MOVING FORTH AND BACK IN TIME

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Clearly objects do move forth and back in space.
Thus, for instance, Jackson walks from home to the
corner drugstore and then walks back home. But do
objects also move forth and back in time? And if not,
would it be logically possible for them to do so?
Indeed, what would even constitute a proper description
of an object's moving forth and back in time? My aim
in this paper is to answer these perplexing questions.[1]

Richard Taylor has developed a procedure for con-
structing spatio-temporal analogies which enables us
to find straightforward answers to these questions.[2]
According to his procedure, in order to obtain a descrip-
tion of an obscure temporal notion, one first produces
an exact description of the analogous spatial notion,
and then one derives from that description, by substi-
tuting temporal for spatial terms and vice versa, a
description of the temporal notion. Naturally this
procedure will generate correct results only if space
and time are radically similar to each other. For the
purposes of this paper I shall assume that they are so.

Now Taylor contends, on the basis of a spatio-temporal
analogy which he develops, that objects do move forth and
back in time, and that they do so in a certain uncon-
troversial manner. In this paper I shall, first of all,
undermine Taylor's contention by showing that the analogy
which he develops does not succeed in capturing the
notion of an object moving forth and back. Secondly, I
shall examine, and show to be unsuccessful, three other
attempts at constructing the correct analogy for the
notion of an object moving forth and back. Each of
these unsuccessful analogies, including Taylor's, is
infected by one or the other of two mistakes: either
(a) such an analogy gives a mistaken description of the
spatial notion in question; or (b) it commits a procedural
mistake in generating the temporal analogue (i.e. the
description of the analogous temporal notion) from the
description of the spatial notion. Finally, I shall
state and defend the correct analogy which, it will be
seen, involves the quite controversial notion of time-
travel.

Let us begin, then, by examining Taylor's analogy. He describes the fact that an object O moves forth and back in space in the following way:

(1S) O is at $place_1$ both at $time_1$ and at $time_2$. O endures from $time_1$ through $time_2$. At $time_k$ within the interval $time_1$-$time_2$ O is at $place_k$ ($\neq place_1$).

More precisely, this purportedly describes the fact that during the temporal interval $time_1$-$time_2$ an object O moves from $place_1$ to $place_k$ and then back again to $place_1$. Rewriting this description according to the specified procedure, Taylor derives this temporal analogue:

(1T) O is at $time_1$ both at $place_1$ and at $place_2$. O extends from $place_1$ through $place_2$. At $place_k$ within the interval $place_1$-$place_2$ O is at $time_k$ ($\neq time_1$).[3]

Admittedly if description (1T) correctly depicts the notion of an object moving forth and back in time, then objects do move forth and back in time, and they do so in an uncontroversial manner. As an example of an object to which description (1T) applies, Taylor portrays an earthquake which at $time_1$ occurs "in two nearby towns, which we may refer to as $place_1$ and $place_2$, and . . . it occurs everywhere between these two towns, but at one of those intermediate places at a time other than $time_1$."[4]

However, description (1T) cannot be accepted as a correct description of the notion that an object moves forth and back in time since description (1S), from which it is derived, is incorrect. As Taylor himself implies, description (1S) constitutes an exact description of the relevant notion only if "any object O whose behavior fits that description is one that moves from its place and returns to it, and one that, therefore, can be described as 'moving forth and back in space.'"[5]

Now some objects whose behavior description (1S) fits cannot be described as moving forth and back in space. Consider this example. Two towns, Middletown and Springfield, are situated one mile apart. Before noon on a certain day Wilson parks his two-mile long train in such a way that it occupies the tracks both in Middletown and in Springfield, as well as the tracks in between the two towns, and he leaves it parked there throughout the afternoon. During the afternoon the train does not move from one town to the other and then back (it does not move at all), yet description (1S) applies to this case.

So, description (1S) is <u>not</u> a correct description
of the fact that an object mo<u>ves</u> forth and back in space.
It must be concluded, therefore, that Taylor's analogy
fails to capture the notion we want.

