1
3
2

McTaggart and Modern Physics

4

Bradley Monton

5

8

Abstract This paper delves into McTaggart's metaphysical account of reality   9
without time, and compares and contrasts McTaggart's account with the account of   10
reality given by modern physics. This comparison is of interest, because there are   11
suggestions from contemporary physics that there is no time at the fundamental   12
level. Physicists and philosophers of physics recognize that we do not have a good   13
understanding of how the world could be such that time is unreal. I argue that, from   14
the perspective of one who is trying to understand modern physics, McTaggart's   15
metaphysical views do provide some insight into how reality can be timeless at the   16
fundamental level, but the insight that they provide is limited.   17

20

Introduction

21

McTaggart is well known for his argument supporting the unreality of time, but   22
McTaggart's positive views about the nature of timeless reality are not a focus of   23
contemporary philosophical discussion. This is prima facie surprising, because there   24
are strong suggestions from contemporary physics that there is no time at the   25
fundamental level; there are suggestions that time is in some sense an emergent   26
phenomenon. While these suggestions are prominent, both physicists and philoso-   27
phers of physics recognize that we do not have a good understanding of how the   28
world could be such that time is unreal. This leads to the hope that McTaggart's   29
positive metaphysical views can provide insight into how reality can be timeless at   30
the fundamental level.   31

Q1   B. Monton (✉)
University of Colorado at Boulder, Boulder, CO, USA
e-mail: monton@colorado.edu

The goal of my paper is to explore the value of this hope. I will argue that there are interesting parallels between some of McTaggart's metaphysical views and developments from contemporary physics. I'll structure my discussion by focusing in turn on special relativity, general relativity, quantum mechanics, and quantum gravity. It would be a great boon to McTaggart (and the project of systematic metaphysics in general) if McTaggart were able to give guidance as to how contemporary physicists and philosophers of physics should understand a world without time. I will conclude that the guidance McTaggart actually provides is limited — though not by any means useless.

One might wonder — why should we think, even prima facie, that McTaggart's metaphysics could provide insight into contemporary physics? The problem is that we don't have much better to go on. There has been little work by metaphysicians on developing accounts of reality where time does not exist at the fundamental level. Given that there are hints from physics that time does not exist at the fundamental level, it would be worthwhile for metaphysicians to spend some effort exploring accounts of reality along these lines. If nothing else, my examination of McTaggart's metaphysics in light of modern physics can provide a starting point for this much-needed metaphysical endeavor.

Special Relativity

I'll start by describing some aspects of McTaggart's timeless metaphysics, and then will draw some parallels between these metaphysical views and the view of time in special relativity.

McTaggart holds that the A-series (the series of pastness, presentness, and futurity) and the B-series (the series that gives relations of earlier and later) are both illusory, while the C-series is real. In every case in which there is the illusory appearance of a time-series, there is a C-series. (McTaggart makes this point on page 30 of *The Nature of Existence, Volume II* — all McTaggart page references will be to this text.) In the C-series, the terms are connected by a permanent relation, and the relation is asymmetric and transitive.

So far, this is part of the standard McTaggart canon. But one of the underappreciated aspects of McTaggart's metaphysics is that according to him, there are *multiple* C-series. McTaggart writes:

> there are as many time series as there are selves who perceive things as in time, since the only real series in the matter is the series of misperceptions in the percipient. (p. 214)

For McTaggart, each observer has his or her own C-series: "The terms of the *C* series are all parts of the self in which they fall" (p. 234).

This view of time is quite different from the view of time one gets from 19th century physics. In addition to the obvious difference, that McTaggart denies the reality of time, the other key difference is that McTaggart denies that there is a single time-like series. Contrast McTaggart's view of observer-dependent time-like series with Newton's view of the time series: "Absolute, True, and Mathematical Time, of itself, and from its own nature, flows equably without regard to any thing external."

While McTaggart's view does not cohere well with the Newtonian physics framework, it coheres much better with the framework from special relativity. In special relativity, an observer in a particular frame of reference will perceive observers in other frames of reference to have time pass at different rates than it passes for her. In allowing for this possibility in his metaphysics, McTaggart is promulgating a view of reality that is — in this sense, at least — fitting for modern physics.

