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Extrinsic Temporal Metrics
(abstract)

When distinguishing absolute, true, and mathematical time from relative, apparent, and common time, Newton wrote: "absolute, true, and mathematical time, in and of itself and of its own nature, without reference to anything external, flows uniformly." Newton thought the temporal metric was intrinsic. Many philosophers have argued—for empiricist reasons or otherwise—that Newton was wrong about the nature of time. They think that the flow of time *does* involve "reference to something external." They think that the temporal metric is extrinsic. And these possibilities are not exhaustive. Perhaps both Newton and his opponents are wrong and there is no temporal metric at all.

Many philosophers believe that if the temporal metric is extrinsic, then it is conventional. My first goal in this paper is to argue that this view is false. An extrinsic temporal metric can be just as non-conventional and objective as the intrinsic temporal metric Newton believed in. My second goal is to use the distinctions presented in the first part of the paper to solve an interpretive puzzle about the status of the temporal metric in Julian Barbour's Machian replacement for Newtonian mechanics.

I here outline the first part of the paper. After clarifying what I mean by "intrinsic" and "extrinsic" I turn to defining "conventionalism about the temporal metric." It is notoriously difficult to give a definition that does not trivialize the claim that the temporal metric is conventional. (Putnam, for example, argues that he can find no definition that does not make this claim a consequence of the widely-accepted view that the meaning of every word depends on the linguistic conventions governing its use.) I defend a definition according to which a temporal metric is *non*-conventional just in case there is a natural assignment of lengths to temporal intervals, and that metric assigns those lengths to the intervals. After clarifying what I mean by a "natural assignment," I offer my arguments that extrinsic temporal metrics can be non-conventional.

One of my arguments has the following two premises. First, I claim that if a temporal metric plays the right sort of role in the fundamental laws of physics, then that metric is non-conventional. Second, I claim that an extrinsic temporal metric can play that sort of role in the fundamental laws.

Some conventionalists reject the first premise. They deny that you can appeal to a metric's role in the laws of physics to show that it is not conventional. I explain why I think this objection fails. I also respond to an argument that the second premise is false. The argument runs as follows. Consider the extrinsic temporal metric that says that the length of a temporal interval is equal to the number of times my watch ticks during that interval. This metric is non-qualitative: according to it, if any time passes, some particular individual (namely, my watch) exists. But, plausibly, the laws of nature are purely qualitative. So no extrinsic metric can appear in the laws of nature. In response, I deny that an extrinsic temporal metric must be non-qualitative, and give an example of a purely qualitative extrinsic temporal metric.

Now I discuss the second part of the paper. This part addresses a puzzle about the nature of time in Barbour's replacement for Newtonian mechanics. The puzzle is this: Barbour often says that if his Machian theory is true, then there is no temporal metric. On the other hand, some of Barbour's interpreters (Jeremy Butterfield, for example) claim that if Barbour's theory is true, then there is a temporal metric, it is just "emergent." Who is right?

I start by clarifying the question. Call a possible world in which Barbour's theory is true a "Machian world." Using the distinctions I draw in the first part of the paper, we can distinguish three claims about the status of the temporal metric in Machian worlds:

1. In those worlds, there is no temporal metric.

2. In those worlds, the temporal metric is extrinsic and conventional.

3. In those worlds, the temporal metric is extrinsic and non-conventional.

I argue, first, that there is no deep difference between (1) and (2), and second, that (3) is correct.

There are at least two temporal metrics definable in a straightforward way within Barbour's theory. One is the metric that turns Barbour's equations into the familiar Newtonian equations of motion. Another is the metric that parameterizes physically possible paths through configuration space by arc length. If (3) is correct, then one of these metrics is a more natural assignment of lengths to intervals. I argue that the first metric is more natural than the second.