A Dilemma for a Picture of Motion
James Blackmon

In 'Moving faster than light' Hud Hudson presents a reason to believe there are objects which move faster than light. (Hudson 2002) This involves accepting a particular metaphysical picture of what it is to be an object in motion, one that would appear to be the straightforward consequence of an unqualified Temporal Parts Theory (*TPT*) conjoined with a common construal of motion. But on this picture one faces a significant dilemma that I will present here. I will first present Hudson's argument, then I will characterize the dilemma and show how it is engendered on Hudson's view.

Hudson's argument is based on TPT conjoined with the presupposition that there is at least one *n*-dimensional non-scattered solid that, as he puts it, "has a full complement of *n* – 1-dimensional, cross-sectional, spatial parts." On this view, a filled space-time region that has extension along the temporal axis is filled by an object perduring through time. That is just what it is to persist through time, to be (or to be properly associated with) a four-dimensionally extended thing.[1, 2] At every instant, this four-dimensionally extended thing has three-dimensional temporal parts. If the spatial locations of the temporal parts vary as a function of time, then, on what Hudson holds "can be reasonably called an orthodox view", we have a moving object.[3, 4]

---

[1] See Sider 2001, especially §6.5, for various accounts of motion on temporal parts views.
[2] Whether it is appropriate to predicate 'persists' of the four-dimensional object or of its stages is a debate internal to TPT and four-dimensionalist theories in general.
[3] Again, whether it is appropriate to predicate 'moves' and 'is a moving object' of the four-dimensional object or of its stages is debated.
[4] Not every four-dimensionalist holds this view that motion reduces simply to the manner in which spacetime is filled. As Sider (2001, §6.5) reports, there are various efforts (by Tooley, Robinson, Hawley, and Sider) to provide a plausible account of a sameness or genidentity relation that must hold between stages. But see Paul Teller's 2002 article where he presses the point that, on a perdurance theory, there appears to be nothing on which to base a sameness or genidentity relation.

How, then, might we get an object moving faster than the speed of light? As Hudson demonstrates, this picture of motion, along with the presupposition that there is at least one non-scattered solid of the kind described above, yields uncountably many objects moving faster than light. For brevity, an "impressionistic" sketch of Hudson's demonstration follows. (For more realism, see Hudson 2002.)

Hudson first defines Cone as a non-scattered solid that is a closed section of a cone and has a lifespan of an hour. On TPT, Cone is a four-dimensional object that fills a certain region of space-time and its maximal temporal parts are three-dimensional cones each existing at a different time. Hudson then defines Quick in such a way that it is a proper part of the four-dimensional object, Cone, and occupies a very brief period of time. Quick is a fusion of contiguous temporal parts, each of which is a proper part—a circular cross-section in this case—of a temporal part of Cone. On TPT, any such fusion is a persisting object.

However, Quick does not consist of what we would intuitively take to be "the same cross-section of Cone" as time goes on. Instead, Quick's temporal parts are continually higher cross-sections of Cone's temporal parts as time elapses. Let T be an appropriately short interval of time. Then, the proper part of Cone that Quick fills travels from Cone's base at the beginning of T to Cone's tip at the end of T. On a space-time diagram with time as the horizontal axis the representation of Quick should run diagonally and at a steep incline. Because Cone is a non-scattered solid, Quick is in continuous motion.[5] Quick rushes up Cone from bottom to top. And, as long as T is

[5] We assume that time is modeled by the real numbers.

sufficiently brief for whatever is the height of Cone, Quick is moving faster than light.[6] It should be obvious that uncountably many things can be defined in the manner Hudson employs.

Now to the resulting dilemma and its costs. I will soon argue that the account of motion under which Hudson argues yields the following two options: Either accept that there are many spatiotemporally coincident objects that are behaving differently or give up a very intuitive understanding of the compositional behavior of material things.

The first option involves permitting the existence an uncountable multitude of objects that fully coincide in space throughout their temporal existence. Some philosophers accept spatiotemporal coincidentals for reasons brought to light by considering statue-clay cases.[7] But there is an important difference between the spatiotemporally coincident objects admitted by these philosophers and the ones that would result under the first option. The objects suggested by the relevant statue-clay case differ with respect to modal properties. The objects that would result under the first option, however, are literally behaving differently in the actual world.

