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A New Perspective on Enantiomorphic Pairs and Substantivalist Spacetime

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Note: Ms. Hutchens' paper was selected as the Best Paper for the 2011 Undergraduate Philosophy Conference.

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Abstract

I present a logical argument for the existence of substantivalist spacetime: We should consider the account presented by Kant of spacetime as a genuine substance because it provides a plausible alternative to the widely held relationist viewpoint. I present several examples of enantiomorphic pairs, including the lowercase letters p and q to illustrate differences between such objects that have no apparent connection to the internal structure of each. These differences, I claim, must stem from a direct relationship between the objects and space itself. Furthermore, I examine the implications presented by enantiomorphic objects when time is taken to be the fourth dimension based on Einstein's view of general and special relativity.

Introduction

Most scientists and philosophers in recent years have agreed that space and time exist in some form, but opinions vary wildly as to its nature. Does it exist as an independent thing, a container within which all other objects fall? Or does it merely exist as a relation between objects? While this debate has existed since the early 18th century, the views held by contemporary scientists have changed little. The substantivalist position asserts that space is a thing that exists independently of objects. The relationist position in direct contrast maintains that space exists only as a mere relation between objects.

Both views accept the existence of space; however relationists believe that space is directly dependent upon objects; if there were no objects in the universe, space would simply not exist. Space comes into existence when we begin referring to objects or possible objects. In referring to right, left, or other orientations in space we are referencing a space that merely exists through the relation between two or more objects. Substantivalists, on the other hand, believe that space clearly exists independently of objects as an object itself. If a universe existed in which there were no objects, space could still exist like an empty container. Immanuel Kant is one such philosopher who deemed it possible for space to exist independent of objects based upon a simple example involving a pair of gloves. He thoroughly examined the metaphysical

implications of earlier philosophers, and eventually ascribed to the substantivalist position.

By first examining Kant's original argument, then looking at the contemporary responses to it, I will identify the unstated assumptions as well as the implications inherent in each view; concluding that substantivalism is both a view that has maintained logical merit, and provided an interesting alternative to the increasingly popular relationist position. First I will evaluate the argument from the handedness of objects proposed by Kant, and expanded upon by Lawrence Sklar. I will then invoke the letters p and q as an equally effective alternative. Finally I will illustrate how Kant's example is logically compatible with Albert Einstein's theory of general relativity in order to illustrate that substantivalism is still a cogent hypothesis.

Gloves as Enantiomorphs

While a pair of gloves lying palm down side by side on a flat surface possess qualities that make them distinct objects, the exact differences are curiously difficult to articulate. Kant pointed to the structure of each glove, showing how the measurements and angles are exactly the same, simply appearing to be mirror images of each other. In doing so, he showed that though they appear identical; they are in fact very different. No matter which way the gloves were moved, they could not be made to appear oriented in the same way; this illustrates that even though a pair of gloves appear identical in structure, they are actually incongruent to one another. This incongruent quality can be applied not only to gloves, but also to the hands themselves.

Congruence can be pictured by imagining two right isosceles triangles with sides of identical length both resting on a two-dimensional plane. The two triangles are congruent, because a rotation of one triangle can bring it into alignment so that it looks identical to the other. Congruence thus means that a continuous rigid motion (CRM) can bring two things which are oriented differently into a position in which they are identical in appearance; in the case of the triangle, a simple rotation (Sklar 236).

In opposition to the term congruent is the phrase incongruent counterpart. This idea takes two shapes which are again identical in structure, however cannot be brought into congruence by a CRM. Take for instance the lowercase letters p and q. Both letters are structured in an identical manner on a two-dimensional surface with their only difference being position in relationship to space. The difference in this case from the congruent pair of triangles above, is that no rotation or two-dimensional movement of any kind will bring them into congruence. Likewise, the gloves mentioned above cannot be brought into congruence through any CRM in three-dimensional space. Even

inverting the gloves fails to bring them into congruence; thus Kant deems them to be an enantiomorphic pair, another term for a pair of incongruent counterparts.

