist' and 'relationist' views of space

Preliminary reading: Sklar, pp. 19-25.

Now that we have seen Newton's and Leibniz's views of space and some of the problems they face, we now turn to the major arguments for and against their positions. We start with Newton's 'bucket argument' which purports to show that an absolute space is needed to account for certain physical phenomena. We then turn to Leibniz's arguments against absolute space as put forward in the Leibniz-Clarke correspondence. Then, as a precursor to our study of Relativity Theory and the notion of 'space-time' we briefly consider Newton's and Leibniz's views of time.

1 The 'bucket argument'

Newton thought that the results of experiment and observation established that there was absolute motion, i.e. motion relative to absolute space. His main argument for this is the 'bucket argument' and it challenges the relationist position in the following way:

- For a relationist, a notion like 'unchanging speed' can only be understood relative to a framework fixed by some material objects. For example, something *at rest* relative to the Earth's surface is *in motion* relative to a reference frame fixed to the Sun.
- However, Newton argues that the notion of *non-inertial* (or *accelerated*) motion, is not 'merely relative', it is 'absolute'.

We shall start by examining the observed effects that form the basis of the argument, and then we shall turn to the argument itself.

To start with, consider the case of a body which is accelerating in a straight line, i.e. a body which is travelling in some fixed direction with a steadily increasing speed. For example, consider the case where you and I are in cars on a straight stretch of motorway. However, I am in a car which is at rest on the hard shoulder (I have broken down) and you are accelerating away from me down the motorway. Now, the point is that you will feel *inertial effects* due to your acceleration, i.e. you will feel yourself being pulled back into your seat as you accelerate, and I won't. As such, the Newtonian would claim that you are *really* accelerating and that is why you experience the inertial effects and I don't. However, the Leibnizian can't say this since, you can think of me as accelerating away from you just as much as I can think of you as accelerating away from me. That is, for the relationist, there is only a notion of *relative* acceleration, and as such, neither of us can be taken as the one which is *really* accelerating. Consequently, there seems to be no reason why you experience the inertial effects and I don't!

Now, the 'bucket argument' is based on another kind of accelerated motion, namely *rotational* motion. To see why a rotating body is accelerating consider a point on a turntable which is rotating at a constant rate. The speed at which this point is moving is fixed (i.e. the distance travelled per unit time is fixed), but the direction in which it is travelling is constantly changing so that it can follow the circular path associated with the rotation of the turntable. As such, the velocity (i.e. the speed *in a given direction*) of this point is changing with time and so, this point is accelerating. Consequently, since rotations are examples of accelerated motions, they will have inertial effects associated with them, and such an effect is the basis of the 'bucket argument'.

Now, the specific inertial effect we are concerned with here can be seen in the following phenomenon. Consider a bucket of water which is suspended by a rope so that it is free to rotate as in Figure 1. When both the bucket and the water are at rest, see (a), the surface of the water is flat and there is no relative motion between the bucket and the water. Now, if we make the bucket rotate (say by 'winding up' the rope), we start with a situation where the bucket is rotating and the water is still at rest, see (b). But, as the bucket is moving and the water is not, there will be frictional forces acting between the bucket and the water. In time, the action of these frictional forces will cause the

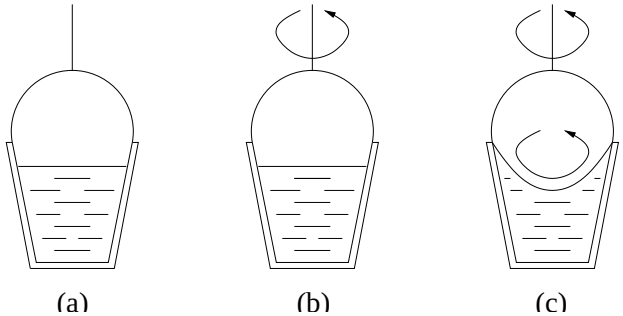

Figure 1: *The 'bucket argument'. (a) The bucket and water are at rest. (b) The bucket is rotating but the water is at rest. (c) The bucket and water are both rotating at the same rate.*

water to rotate, i.e. the water will start to move too. And, these frictional forces will continue to operate until the bucket and the water are rotating at the same rate, i.e. until there is no relative motion between the bucket and the water, see (c).