The second option involves rejecting a very intuitive principle of compositional behavior. It is very intuitive, for instance, to expect that if two objects, each shaped like a half of a disk, exist in such a way that they are connected seamlessly along their flat

[6] A consequence of Hudson's view is that, on a certain view of the nature of light, we should see that it is no longer strictly appropriate to say these objects are going faster than *light* since the same kind of argument can be performed on a "light-filled" spatiotemporal region to show that even light travels at all kinds of velocities. Strictly, certain such objects and parcels of light should be said to move faster than c ≅ 186,000 miles per second. Metaphysicians are not alone in willingness to conceive of motion this way. Recent experiments are (controversially) interpreted by some physicists as having gotten a light pulse to reach "superluminal" speeds. [Wang, Kuzmich, and Dogariu 2000] In this experiment there is another factor compelling their interpretation: a certain qualitative similarity, a similarity of wave formation, holds of the relevant stages.

[7] The view is that, even for cases in which (using the standard example) the statue and the clay are co-located throughout their existence, there are differences between the two. The clay still *could have survived* a deformation that the statue *could not have survived*. The holding of these different modal properties is taken to demand the existence of different objects which are co-located throughout their existence.

edges (so that they look just like a disk) and are such that neither moves with respect to the other, then there exists a disk and that disk's motion supervenes on the motion of these objects. Some will say this notion is obvious. But the intuition must be denied on this picture of motion, if the first option of the dilemma is to be avoided.

Many philosophers accept the existence of "arbitrary" fusions of temporal parts, even such fusions that overlap others. And certainly there are philosophers who are content to let multiple objects share the same spatial region for some time. There are even philosophers who accept that multiple objects properly share[8] the same spatiotemporal region.[9] However, a decidedly more radical thesis is that there are multiple objects that properly share the same spatiotemporal region and they are actually doing different things. But, I will argue, this radical thesis is in fact one of the options Hudson's view faces.

As mentioned, this issue differs from the statue-clay kinds of issues and I believe the general problem is more challenging for proponents of TPT. Some views accept the spatiotemporal coinciding of objects that differ in their modal properties. The objects could have been otherwise in different respects and the different respects are taken to demand a difference in objects despite the fact that they occupy the same space-time region. The lump of clay, then, could have been spherical but the statue could not have been spherical and so there must be two things even if the lump and the statue come into and go out of existence in concert. This is how things stand on what I will call the *Doctrine of Spatiotemporal Coincidentals* (*DSTC*). However, DSTC does not entail that

[8] For any x and y, x and y properly share the same region if and only if x and y occupy some region and neither occupies a region the other does not occupy.
[9] See Johnston 1992.

the lump of clay and the statue differ with respect to their behavior in the actual world.[10] They may actually instantiate different modal properties but they are not taken to be behaving any differently. So, presumably, the radical proposition *that multiple objects that are actually doing different things properly share the same spatiotemporal region* is one even these proponents of DSTC might prefer to deny.

Furthermore, even someone who accepted Hudson's picture of what it is to be a moving object might be inclined to resist both (i) the radical thesis about differently behaving objects properly sharing the same spatiotemporal region and (ii) DSTC. For they can say that, indeed, Cone and Quick overlap, but each inhabits its own spatiotemporal region. Each, then, can be distinguished from the others in a principled manner. There is one object per filled space-time region. As permissive as Hudson's notion of objecthood might seem, it does not even commit one to DSTC. So how, some proponents of this picture might worry, could there be two objects, filling the same space-time region and actually doing different things? We prefer, they might say, to deny DSTC.