While McTaggart wrote *The Nature of Existence, Volume II* after the development of special relativity, I can find no indication that he was influenced by special relativity in the development of his metaphysics. In fact, McTaggart argues that one can establish a correspondence between the different series:

> when terms which are at correspondent stages of different [C] series are taken as events in time, they are taken as simultaneous events in time. They are not really events in time, but their simultaneity is a *phenomenon bene fundatum*. They are as really simultaneous as two things in a single self can be — for example my perceptions of taste and smell when eating an orange. (p. 275)

Here, McTaggart is not recognizing that simultaneity is relative according to special relativity: two events can be simultaneous according to an observer in one frame of reference, but not according to an observer in a different frame, and (according to special relativity) there's no fact of the matter about which one is right. But perhaps this is not a big blow to McTaggart, for sometimes in special relativity two events are really simultaneous — when they are coincident in spacetime.

General Relativity

Special relativity is a false theory, because it does not take into account gravitational effects on spacetime. General relativity does so, with the consequence that the distribution of matter is correlated with the curvature of spacetime. As a result, there are an infinite number of different models of spacetime that are allowed by general relativity, and some aspects of some of these models cohere well with McTaggart's views.

Here is the first correspondence between McTaggart's views and some models of general relativity. McTaggart believes that the C-series is finite (p. 280), and general relativity has models where time is finite — in these models, the universe starts with a big bang and ends a finite time later with a big crunch. The time dimension itself has a start and an end, and hence it makes sense to say that in these models, time is finite.

Here is the second correspondence. McTaggart also believes that the C-series is irreflexive, transitive, and asymmetric, where the (real) relation "included in" corresponds to the (unreal) temporal relation "earlier than" (p. 240). To spell this out more: we pre-theoretically understand the "earlier than" relation to be such that no event is earlier that itself (irreflexivity); and if A is earlier than B and B is earlier than C, then A is earlier than C (transitivity); and if A is earlier than B, then B is not earlier than A (asymmetry). Similarly, this is how McTaggart understands the fundamental relation that governs the C-series, the "included in" relation (where the elements of the C-series that obey this relation are parts of the self (p. 234), as I will discuss in more detail in the next section).

General relativity also has models where the causal dependence relation, 120
representing the "earlier than" relation, is irreflexive, transitive, and asymmetric. 121
But only *some* models of general relativity are like this. Other models of general 122
relativity involve *closed timelike curves*. A closed timelike curve is a special case of 123
a causal loop. A causal loop exists when there is a causal chain such that event A 124
causes event B, event B causes event ..., where the chain eventually links back to 125
event A. A timelike causal connection between events A and B occurs when A 126
causes B and A temporally precedes B. A timelike curve in space-time is a world- 127
line in space-time that represents an object persisting in the forward direction 128
through time, via timelike causal connections between the object at various times (or 129
the temporal parts of the object). A timelike curve that forms a causal loop is a 130
closed timelike curve. It should be intuitively clear that a closed timelike curve is not 131
one where the causal dependence relation corresponding to the "earlier than" relation 132
is irreflexive, transitive, and asymmetric — an object that follows a closed timelike 133
curve is causally dependent on itself. 134

So, some models of general relativity do not cohere with McTaggart's view that 135
the C-series is irreflexive, transitive, and asymmetric, and some do. Which model 136
correctly describes our universe? 137

Contemporary physics does not provide a definitive answer. If the spatial 138
dimensions and the time dimension of the universe were all finite, then general 139
relativity would entail that the universe contains closed timelike curves.[1] But in fact, 140
the evidence, while not conclusive, suggests that the spatial dimensions are infinite.[2] 141
There could still be closed timelike curves in the universe though — J. Richard Gott 142
(2001, Chapter 3), for example, describes models involving cosmic strings coming 143
together in a specific configuration that produces closed timelike curves. But, the 144
evidence from physics is compatible with the claim that these models don't describe 145
our universe, and hence it could be the case that time our universe coheres in this way 146
with McTaggart's view that the C-series is irreflexive, transitive, and asymmetric. 147