Why is it, though, that Wilson's train cannot
properly be described as moving forth and back between
the two towns? What I shall call the <u>part analogy</u>
provides an answer to this question which is based on
the following observation. When an object moves forth
and back in space, the <u>whole</u> object (i.e. all of its
spatial parts) is in one place at one time, it is in a
second place at a later time, and it is back in the
first place at a still later time. Thus, according to
the part analogy, Wilson's train cannot properly be
described as moving forth and back between the two towns
because the <u>whole</u> train did not occupy two different
places during the afternoon, but rather the whole train
remained in one place throughout the afternoon. Obviously
the part analogy will be formulated in terms of spatial
and temporal parts.

According to the part analogy, the fact that an
object O moves forth and back in space should be describ-
ed as follows:

> (2S) All of the spatial parts of O are at
> $place_1$ both at $time_1$ and at $time_2$.
> All of the spatial parts of O endure
> from $time_1$ through $time_2$. At $time_k$
> within the interval $time_1$-$time_2$ all
> of the spatial parts of O are at $place_k$
> ($\neq place_1$).

From this the part analogy obtains the following temporal
analogue:

> (2T) All of the temporal parts of O are at $time_1$
> both at $place_1$ and at $place_2$. All of the
> temporal parts of O extend from $place_1$
> through $place_2$. At $place_k$ within the
> interval $place_1$-$place_2$ all of the temporal
> parts of O are at $time_k$ ($\neq time_1$).

At first glance description (2S) seems to describe
correctly the fact that an object moves forth and back in
space. Shortly, though, we shall see that it does not
correctly describe this fact. Let us first consider its
temporal analogue, description (2T). According to this
description, all of the temporal parts of an object exist
at one time <u>and</u> these same temporal parts exist at
another time. But this clearly is a logical impossi-
bility.

Suppose, for example, that all of Anderson's temporal parts exist during the twentieth century. Now supposing that Anderson moves forth and back in time, as this is construed by the part analogy, then all of his temporal parts exist also at some time other than the twentieth century, say, during the sixteenth century. Of course, this is logically impossible. The identity of a temporal part is a function of the times through which it endures, so that if a temporal part exists at two different times, then at each of those times only some part of that temporal part exists. (Thus, if Johnson suffers from pneumonia in 1970 and in 1974, then the temporal part of Johnson, distinguished by the fact that during its endurance Johnson suffers from pneumonia, exists in 1970 and 1974; but in each of those years only a part of that temporal part exists.) So, if all of Anderson's temporal parts exist in the sixteenth and twentieth centuries, as is implied by the supposition that all exist in each of those centuries, then during each of those centuries only some (i.e. not all) of his temporal parts exist. But this contradicts the supposition that during each century all of his temporal parts exist. Therefore, it must be concluded that description (2T) describes a logical impossibility.

Returning now to description (2S), it can be seen on a closer inspection that this description does not correctly describe the fact that an object moves forth and back in space, but rather it describes, as its temporal analogue does, a logical impossibility. The part analogy, because it divides objects into spatial and temporal parts, requires that objects be viewed as four-dimensional entities--as entities with three spatial dimensions and one temporal dimension. Hence each spatial part and each temporal part of an object is itself a four-dimensional entity.

Notice that since description (2T) asserts that all of the temporal parts of an object exist at two different times, it therefore implies that all of the spatial parts of that object exist at those two times. Similarly, but perhaps not so obviously at first glance, since description (2S) asserts that all of the spatial parts of an object exist at two different times, it therefore implies that all of the temporal parts of that object exist at each of those two times. Yet, as shown above, it is logically impossible for all of the temporal parts of an object to exist at each of two different times.

I conclude, then, that description (2S) portrays a logical impossibility and thus cannot be the correct description of the fact that an object moves forth and

back in space. So, the part analogy fails to capture
the notion of moving forth and back.