But DSTC can only be denied at a cost. The demonstration appeals to the thought experiment about homogeneous rotating disks and spheres going back to Armstrong, Kripke, and Lewis.[11] Let *Disk* be a non-scattered solid that is a perfectly symmetrical disk of some depth and that exists for some duration. On Hudson's picture of motion in TPT, Disk fills a spatiotemporal region and has many proper parts like Quick, many of which are zipping around within Disk. Others are just sitting there.[12] One such thing is a disk

[10] One might argue that the statue is actually pleasing the viewer while the lump of clay is not. It should become evident that this is not how I am using the term 'behaving' and its variants.
[11] Armstrong 1980; Lewis 1994.
[12] This is all, of course, relativized to some frame of reference.

half, just sitting there, at every time being the proper half of Disk that is, say, closest to you.

Now consider the series of temporal parts whose fusion is, $Half_1$, a disk-half that rotates at rate *r* around the center of Disk (i.e., the midpoint of $Half_1$'s straight edge). $Half_1$ is just as legitimate on this picture as is any of these other objects. $Half_1$ has an obvious complement, $Half_2$, which is that half of Disk that does not overlap $Half_1$. $Half_2$ is rotating around Disk's center at *r* as well. In fact, $Half_1$ and $Half_2$ are connected seamlessly since they do not move with respect to each other nor is there anything (space or filler) between them. Together, $Half_1$ and $Half_2$ look just like some disk. In fact, they look just like the individual previously defined, Disk.

There is the temptation to say that together $Half_1$ and $Half_2$ compose Disk or at least that they compose some disk and to think that this disk's motion supervenes on the motion of $Half_1$ and $Half_2$. If so, then we would seem to have a disk that is rotating at rate *r*. But complementary disk halves like $Half_1$ and $Half_2$ can be defined for any rate of rotation. What is important is that the spatiotemporal regions occupied by the halves will be different. Consequently, $Half_1$ and $Half_2$ cannot be ruled out on a principle that denies spatiotemporally coincident objects nor can the complementary pair $Half_3$ and $Half_4$ (defined so that neither is spatiotemporally coincident with $Half_1$ or $Half_2$) be so ruled out, and so on. All such objects would seem to be accepted on the same principles that accept the object Quick, for they are just fusions of certain proper parts of the temporal parts of an object. So if $Half_1$ and $Half_2$ compose to yield a disk that is rotating at *r* and only *r*, then other complementary halves (like $Half_3$ and $Half_4$) can be defined to yield a

disk that is rotating at some rate $r' \neq r$ for any r' and all of these disks are spatiotemporally coincident.[13] This is many spatiotemporally coincident disks.

What has happened? While working under the picture of motion that Hudson uses in his argument for the existence of objects moving faster than light, a seemingly natural principle of compositional behavior has led to the existence of uncountably many things each with a different rotational velocity properly sharing the same spatiotemporal region. We have spatiotemporally coincident objects moving differently in the actual world. If proponents of this picture of motion are going to deny the existence of multiple objects actually behaving differently in the same spatiotemporal region, then they must deny this notion of material constitution. But, if giving up this notion is seen as too costly, they must embrace a radical ontological thesis.

University of California, Davis
Davis, CA 95616, USA
jcblackmon@ucdavis.edu

[13] We have two disks for every rate, one going clockwise, the other going counter clockwise. This is not to mention the possibility of disks whose rotational velocity is non-uniform.

References

Armstrong, D. M. 1980. Identity through time. In *Time and Cause: Essays Presented to Richard Taylor*, ed. Peter van Inwagen. Dordrecht: Reidel.

Hudson, Hud. 2002. Moving faster than light. *Analysis* 62.3: 203-5.

Johnston, Mark. 1992. Constitution is not identity. In *Material Constitution: A Reader*, ed. Michael C. Rea. Rowman and Littlefield Publishers, Inc.

Lewis, David. 1994. Humean supervenience debugged. *Mind*, New Series, Vol 103, No 412, 473-490.

Sider, Theodore. 2001. *Four-Dimensionalism: An Ontology of Persistence and Time*. Oxford: Oxford University Press

Teller, Paul. 2002. The rotating disk argument and Humean supervenience: cutting the Gordian knot. *Analysis* 62.3: 205-10.

Wang, L. J.; Kazmich, A.; Dogariu, A. 2000. Gain-assisted superluminal light propagation. *Nature* 406, 277-279. (For correction see *Nature* 21 June 2001)