The 'bucket argument', in brief, then runs as follows:[1]

- **Premise 1:** The shape of the water's surface is dependent on some motion. (This motion is either absolute or relative.)
- **Observation:** (a) and (c) represent situations where the bucket and the water are rotating at the same rate, yet there is a difference in the shape of the water's surface. (So, in both of these cases, the bucket and the water have the same (i.e. no) relative motion, but the shape of the water's surface is different.)
- **Therefore:** The shape of the water's surface is not dependent upon the motion of the water relative to the bucket. (But, it could be due to the motion of the water relative to something else.)
- **Premise 2:** If the shape of the water's surface was dependent upon some relative motion between the water and a set of objects not in contact with it, then there must be action at a distance. (As we have seen, for Leibniz, relative motion must be motion relative to some other objects.)
- **Premise 3:** There is no action at a distance.[2] (As we shall see, this is the premise that Mach will deny.)
- **Therefore:** The shape of the water's surface can not be dependent on relative motion and, as such, it must be dependent on its absolute motion. (Hence inertial effects, like those due to rotation, can not be accounted for within a relationist framework.)
- **Premise 4:** Absolute motion is motion relative to absolute space. (As this is what absolute motion is.)
- **Therefore:** Absolute space exists. (How else can we have absolute motion?)

Clearly, this argument is a kind of 'inference to the best explanation' of some observed phenomenon. That is, given the choice between the relationist and absolutist view of space, we should choose the latter since the former can't supply an adequate explanation. Furthermore, it should be noticed that this is an argument for an *absolute* space and, as such, it doesn't tell us anything about what space *is*.

[1] Remarks in parentheses indicate key points at each stage of the argument.

[2] What about Newton's gravitational force? This is clearly too weak to generate such effects, but it is a kind of action at a distance.

2 The Leibniz-Clarke correspondence

Much of the *philosophical* debate between Leibniz and Newton appeared in a correspondence between Leibniz and Clarke (a follower of Newton). This correspondence contains a number of important arguments for and against each of the positions. Some of the arguments are quite poor and many of them make reference to God and/or what may now be seen to be dubious metaphysical principles. In particular, it is not always clear what is going on and so we shall present a simplified form of the arguments. Much contemporary debate on these issues goes to great lengths to give more detailed accounts of the arguments involved.

We shall start by commenting on the basis of Leibniz's arguments, namely his two main 'metaphysical principles', and then we shall consider his two main arguments against the absolute view of space.

2.1 Leibniz's metaphysical principles

In his arguments against Newton's view of space, Leibniz adopts two metaphysical principles that are an essential part of his 'deep' metaphysics:

- The *Principle of Sufficient Reason* (PSR): For every event there should be a sufficient reason as to why it is so and not otherwise.
- The *Principle of Identity of Indiscernibles* (PII): Two things which appear to be completely indiscernible must in fact be the same thing, i.e. they must be identical.

Indeed, in the correspondence, what is to count as a 'sufficient reason' is usually something to do with the will of God. In particular, applications of the principle of sufficient reason, often involve God being invoked in one of two distinct ways:

- He is used as the [positive] 'reason' why something must be the case, i.e. He *would* make it so that, and
- He is used as the [negative] 'reason' why something can not be the case, i.e. He *would* have *no* reason to make it so that.

which should, perhaps, be carefully distinguished since they place different constraints on how God acts.[3] Also, by way of general background to the correspondence, we should note that:

- In his second reply to Leibniz, Clarke says that he accepts Leibniz's Principle of Sufficient Reason. But, with the proviso that the 'sufficient reason' motivating God's choice may be nothing more than 'mere will'. (Cf. the distinction made above.)
- Leibniz's arguments against absolute space are actually Clarke's arguments 'turned on their heads'.

So, bearing all of this in mind, let's turn to the arguments themselves.

2.2 The argument from (PII)

In the "Second Letter to Leibniz", Clarke asks the following of Leibniz's view of space:

> For instance: why this particular system of matter should be created in one particular place, and that in another particular place; when (all place being absolutely indifferent to all matter) it would have been exactly the same thing *vice versa*, supposing two systems (or the particles) of matter to be alike; there can be no other reason, but the mere will of God. [Clarke, Second Letter to Leibniz]

In his "Third Letter", Leibniz tries to turn Clarke's argument 'upside down 'and he uses it to

[3] It is, perhaps, interesting to ask whether we can rephrase these theistic arguments in, say, modal terms so that they would be more palatable to our modern philosophical sensibilities...

