Boris Hennig
IFOMIS Saarbrücken

Draft version as of July 17, 2005

Temporal Extension

Abstract. Space and time are continuous and extensive quantities. But according to Aristotle, time differs from space in that its parts do not have a position relative to another. In this paper, I set out to justify this claim.

First, at any time instant at which a temporal entity exists, there will exist at most one of its temporal parts. But there can never be more than one actual time instant. Hence, temporal entities never have more than one (presently existing) temporal part. Second, there can be no adequate and purely spatial representation of a temporal entity. There can be no representation of change without a change in representation.

It follows that there is no point of view from which we can directly access more than one temporal part of a temporal entity. This is the essence of the Aristotelian distinction.

1. Time as Quantity

According to Aristotle, a quantity is anything that can be divided into parts (*Metaphysics* Δ13, 1020a7–8). However, some quantities have parts that have a position (*thesis*) relative to each other, some do not (*Categories* 6, 4b20). Aristotle claims that time is the only continuous quantity whose parts do not have a position relative to one another:

> Nor do the parts of time [have some position in relation to one another]; for none of the parts of a time endures, and how could what is not enduring have any position? (5a26)

Hence, Aristotle concludes, time is not composed of “parts which have position” (5a37).

Ockham sometimes seems to define quantity as anything that has *partes extra partes*. Thus according to the Aristotelian criterion, time again would not qualify as a quantity. Parts that do not have any position relative to another cannot be external to another (*extra partes*). However, Ockham never explicitly makes such a statement. He only claims that every *permanent* continuous quantity has *partes extra partes* (e.g. *In Physics* 4,6, Opera Phil. V 52). Occasionally, he calls such quantities *extended* (*De corpore Christi* 17, Opera Theol. X 125). We might thus call time a nonextended quantity.[1]

In early modern times, having *partes extra partes* is commonly considered a mark of extension (cf. Locke, *Essay* II,xii,15). Extension, in turn, is the essential attribute of the corporeal nature. Time does *not* appear to be extended in that sense. When Descartes inquires into the nature of quantity, he considers only length, breadth and depth (AT VII 63). Further, he claims that the extended world is just what pure geometry describes (AT VII 87).

But why should time not also be considered the subject matter of pure geometry? Kant sometimes divides mathematics according to the spatial and temporal modes of extension: geometry is concerned with space, arithmetic with time (*Prolegomena*, §10). But at least since the invention of analytical geometry, there is no gap between geometry and arithmetic. Accordingly, Kant also introduces time as the subject matter of a one-dimensional geometry (*Critique of Pure Reason*, B 47).

[1] Which is not to say that time is an intensive quantity in the Kantian sense.

For such reasons, time may appear to be just a fourth geometrical dimension. However, as I will argue, the essential difference between time and spatial extension is precisely the one that Aristotle points out in the *Categories*. Time is not a kind of quasi-spatial extension since tokens of temporal entities do not have parts that occupy positions relative to one another. The reason is that there "is" no dimension in which they could be placed next to each other.

The following arguments hold for specimens of any kind of temporal entity: stretches of time, process tokens or alleged four-dimensional objects. I will call all these, for short, *temporal tokens*. I remain silent about the ontological status of *types* of temporal entities.

I will put forward two related arguments that support the Aristotelian distinction. First, no temporal token can be divided into more than one *currently existing* part. The other parts do not exist on the same plane; they will always be either past or future. Second, there can be no representation of change without a change of representation. Therefore, temporal tokens cannot be adequately represented by non-changing geometrical items.

2. Temporal Parts of Temporal Tokens

The first argument proceeds in several steps. I will argue that temporal tokens can only metaphorically be split up into their parts. Second, when dividing a presently existing token, only one of the temporal parts can presently exist. This claim may be countered by an attempt to leave the present tense out of the picture. Such attempts, however, directly lead to fatalism, which I consider an absurd consequence.