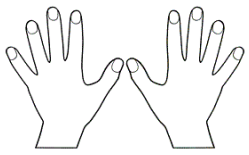
Kant's inquiry into the handedness of gloves was for the purpose of determining whether or not right or left-handedness could be determined by some relational property of the gloves themselves, or whether or not an external substance known as space would have to be utilized to account for the obvious spatial difference between the two. His account ultimately found that space was a necessary prerequisite to explain the difference between the two objects. Kant insisted that because the pair of gloves is identical in structure and cannot be brought in congruence, that the only way to reference them individually as a right or left-handed glove in a universe in which the gloves were the only thing in existence, is through a reference to space itself (Sklar 235).

Other philosophers responded, claiming that there was in fact a way to distinguish the two gloves; through a reference to the internal features of one of the gloves.[1] By examining each and recognizing that on the right-handed glove the thumb is at a 45 degree angle to the left of the palm and that on the left-handed glove the thumb was at a 45 degree angle to the right of the palm they could tell which glove was right and which glove was left without having to reference the counterpart.

The problem with this is that in order to consider something right-handed or left-handed in the truest sense, its handedness must be preserved regardless of its orientation. In the case of the gloves, they must have the property of being right-handed or left-handed whether the palm of the glove is facing toward an observer or away. In this example, there is no way to discern whether or not a single glove is right or left-handed; if the observer merely changed position so that they were looking at the opposite side of the glove, their perception of the handedness of the glove would change. However this does not preclude the existence of handedness; rather it is impossible to imagine a glove or hand that exists without the property of handedness. Both sides of the debate acknowledge that this characteristic exists. As a result, the existence of an observer is inadequate to explain the apparent handedness.

Kant reasoned that without some way of using an external factor to determine whether or not a glove is right or left-handed, there would have to be some intrinsic difference within the glove to account for handedness. He assumed that handedness was not a

[1] By examining the relation of the internal parts of each glove individually, some philosophers came to the conclusion that "handedness" is a property intrinsic to each glove (Sklar 235).



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feature about a glove that could be changed along with the gloves' orientation; and as such no intrinsic feature of the glove was sufficient to explain the difference. The relationship of the thumb with regard to the rest of the glove is irrelevant; if the glove was turned so that that palm faced away from you the glove would appear to switch handedness, which Kant asserts cannot happen (Sklar 237).

The same can be said for the p and q example. Without any reference point to determine how the letters should be viewed directionally, how could one determine whether they were viewing a p or a q? It would be impossible. Yet there is a fact of the matter. To better imagine this, picture both the p and the q drawn on a window. From inside the window one would appear as a p and one as a q. From the outside the effect would be reversed. Without some element of space determining the perspective by which the objects should be viewed, there is no viable way to tell the difference; and yet we know that there is in fact a difference between the two objects.

Stick Figures and Facings

When another pair of objects with defined facings exists within the context of surrounding objects, their orientation remains no less mysterious. Imagine two stick figures with no faces; one of the stick figures is facing toward an observer, and the other is facing away. How would one go about determining which stick figure was facing which direction? This thought experiment created by John Koolage follows the same process as with the p and q example. We know that there is a fact of the matter that one is facing the observer and the other is facing away. We also understand that there is some intrinsic difference between the two objects, because although they appear identical, there are in fact two separate objects by stipulation.

The relationists would say that provided space exists objectively we should be able to discern which is facing toward and which is facing away. Of course, there are no distinguishing features to hint as to which is which, and the knowledge of which is to the right and which is to the left of the other is not helpful in answering this question. The relationists rightly conclude that according to that definition of space, the orientation of each stick figure is impossible to determine. That being the case, they make the jump to assuming that space cannot exist within the realm of objective reality. However, they make the jump based on the assumption that for space to exist, the orientation must be discernable by an observer. Substantivalists claim that space can exist and give objects a specific orientation, even if the true orientation is inherently unknowable; as a result this determination by no means makes or breaks the substantivalist viewpoint.