> . . . confute the fancy of those who take space to be a substance, or at least an absolute thing. [Leibniz, Third Letter to Clarke]

and Leibniz's argument for this relies on (PII). However, we should be careful to distinguish (PII) *qua*

> (PIIO) The *Principle of Identity of Indiscernibles for Objects*: If two objects have exactly the same genuine properties, then they are one and the same object.

as it is normally, and some would say unproblematically, used in philosophy, and (PII) *qua*

> (PIIPW) The *Principle of Identity of Indiscernibles for Possible Worlds*: If two possible worlds are exactly similar with respect to all genuine properties, then they are one and the same possible world.

which is how Leibniz is using it in the argument that follows. In particular, Leibniz believes that he can utilise (PII) since, according to Newton's theory of motion, there are two kinds of 'shift' that the world can undergo which are *undetectable*, namely:

- Static shifts (SS): Newton claims that the material universe has a particular location within absolute space. Thus, if the material universe were situated somewhere else in absolute space, then everything would appear just as it does (provided that all the distances and relative motions between bodies are preserved).
- Kinematic shifts (KS): Newton claims that everything in the material universe has a definite (but undetectable) state of motion *relative* to absolute space. Thus, if everything in the entire universe had a different state of motion relative to absolute space, then there would be no observable differences (provided that all the distances and relative motions between bodies are preserved).

These 'shifts' generate what we could call 'Leibnizian alternatives', possible situations with the following characteristics:

- all the material bodies in the material universe are differently related to absolute space;
- all the spatial and temporal relations between the bodies are the same;
- the situations in question are exactly the same in all observable respects (according to Newtonian physics).

and, these Leibnizian alternatives give rise to two very similar arguments.

Leibniz's argument from (PII) with (SS)

Leibniz's first argument now runs as follows:

- If space is absolute, then the material universe could be located in one region of absolute space or another different region of absolute space (where all of the distances and relative motions between the bodies in the material universe the same). These correspond to two different states of affairs for the absolutist. (But, the same state of affairs for the relationist.)
- But, this is a static shift and so it is undetectable according to Newton's physics.
- Thus, since we can not detect the difference between these two states of affairs, by (PIIPW), these two states of affairs must be the same. Contradicting the absolutist claim that there are two distinct states of affairs, i.e. there can be no absolute space to distinguish them. (And, incidentally, agreeing with the relationist.)

Thus, this argument utilises (PII) to show that two situations which are observationally indistinguishable (in this case, with respect to their location in absolute space) must be the same situation.

Leibniz's argument from (PII) with (KS)

Leibniz's second argument is very similar:

- If space is absolute, then the material universe could have one state of uniform motion relative to absolute space or another different state of uniform motion relative to absolute space (where all of the distances and relative motions between the bodies in the material universe the same). These correspond to two different states of affairs for the absolutist. (But, the same state of affairs for the relationist.)
- But, this is a kinematic shift and so it is undetectable according to Newton's physics.
- Thus, since we can not detect the difference between these two states of affairs, by (PIIPW), these two states of affairs must be the same. Contradicting the absolutist claim that there are two distinct states of affairs, i.e. there can be no absolute space to distinguish them. (And, incidentally, agreeing with the relationist.)

Thus, this argument utilises (PII) to show that two situations which are observationally indistinguishable (in this case, with respect to their uniform motion relative to absolute space) must be the same situation.

Leibniz's strategy

So, Leibniz is clearly using the same strategy in both arguments. In particular, we see him claiming that the Newtonian is committed to saying that different states of affairs relative to absolute space[4] cannot be observationally distinguished and hence must be the same. As such, there is no warrant for presupposing an absolute space since there is no way of inferring its existence in these cases. However, the relationist can quite happily maintain that such shifts (relative to absolute space) are 'meaningless' since there is no change in the spatial and temporal relations between the bodies in the material universe.

But, there is an **objection** to Leibniz's argument, namely that he begs the question:

- For (PII) to apply, Leibnizian alternatives have to be *indiscernible* with regard to all *genuine* properties. As such, a Newtonian could claim that they *are* discernible due to a genuine relation which holds between these alternatives and absolute space, i.e. he can just deny that the pre-shift and post-shift worlds are the same. Indeed, Leibniz's arguments play on the difference between *indiscernible* and *undetectable*, and until he has established that only *empirically* detectable differences in properties are to count as *genuine* differences his argument fails. The fact that 'indiscernible' can be read as 'not detectably different' can easily obscure this point.

Of course, there is also the point raised in the 'bucket argument' since, *contra* Leibniz, there are *some* observational grounds for believing in absolute space.