As for the first step, spatially extended token objects can often be cut or broken into their parts. For instance, a bit of chalk can be broken into two halves. For the obvious reason that breaking occurs in time, it is not possible literally to break a temporal token into its temporal parts (Thompson 1983:212).

But let us nonetheless imagine such a division of a given temporal token into its temporal parts. If this division is a partition (that is, the parts do not overlap), there will always be exactly one part that is present, the other parts being past or future. Which is to say that only one of the temporal parts of a temporal entity *is existing* while the others *have existed* and *will exist*. We may agree with Aristotle, on this basis, that temporal tokens can have only one temporal part that exists (present tense), and hence no temporal part can be related to another existing temporal part.

(Let me remark that the case must be put differently for teleological processes. Breaking an egg and inverting the omelette are both parts of making an omelette. Hence, both are related to making an omelette. By virtue of that, they are presumably related to each other. In addition, there *is* a sense in which the remaining parts of making an omelette exist even before take place; perhaps they presently exist “in intention”.)

Some will object that by relying on the use of the present tense, this argument presupposes the disanalogy between space and time. For one might as well want to argue that no object can be split into more than one spatial part, since only one of the parts can be *here*, the others necessarily being elsewhere. If that argument appears to be inconclusive, why should we be persuaded by its exact temporal analogon?

The suggestion is, then, to treat reference to time instants exactly analogous

to reference to points in space. In order to do this, we might define a tenseless copula “is” as “was, is, or will be” and refer to time instants only by using expressions like “now” and “at time instant *t*”. However, combining this kind of tenseless verb with demonstratives like “now” and “at time *t*” will not have the desired effect. Any fact *p* is* true *now* if and only if *p* is* true at any other time. For instance, if Socrates is, was, or will be walking now, it is necessarily also true that relative to *every* time instant, he is, was, or will be walking. The demonstratives “now” and “at time *t*” do not make any difference in the truth-value of such tenseless sentences.

Several more sophisticated temporal semantics have of course been suggested. Usually one starts by assuming a set of time instants, analogous to the set of points in space. Then one can say that a fact holds true *at* or *for* one such time point, thereby defining the copula relative to some time instant.

The final step in the current argument concerns this assumption of a set of time instants. Consider, for instance, the following passage from Sider’s *Four-Dimensionalism*:

> Objects move in both space and time. Other times are as real as the present, just as other places are as real as here. (2001:87)

It is not at all clear what the first sentence is supposed to mean (compare “I will be in both New York and a week”). It takes time to move in space; does it take space to move in time? Can anything literally move from one time to another? Would such a movement not take its own time? However that may be, Sider does assume that time instants exist next to each other in the same sense in which points in space are located relative to each other. That is to say, Sider does not acknowledge the Aristotelian distinction.

The next step would be, then, to assign facts to all these really existing time instants. But here we are faced with a dilemma. Either the facts and their assignments to time instants are as unchanging as the set of time instants itself, such that every fact about the so-called future would already (tenselessly) obtain. This is fatalism. Or part of the four-dimensional space is still empty and will gradually be "filled with events". Strangely enough, Sider considers this a valid option, which he calls the "growing block universe" view (2001:12). It should be obvious, however, that every growth must occur *in some time*. But the growth of the four-dimensional block cannot occur *within* one of its dimensions. We need a tensed metalanguage in order to say that the growing block universe *is not yet* completely filled with events or that it *is still growing*. The conclusion should be that we have to presuppose time anyway. If we stick to a tenseless language and only introduce references to time instants ("now", "at *t*"), we have not yet introduced time.

I have argued that it may be true that temporal tokens have only one existing temporal part, even though spatial tokens obviously have more than one spatial part. The reason is that it does not make sense to assume a multitude of equally existing time instants. Rather, only one time instant exists, others will exist and have existed. We cannot make sense of time without using a tensed metalanguage. Time differs from space. The following argument is intended to establish this point more directly.

3. McTaggarts Time Representation Device

It is indeed possible to represent temporal tokens by using, *inter alia*, spatial diagrams. The point that I want to stress here is that purely spatial entities

could never be *enough* to represent time adequately.