The relationists seem keen on declaring based upon this argument that space does not exist except as a mere relation between objects. However this conception is misguided

at best. Their argument essentially begins to fall apart before it even fully forms because there is an unstated assumption made at the very beginning of this thought experiment. By claiming that p and q both have a specific identity and claiming that the stick people do in fact have a specific orientation, they are unwittingly accepting the idea that there is objective and independently existing space to begin with.

Objective space in this sense is evidenced by the fact that even though both stick figures appear identical, they are not the same, because they both occupy different points and have different orientations with regard to space. Essentially, the relationists attempted to illustrate the inadequacy of the substantivalist viewpoint by attempting to argue the idea that even objective independent space does not provide the ability to identify orientation of objects in relation to itself. However, this implies that there is a definite directionality; which implies the existence of spacetime. In effect, the relationists are assuming that the objective view of spacetime they were trying to disprove actually exists for their argument to work correctly.

A Relationist Response

One argument for the relationist view of space is that there are in fact no such things as incongruent counterparts. While this may sound far-fetched, at face value they make an interesting point. There is an aspect of observation that can have a definite effect of the appearance of congruity. Lawrence Sklar used the example of a circle with one line outside of it and one line drawn inside.[2] While it is impossible to move the line outside of the circle to an interior position without crossing the edge of the circle and without moving it in a CRM that breaks the two-dimensional plane, he illustrates that this by adding a third dimension, it becomes easy to reconcile (Sklar 238). By changing perspective and moving to the far edge of the paper, viewing the shape at an extreme angle, it is impossible to make the exterior line appear as though it lies within the bounds of the circle. However in three-dimensions a CRM can easily move the line outward and into the circle. In this way Sklar posits that it may be possible to bring incongruent counterparts into congruence by merely considering a higher dimension (Sklar 238).
While this is interesting in theory, it becomes much more difficult to fathom with three-dimensional objects. Because with the two-dimensional example a three-dimensional perspective change is necessary to view the shape with both lines inside the circle, to do

[2] Lawrence Sklar's Depiction of a circle where the exterior line cannot be moved to the interior of the circle without breaking the two-dimensional plane (Sklar 238)

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the same to a three-dimensional incongruent counterpart would involve some sort of four dimensional perspective. The fourth dimension, which is considered to be time according to Einstein's theories of general and special relativity, must have some property by which we can move the object into congruence through a valid CRM if this theory is to hold.

Unfortunately, the concept of being able to shift one's seemingly fixed position in time in order to view three-dimensional enantiomorphic pairs in such a way that they appear to attain some form of congruency is to me unrealistic. If the fourth dimension is time, there is no apparent way to move the objects according to any CRM and have them appear congruent. The object would have to change its position with regard to time in some way in order for this to occur. Things that can be easily demonstrated in two-dimensions frequently fail to hold to the same principles in three and four dimensions. Unless a valid example can be given to illustrate that such a shift can and does actually occur, there is no reason to accept one two-dimensional simplified example as the lynchpin upon which one should build their entire viewpoint regarding the nature of space and time.

Indeed, if one appealed to this sort of argument to prove their position it could simply be reversed. In two-dimensional space the p and q which are enantiomorphs would appear merely as identical lines. Appearing congruent from a 2D perspective ultimately has no bearing on whether or not the shapes are actually congruent. If we were to begin looking in higher dimensions such as the third and fourth for congruency, we may be just as likely to find even more instances of incongruent counterparts. Without any real opposition to the existence of incongruent counterparts otherwise known as enantiomorphic pairs, we can safely assume that these pairs do in fact exist in reality beyond mere abstraction. Evidence of pairs such as gloves and letters provide tangible evidence for this idea.