2.3 The argument from (PSR)

Leibniz's other main argument against absolute space is based on (PSR) and it runs as follows:

- Absolute space is something completely uniform, i.e. in the absence of any material bodies, no point in space differs in any respect whatsoever from any other point of space.[5] (Recall that Newton's absolute space is both homogeneous and isotropic.)
- If space were absolute, then there would be no reason why the material universe should be located at one place rather than another. (That is, God would have no reason to create the universe in one place rather than another.)

[4] At least, those which rely only on different positions and uniform motions.

[5] So, using (PII), there can only be one point?

- But, this violates the Principle of Sufficient Reason. (After all, what reason could God have to choose between these indistinguishable alternatives?)
- Thus, there can be no absolute space. (However, the relationist is immune to this argument since, once God has decided on the spatial configuration of the universe, that's it! He doesn't have to worry about where it is to be located in absolute space.)

In this argument, Leibniz seems to be considering static shifts in the context of an initial act of creation. God has to put the material universe *somewhere* in absolute space, but given the uniformity of such a space, what reason could he have for placing it in one region rather than another? If, along with (PSR), we assume that God does nothing without good reason, we seem forced to conclude that he wouldn't create absolute space since, if he did, he would be putting himself in a position where he would have to make 'reason'-less choices which, surely, he would never do. On the other hand, by not creating absolute space, i.e. by only creating material bodies that are spatially related to one another in certain ways, this problem is avoided.

Notice however that the same argument cannot be run with kinematic shifts. To see why, note that the isotropy of space means that God would have had *no* reason to set the material universe moving in *any* of the available directions. As such, once he has decided *where* to put the material universe, he has a good reason *not* to set the material universe in motion at all! That is, he has a reason to create the universe at rest relative to absolute space.

But, there are **objections** to Leibniz's argument:

- Non-theistic Newtonians can simply deny that there was an initial creation event and so the need for a 'reason' for the material universe to be situated in one region of absolute space rather than another never arises.
- Theistic Newtonians, such as Clarke, can deny that God needs a 'reason' in Leibniz's sense. For, as Clarke argued when he *introduced* the 'shifts' in order to show that Leibniz couldn't account for such distinct possibilities, to suggest otherwise is to claim that God, in all his glory, cannot act when faced with such 'arbitrary' choices. That is, if God can't act in such situations then his actions must always determined by extrinsic factors despite his supposed omnipotence.
- Modern philosophers all agree that Leibniz's (PSR), in its psychologistic and theistic form is completely untenable.

3 Newton and Leibniz on time

Parallel to the development of their views on space, both Newton and Leibniz had corresponding views of time. This isn't particularly important here, but it will become relevant in the next lecture.

3.1 Newton's 'absolutist' view of time

Unsurprisingly, Newton has an 'absolutist' view of time to accompany his view of space. In the Principia, he famously says that:

> Absolute, true and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration. [Newton, Principia]

which is analogous to his view of space.

3.2 Leibniz's 'relationist' view of time

Also unsurprisingly, Leibniz has a 'relationist' view of time to accompany his view of space. He says:

> Instants, considered without the things, are nothing at all; and ... they consist only in the successive order of things. [Leibniz, Third Letter to Clarke]

and, to further stress the fact that time is 'constructed' out of temporal relations, he says:

> Time, without things, is nothing but a mere possibility; ... time does only consist with the creature, and is only conceived by the order and quantity of their changes. [Leibniz, Fifth Letter to Clarke]

So, as before, Leibniz's motivation is clear:

- Consider two events E_1 and E_2, thought of as happenings between material objects. These events stand in temporal relations to one another[6] and they can stand in quantitative relations to one another.[7]
- As such, Leibniz claims that time is just the collection of all such temporal *relations* amongst such events.
- Note: if there were no events, there would be no temporal relations. As such, time in this sense has no existence independent of events.
- But, the relations among the events are a real component of the world and, as such, it would be misleading to say that there is no such thing as time at all.

In particular, notice that unlike his view of space which is founded upon the relations between *possible* material objects, his view of time relies only on the relations between *actual* events. As such, his view of time is analogous to the *non-modal* relationist view of space which we used to motivate Leibniz's relationism.[8]

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[6] For example, E_1 can be before E_2 or E_2 can be before E_1 or E_1 and E_2 can be simultaneous.
[7] For example, E_1 can be separated in time from E_2 by a definite time interval.
[8] Compare and contrast this with the metaphysical debate about the relationship between 'time' and 'change'.