Before moving on, I'd like to present one more way that general relativity and 148
McTaggart's metaphysics are partly compatible and partly incompatible. To explain 149
this, I have to fill in some more details regarding McTaggart's metaphysics. When 150
McTaggart says that the C-series is finite, what he means is that there are a finite 151
number of stages in the C-series. But in fact he thinks there is an important 152
difference between (what appears to be) the beginning and the end of the C-series: at 153
what appears to be the beginning, "the boundary of the series is nonentity" (p. 378), 154
but at what appears to be the end, the C-series is unbounded. This leads McTaggart 155
to say, when talking about our non-veridical perception of time, that "past time is 156
only finite, but future time is infinite" (p. 378). One could argue for compatibility 157
between McTaggart and general relativity by pointing out that this idea about time 158
mirrors the model of general relativity that most physicists think matches the actual 159

---

[1] For a proof of this, see Hawking and Ellis 1973, 189–90.

[2] See Spergel et al. 2003 and Bennett et al. 2003. For an accessible discussion, see NASA (2007). To be precise, the evidence is that on a large scale, the universe is spatially flat. It is mathematically possible for the universe to be spatially flat and yet finite (as explained by for example Heckmann and Schücking (1962), 441–2)), but such non-standard topologies are usually rejected by physicists. In addition to the empirical evidence, there is theoretical support for the hypothesis that the universe is spatially infinite. Most versions of inflationary cosmology make this prediction, as explained by Linde (2000, 584–6).

world: a model where the universe started a finite amount of time ago at the Big Bang, 160
and will continue in existence forever. But in fact, in models of general relativity where 161
the universe evolves endlessly into the future, there is no one final stage — the 162
universe keeps evolving. The reason McTaggart says that future time is infinite is that 163
he holds that the final stage of the C-series is an endless one. Since there is no final 164
stage in general relativity, McTaggart's metaphysics isn't fully compatible with the 165
model of general relativity that most physicists think describes our universe. 166

To sum up this section: while it is intriguing that McTaggart developed a non- 167
classical view of reality that to an extent parallels the non-classical description given 168
by general relativity, the parallels are not as close as a science-minded McTaggartian 169
would like.[3] 170

Quantum Mechanics 171

A key part of McTaggart's metaphysics that I have not yet discussed is his thesis that 172
all there is is spirit — matter does not exist. This helps explain why McTaggart says 173
that "the terms of the C series are all parts of the self in which they fall" (p. 234) — 174
selves are all that exist. While this view may prima facie seem at odds with all of 175
contemporary physics, in fact there is an interpretation of quantum mechanics that 176
coheres well with this idea. This interpretation, the mental monist interpretation, has 177
not been much-discussed in the literature, but it is an improvement on dualistic 178
interpretations of quantum mechanics, which have been much-discussed. 179

The quantum-mechanical measurement problem arises because the standard 180
quantum dynamics (the Schrödinger equation) and the standard quantum semantics 181
(the eigenstate-eigenvalue link) make predictions about systems that seem to be 182
incompatible with our experience. The standard dynamics and standard semantics 183
predict that one can easily set up a system whereby a cat is neither alive nor dead, for 184
example, and yet we always experience cats as being either alive or dead. 185

It is often said that, in order to solve the measurement problem, either one must 186
modify the standard dynamics (as is done by GRW theory, for example), or one must 187
modify the standard semantics (as is done by modal interpretations, for example). 188
Dualistic interpretations, however, modify neither the standard dynamics nor the 189
standard semantics. Dualistic interpretations solve the measurement problem by 190
postulating the existence of non-physical minds, and by giving a dynamics for these 191
minds which ensures that the probabilities for experiences of measurement outcomes 192
are given by Born's rule. Albert and Loewer (1988) have postulated dualistic 193
interpretations of quantum mechanics, as has Euan Squires (1990). 194

For all of these dualistic interpretations, the minds evolve independently of the 195
physical universe, and hence render the physical universe otiose; the interpretations 196
are better viewed as supporting not dualism, but mental monism. (For a more 197
developed argument in favor of the mental monist interpretation over the dualist 198
interpretations, see Monton 2007.) The idea behind the mental monist interpretation 199
is that all that exists are minds, and these minds evolve in such a way that their 200

---

[3] John Earman (2002) also suggests parallels between McTaggart and general relativity, but his argument does not take into account McTaggart's actual views on the nature of the C-series.