Reductionism and the Third Reference Point

Reductionism asserts that space and time are mere conventions; that they do not exist in objective reality. If space and time are merely a convenient way of speaking, then there would be no potential for enantiomorphic objects to exist. This is because without a tangible difference between the two objects, there would be no way to differentiate them from one another. According to the laws of logic, two things by definition cannot be one thing; and thus there must be some difference, whether it is their location in space or their orientation. In the case of enantiomophs that difference must be in relation to the object's orientation; one glove is right-handed because it is oriented differently than the other. Which is entitled right-handed and which left-handed does not actually make a difference. The fact of the matter remains, that there is a difference

beyond what term we use. Thus, the substantivalist will assert that space exists. The nature of that space however, still has the potential to be debated between the remaining viable views: relationism and substantivalism.

If space exists, and if two incongruent counterparts such as p and q exist in a plane, we should be able to tell which is which through a reference to space itself. The question with this premise arises with the use of the word "space." There are two possible definitions of space that we are considering. The first is the view held by the substantivalists, or objective space. The second, space relative to the relation between objects, or relationist space.

If we assume space is merely relationist and apply this idea, then we end up with an altogether different response than that of a substantivalist. The relationist view sees the enantiomorphic objects as creating space through their relationship to each other. If this is the case and there is no objective space except the relation between objects then the orientation of the objects cannot be defined; thus p and q to the relationist remain undetermined without some third reference point. Essentially, this example is the same as when p and q were written on a glass window; from different perspectives it is always possible to differentiate two objects, but impossible to tell which is p and which is q without some third reference point.

Why is it important that we are able to discern the difference between the two objects in the first place? Because if we are able to distinguish a difference between the two, then some trait external to their structure has to determine which shape is which; barring the existence of some obscure intrinsic property that remains unknown to us. Proving a definite property, whether internal or external, that differentiates the shapes would provide compelling evidence for the idea that space exists as an external independent substance.

While the relationists are convinced that the substantivalists cannot discern between the two shapes either, the substantivalists are convinced that the concept of objectively existing space is a necessary prerequisite of the entire argument to begin with. The substantivalist view actually works quite well with the scenario of the indefinable p and q. With orientation defined, we know the proper perspective by which we should be examining the two shapes; it is quite easily to tell the difference between the letter p and the letter q. In fact, it's virtually identical to simply reading the letters off this page.

Without some sort of third reference point, the relationists cannot determine which way the letters should be examined and thus cannot tell the difference between the two. The substantivalists, on the other hand, have the third reference point built in; "space" itself. The substantivalist perspective seems to provide the third reference point by which we

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are able to ascertain the proper orientation and perspective, thus having the ability to determine which the identity of each letter, both p and q.

While the substantivalists would be content to stop here, the relationists continue with their argument. They claim that because the orientation of p and q cannot be determined the identity of each letter remains unknown. If we assume that we can only use the letters themselves to determine which is which, and their structure is identical, we have no way of ascertaining the difference. Because of this the relationist is faced with quite a problem.

With no way to bring the shapes into congruence via a CRM and show that incongruent counterparts do not in fact exist, and without a way to differentiate the shapes from each other except with regard to their orientation; they must claim that which is the letter p and which is the letter q is inherently unknowable without some third object. Internal directionality fails to ascertain which is which, because the moment the perspective is changed the perception of which shape is which changes with it. The problem with this idea is that the relationists are utilizing their own concept and definition of space for the purpose of determining the validity of the substantivalist viewpoint. This does not work because utilizing the substantivalist view of time including the concept of the third reference point the identity of which letter is which is easily ascertained.

In this way, space appears to be an irreducible concept; we cannot refer to any object without referring to its position with regard to space. Time functions in much the same way. We cannot make references to any particular thing or object without referencing it within the paradigm of time. Whether past, present, or future, the tense with regard to time is just as vital as its position in three-dimensional space. Because of this, I am inclined to pair time as the fourth dimension in addition to the three-dimensional space as spacetime. While time adds another level of complexity to traditional 3D space, it provides an interesting change in possibilities for reference point changes in such thought experiments. Many contemporary scientists and philosophers have wrestled with these ideas and believe that the concept of spacetime based on both thought experiments and physical research; however the details of those inquiries are best left to another time.

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