The observation underlying the part analogy seems
plausible enough: When an object moves forth and back
in space, the whole object occupies different places at
different times. This is plausible, though, only if
objects are regarded as changing three-dimensional
entities, as entities which can be divided into spatial
parts but not into temporal parts. But, of course, the
terminology of spatial and temporal parts demands that
objects be regarded as unchanging four-dimensional
entities. What we are doing, in formulating our spatio-
temporal analogy in terms of spatial and temporal parts,
is translating a three-dimensional notion--the notion of
moving forth and back--into the four-dimensional idiom.
In order to represent this notion accurately, the
translation must be complete.[6]

What I shall call the four-dimension analogy pro-
vides such a complete translation. This analogy recon-
strues the observation underlying the part analogy in
the following way: When an object moves forth and back
in space, one temporal part of the object exists in one
place at one time, another temporal part exists in a
second place at a later time, and yet another temporal
part exists in the first place at a still later time.

So, according to the four-dimension analogy, the
fact that an object O moves forth and back in space can
be exactly described as follows:

> (3S) Temporal-part$_1$ of O is at place$_1$ at time$_1$.
> Temporal-part$_2$ of O is at place$_1$ at
> time$_2$. The series of temporal-parts
> of O from temporal-part$_1$ through
> temporal-part$_2$ fills the interval
> time$_1$-time$_2$. At time$_k$ within the
> interval time$_1$-time$_2$ temporal-part$_k$
> of O is at place$_k$ ($\neq$ place$_1$).

Rewriting, the four-dimension analogy derives this temporal
analogue:

> (3T) Spatial-part$_1$ of O is at place$_1$ at time$_1$.
> Spatial-part$_2$ of O is at place$_2$ at time$_1$.
> The series of spatial-parts of O from
> spatial-part$_1$ through spatial-part$_2$
> fills the interval place$_1$-place$_2$. At
> place$_k$ within the interval place$_1$-place$_2$
> spatial-part$_k$ of O is at time$_k$ ($\neq$ time$_1$).

Now description (3S) does constitute an exact description of the fact that an object moves forth and back in space. However, description (3T) is not the appropriate temporal analogue, for some procedural mistake has occurred in generating description (3T) from description (3S). I shall show later precisely what this mistake is. First, though, I want to examine an analogy which is closely similar to the four-dimension analogy.

What I shall refer to as the event analogy takes description (3S) to be the correct description of the fact that an object moves forth and back in space, but the temporal analogue which it generates from this description is quite different from the temporal analogue of the four-dimension analogy. This difference is due to an assumption which the event analogy makes, but which the four-dimension analogy does not make, about the construction of spatio-temporal analogies. According to this assumption, when constructing a spatio-temporal analogy one must replace in the description of the spatial fact all spatial terms by temporal ones and all temporal terms by spatial ones.[7]

As Taylor correctly remarks, "object" is a spatial term and "event" is the temporal term corresponding to it.[8] Taking this into consideration, the event analogy maintains that the following description is the appropriate temporal analogue to description (3S):

(4T) Spatial-part$_1$ of event $\underline{E}$ is at place$_1$ at time$_1$. Spatial-part$_2$ of $\underline{E}$ is at place$_2$ at time$_1$. The series of spatial-parts of $\underline{E}$ from spatial-part$_1$ through spatial-part$_2$ fills the interval place$_1$-place$_2$. At place$_k$ within the interval place$_1$-place$_2$ spatial-part$_k$ of $\underline{E}$ is at time$_k$ ($\neq$ time$_1$).

Now it is plainly absurd to suppose that description (4T) presents us with a description of the notion that an object moves forth and back in time. Rather, what it presents us with is, at best, a description of the notion that an event moves forth and back in time. In short, it does not give us what we want. Where the event analogy goes wrong is in its assumption that in the construction of a spatio-temporal analogy one must replace in the description of the spatial fact all spatial terms by temporal ones and all temporal terms by spatial ones. Consider for a moment the following statement:

(S) An object moves forth and back in space.