Consider first the inverse case. Imagine a spot moving over a grey scale picture and registering the degrees of brightness at every point. A machine might record the purely temporal sequence of changes in brightness, and then reconstruct the original spatial pattern from that information. But in order to do so, it will need more information, for instance the speed and exact course of the movement of the spot. If the speed of the spot is not known, the representation will probably differ in size. If changes in the speed of the spot are not accounted for, the proportions will get distorted. Speed, however, concerns the ratio between spatial and temporal quantity. Hence, any reference to speed would introduce space again.

The situation is the same regarding spatial representations of temporal items. One may use a line in order to indicate how long an event takes. But in order to understand such a representation, it is important to know at what *speed* one should read the diagram. This would introduce time again.

I think this is the core of at least the first part of Ellis McTaggart's famous argument for the unreality of time (1908). In order for a line to represent time, McTaggart argues, it is not sufficient that it be extended and directed. If we know what happens first and what next, we still do not know how long it takes. In order to know this we need to use a more complicated device, consisting of *two* parallel lines that are *moved* relatively to each other. McTaggart calls these lines the *A*-series and the *B*-series.

While the *B*-series contains marks for several events or moments, the *A* series has only one important mark, which represents the present. On both series, 'right' means 'later' and 'left' means 'earlier', but in the *A* series, 'later

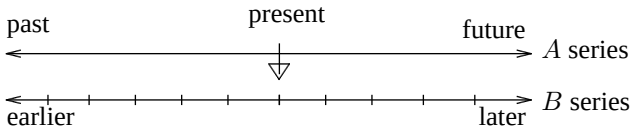

Figure 1: Cut out the A series and move it to the right at constant speed.

than present' is replaced by the synonymous 'in the future', and 'earlier than present' is replaced by 'in the past'. Taken in isolation, the *A* series does not differ much from the *B* series.[2]

Now everything depends on how we use this time representation device. In order to obtain an adequate representation of the temporal sequence of events that is encoded in the *B* series, one has to move the *A* series to the right, relatively to the *B* series. Only then will a sequence like the following be generated: "now this happens and that is still in the future, then that later happening occurs, and the first is already in the past". But obviously, the movement of the *A* series against the *B* series is itself something that happens in time. The conclusion is that there can be no adequate representation of time that is not itself temporal. As a slogan, *there can be no representation of change without a change of representation*.

[2]People have asked whether the correct theory of time should be an 'A-theory' or a 'B-theory'. Neither is the case. McTaggart shows that if there is any theory of time at all, then it must be an 'A-B-theory'. However, he thinks that there can be no coherent A-theory, and hence no A-B-theory.

4. Conclusion

I have thus shown that time and space differ. Wherein lies this difference? Both time and space are extensive and continuous quantities. But whereas the spatial parts of spatially extended tokens all exist in the same sense, there is always exactly one distinguished temporal part of a currently existing temporal token. All other temporal parts *do not exist* — they have existed or will exist. Spatially extended entities can be viewed from several spatial points of view at once. They are realized or constituted by several parts at once. Temporally extended entities cannot be viewed from several temporal points of view "at once". There is never more than one temporal point of view.[3]

References

Ackrill, J. L. (Ed.) (1963). *Aristotle, Categories and De Interpretatione*. Oxford: Clarendon.

McTaggart, E. (1908). The unreality of time. *Mind 17*(68), 457–474.

Oehler, K. (Ed.) (1984). *Aristoteles, Kategorien*. Berlin: Akademie Verlag.

Sider, T. (2001). *Four-Dimensionalism. An Ontology of Persistence and Time*. Oxford: Clarendon Press.

Thompson, J. J. (1983). Parthood and identity across time. *The Journal of Philosophy 80*(4), 201–220.

[3]This paper was written under the auspices of the Wolfgang Paul Program of the Alexander von Humboldt Foundation and the project "Forms of Life" sponsored by the Volkswagen Foundation.