One can derive seven different temporal analogues for
this statement by distinguishing the following seven
"replacement-versions" (only the underlined terms in a
replacement-version are subject to replacement by the
analogous spatial or temporal terms in the construction
of a spatio-temporal analogy):

>   (a)   An object moves forth and back in <u>space</u>.
>
>   (b)   An object <u>moves</u> forth and back in space.
>
>   (c)   An <u>object</u> moves forth and back in space.
>
>   (d)   An object <u>moves</u> forth and back in <u>space</u>
>
>   (e)   An <u>object</u> moves forth and back in <u>space</u>.
>
>   (f)   An <u>object</u> <u>moves</u> forth and back in space.
>
>   (g)   An <u>object</u> <u>moves</u> forth and back in <u>space</u>.

Obviously the spatio-temporal analogy which we are
attempting to construct is based on replacement-version
(a), for we want to know what it is like for an object
to move forth and back in time, rather than in space.
But the event analogy is based on replacement-version
(g).[9] I conclude, then, that the event analogy fails
to capture the notion we want. Its failure lies in the
procedural mistake which it makes by virtue of using an
incorrect replacement-version in deriving the temporal
analogue.

Now I want to return to the four-dimension analogy
in order to expose the procedural mistake which is in-
volved in it. This mistake, like the one involved in
the event analogy, is due to its using an incorrect
replacement-version in deriving the temporal analogue.
Exposing this mistake requires that we first examine
two contrasting views concerning change and movement.
I shall call these the temporalist and the spatio-
temporalist views.

According to the temporalist view, the notion of
change is an essentially temporal notion. Temporalists
maintain that change can occur only over an extent of
time. Nelson Goodman, for instance, says that "change
is concomitant variation in time and some other respect.
Since time is always one of the variant factors in
change, we speak of change in whatever is the other
variant factor in the given case."[10] Let us say that
the temporalist notion of change is the notion of
temporal change. So, an object undergoes temporal change
with respect to a property just in case its temporal
parts differ with respect to that property.

On the other hand, according to the spatio-temporalist view, our notion of change is not an essentially temporal notion. Spatio-temporalists contend that besides the notion of temporal change there is also a notion of <u>spatial</u> <u>change</u>. Thus, Taylor says that "something, such as a wire, might be blue at one end and red at the other, and perhaps various other colors between these two places. This would accordingly be an example of <u>spatial</u> change."[11] An object undergoes spatial change <u>with</u> respect to a property, then, just in case its spatial parts differ with respect to that property.

Movement, of course, is a kind of change. To say that an object moves in a frame of reference (e.g. space or time) is just to say that it changes its position in that frame of reference. Using the two notions of change, we can distinguish two notions of moving forth and back: to say that an object <u>moves</u> <u>temporally</u> forth and back in a frame of reference is just to say that it undergoes temporal change forth and back in its position in that frame of reference; and to say that an object <u>moves</u> <u>spatially</u> forth and back in a frame of reference is just to say that it undergoes spatial change forth and back in its position in that frame of reference. Furthermore, since the frame of reference may be space or time, we can distinguish the following notions of moving forth and back:

> (1) An object moves temporally forth and back in space.
>
> (2) An object moves temporally forth and back in time.
>
> (3) An object moves spatially forth and back in space.
>
> (4) An object moves spatially forth and back in time.

Temporalists would maintain, of course, that notions (3) and (4) are not legitimate notions of moving forth and back since they presuppose the notion of spatial change. At any rate, it is not necessary for us to settle the dispute between the temporalists and the spatio-temporalists. Which view is the correct one does not have a direct bearing on which analogy is the appropriate spatio-temporal analogy. Yet this dispute does help us to see what the appropriate analogy is.

Recall that the sense of moving forth and back in space in which we are interested is expressed by notion

(1). Thus, when Jackson walks from home to the corner
drugstore and then back home again, he is moving
temporally forth and back in his position in space;
that is, he is moving temporally from one spatial
position to another and back to the first position.
Now as remarked earlier, our spatio-temporal analogy
should be based on this replacement-version:

> (a) An object moves forth and back in space.

Or, more precisely, it should be based on the following
replacement-version:

> (a') An object moves temporally forth and back
> in space.

It follows from this that the temporal analogue which
we generate should be a description of notion (2).

We are at last in a position to see what is wrong
with the four-dimension analogy. Description (3T) of
the four-dimension analogy is a description not of
notion (2), but rather of notion (4). Description (3T)
speaks of spatial-parts being at places, whereas the
correct temporal analogue should instead speak of
temporal-parts being at times. It must be concluded,
therefore, that the four-dimension analogy does not
capture the notion of moving forth and back in which
we are interested.

What I shall call the time-travel analogy does cap-
ture this notion. This analogy is constituted by
description (3S) and the following temporal analogue
to it:

> (5T) Temporal-part$_1$ of 0 is at $\underline{time_1}$ at time$_1$.
> Temporal-part$_2$ of $\overline{0}$ is at $\overline{\underline{time_1}}$ at time$_2$.
> The series of temporal-parts of 0 from
> temporal-part$_1$ through temporal-part$_2$
> fills the interval time$_1$-time$_2$. At
> time$_k$ within the interval time$_1$-time$_2$
> temporal-part$_k$ of 0 is at $\underline{time_k}$
> ($\neq \underline{time_1}$).

At this point, assuming that only one temporal
frame of reference is being referred to in description
(5T), it is tempting to conclude the notion of moving
forth and back in time is in part contradictory and in
part meaningless. To see why this is so, consider the
following example to which description (5T) applies.
Let us distinguish three of Anderson's temporal-parts:
his 1976-temporal-part endures only throughout 1976,
his 1977-temporal-part endures only throughout 1977,

and his 1978-temporal-part endures only throughout 1978.
Moreover, let us assume that description (5T) applies
to Anderson in this way: his 1976-temporal-part is in
1976 in 1976; his 1978-temporal-part is in 1976 in 1978;
the series of his temporal-parts from his 1976-temporal-
part through his 1978-temporal-part fills the interval
1976-1978; in 1977, within the interval 1976-1978,
Anderson's 1977-temporal-part is in 1977 ($\neq$ 1976).

Now what is so troublesome about this case is that
Anderson's 1978-temporal-part is in 1976 in 1978. Given
the way in which we defined Anderson's 1978-temporal-
part, it is contradictory to say that his 1978-temporal-
part is in 1976. And it is meaningless to say that some-
thing is in 1976 in 1978. Indeed, if all of the times
mentioned in description (5T) refer to the same temporal
frame of reference, then it must be concluded that the
notion of moving forth and back in time is in part
contradictory and in part meaningless.

But we need not assume that all of the times
mentioned in description (5T) refer to the same temporal
frame of reference. In fact, since description (5T)
portrays the notion of an object moving <u>temporally</u> forth
and back in <u>time</u>, it is quite natural to assume that two
temporal frames of reference are involved: an objective
frame of reference, to which the italicized temporal
expressions in description (5T) refer, constituted by
the time-lines of those objects which, so to speak, move
equably forth through time; and a proper frame of
reference, to which those temporal expressions not
italicized in description (5T) refer, constituted by the
time-lines of the object <u>0</u>.12

When description (5T) is construed in this way, as
referring to an objective and a proper frame of reference,
the notion of moving forth and back in time no longer
seems either contradictory or meaningless. To see this,
consider the following example to which description (5T),
as now construed, applies. Let us distinguish three of
Thompson's temporal-parts: his thirtieth-temporal-part
endures only throughout the thirtieth year of his life;
his thirty-first-temporal-part endures only throughout
the thirty-first year of his life; and his thirty-
second-temporal-part endures only throughout the thirty-
second year of his life. We can assume that description
(5T) applies to Thompson in this manner: his thirtieth-
temporal-part is wholly within 1976 in the thirtieth
year of his life; his thirty-second-temporal-part is
wholly within 1976 in the thirty-second year of his
life; the series of his temporal-parts from his thirtieth-
temporal-part through his thirty-second-temporal-part

fills the interval between the thirtieth and thirty-second years of his life; in the thirty-first year of his life, within the interval between his thirtieth and his thirty-second years, Thompson's thirty-first-temporal-part is wholly within 1977 (≠1976).

What is disturbing about this case is that each of two separate temporal parts of Thompson supposedly occupy the whole of 1976, and if this were the case some disturbing things conceivably might happen--for instance, the older Thompson conceivably might kill the younger Thompson. At any rate, however disturbing it may be to assert that each of two different temporal-parts of an object occupy the whole of one and the same time, clearly it is neither contradictory nor meaningless.[13] Naturally it would be contradictory to assert that Thompson's thirtieth-temporal-part occupies the whole of 1976 wholly within one place and that his same temporal-part occupies the whole of 1976 wholly within a separate place; and it would be meaningless to assert that Thompson's thirtieth-temporal-part is in 1976 in 1977. But these kinds of situations are not envisioned in this example, and they do not fall under description (5T) as it is now construed.

I conclude, then, that description (5T), as construed with two temporal frames of reference, correctly describes the notion of moving forth and back in time, and that it is logically possible for objects to move forth and back in time. It is an incontestable fact, of course, that objects do not move forth and back in time, for we simply never observe objects behaving in such a way that description (5T) can properly be applied to them.[14]

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NOTES

[1] The notion of moving forth and back should be understood not as the notion of moving forward and then backward, but rather as the notion of moving from one position to another and then back again. So, if Wilson were to back away from a lion, pick up his gun, and then move forward to where he first stood, this would count as moving forth and back in space.

[2] Richard Taylor, Metaphysics, second edition (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1974), pp. 75-77. He also develops this procedure in two articles: "Moving About in Time," The Philosophical Quarterly, IX (1959), pp. 289-301; and "Spatial and Temporal Analogies and the Concept of Identity," The Journal of Philosophy, LII (1955), pp. 599-612. The latter article is reprinted in J. J. C. Smart, ed., Problems of Space and Time (New York: Macmillan, 1964), pp. 381-96; my page references are to the Smart volume.

[3] See Metaphysics, p. 76.

[4] Ibid.

[5] Ibid.

[6] J. J. C. Smart makes this point in his article "Spatializing Time," Mind, LXIV (1955), pp. 239-41; this is reprinted in Richard M. Gale, ed., The Philosophy of Time (Garden City, N.Y.: Doubleday, 1967), pp. 163-67. Smart writes: "What we must be careful to avoid, however, is mixing our terminologies, and talking of enduring, changing, and not changing, in the context of our four-dimensional representation" (p. 166).

[7] Taylor does not explicitly endorse this assumption, but it seems that he is implicitly committed to it. For a discussion of this, see J. W. Meiland, "Temporal Parts and Spatio-Temporal Analogies," American Philosophical Quarterly, 3 (1966), p. 66.

[8] After mentioning this distinction between "object" and "event," Taylor sloughs over it, saying, "no such distinction is necessary and none will be made here" ("Spatial and Temporal Analogies," p. 381). So, for Taylor even events are "objects." Interestingly enough,

the examples which he gives of "objects" which move
forth and back in time are events, whereas the examples
which he gives of "objects" which move forth and back in
space are what we ordinarily call objects. At any rate,
I am concerned with the notion of an object (which is
not an event) moving forth and back.

[9]Later it shall become evident that the event
analogy is based on replacement-version (g) rather than
replacement-version (e).

[10]Nelson Goodman, The Structure of Appearance,
second edition (New York: Bobbs-Merrill, 1966), p. 374.

[11]Metaphysics, p. 78.

[12]For an excellent discussion of the distinction
between objective and proper times, see John G. Graves
and James E. Roper, "Measuring Measuring Rods," Philosophy
of Science, 32 (1965), pp. 39-55, esp. p. 42.

[13]Paul Horwich provides a convincing rebuttal of
some standard arguments against time-travel (and hence
against the notion of moving forth and back in time) in
his paper "On Some Alleged Paradoxes of Time Travel,"
The Journal of Philosophy, LXXII (1975), pp. 432-44.

[14]I have defended the view that objects move forth
through time in a paper entitled "The Passage of Time,"
in Richard Taylor, ed., Readings in Metaphysics,
forthcoming.