experiences reproduce the quantum-mechanical statistics. Contrary to the Albert-Loewer many-minds interpretation, there is just one mind per observer, and contrary to the Albert-Loewer single-mind interpretation, the experiences that the minds have are correlated in the expected way. (In the Albert-Loewer single-mind interpretation, in contrast, I can have the experience of opening up a box and seeing that the cat is alive, while you can have the experience of looking in the same box and seeing that the same cat is dead). 201 202 203 204 205 206 207

While these dualist and mental monist interpretations of quantum mechanics are not especially popular amongst philosophers of physics, many philosophers of physics at least take them seriously enough to think them worth discussing. If McTaggart were a contemporary philosopher of physics, I think it likely that he would be sympathetic to the mental monist interpretation, since it fits so well with his idea that there is no matter, only spirit. 208 209 210 211 212 213

Quantum Gravity 214

While I think that McTaggart would be sympathetic to the mental monist interpretation, I do not think he would completely endorse it. One obvious reason for him not to endorse it is that the minds are presented as evolving *in time*. But there is another reason that he — or anyone else — would potentially not want to endorse it. This reason is that the mental monist interpretation is an interpretation of non-relativistic quantum mechanics, but non-relativistic quantum mechanics is not a true theory of the world — it ignores relativistic effects, for which we have solid empirical evidence. This is why physicists are trying to come up with a theory of quantum gravity — a theory that will supplant both non-relativistic quantum mechanics and general relativity. 215 216 217 218 219 220 221 222 223 224

There is no fully worked-out and empirically supported theory of quantum gravity yet, so any discussion of the nature of quantum gravity theory is speculative. Nevertheless, there are hints that, in the true theory of quantum gravity, time is not a part of fundamental reality. For example, prominent string theorist Ed Witten writes: 225 226 227 228

> Contemporary developments in theoretical physics suggest that … spacetime itself may be reinterpreted as an approximate, derived concept. (Witten 2001, 125) 229 230 231

Prima facie, this coheres well with McTaggart's metaphysics — the concepts of the A- and B-series are derived concepts; all fundamental reality really consists of are C-series. 232 233 234

The problem though is that our best evidence suggests that time (or spacetime) in quantum gravity is a derived concept in a rather different way than the A- and B-series are derived concepts. Physicist John Wheeler approvingly quotes the following passage: 235 236 237

> 'Time' itself loses its meaning, and the words 'before' and 'after' are without application. These long-known considerations are of importance only at the Planck scale of distances. (Wheeler 1994, 11) 238 239 240 241

The Planck scale is, roughly, the scale at which quantum effects predominate — about 10^{-43} s. McTaggart does not base any of his metaphysics on the Planck scale, or even on any particular temporal scale. 242 243 244

Wheeler's specific proposal for how there can be a timeless reality is to postulate   245
superspace: the space of all potential three-dimensional geometries, and to give a   246
quantum wave function over that superspace (Wheeler 1994, 9–10). This sort of   247
proposal has been developed most extensively by Julian Barbour, who has done   248
careful work describing a timeless theory of the world (developed most accessibly in   249
Barbour 2001). Barbour holds that "what we experience psychologically is always a   250
time capsule" (Barbour 1994, 408), and the quantum wave function is defined over the   251
space of time capsules. The time capsules are not linearly ordered, but there is   252
asymmetric structure to the configuration space, and this asymmetric structure is the   253
source of the appearance of the direction of time. This is a quite different view of the   254
world than McTaggart's: in McTaggart's C-series, the stages of the C-series are   255
linearly ordered along a single dimension; they are not ordered in a many-dimensional   256
configuration space. McTaggart does think that there are multiple C-series, but (as   257
discussed in "Special Relativity" above) these C-series all line up in the same way.   258

In sum, McTaggart's metaphysics of the C-series, while at first appearing radical   259
in endorsing the unreality of time, now appears overly classical. The structure of the   260
C-series is not affected by quantum effects at small scales, and the stages of the C-   261
series are linearly ordered.   262

Nevertheless, McTaggart's metaphysics can have some use in the contemporary   263
debates about the nature of time in quantum gravity. His metaphysics can be used as   264
a "proof of concept" — a description of the way the world could be such that time is   265
unreal. I have had personal conversations with physicists where they have wondered   266
whether philosophical arguments show that time has to be an aspect of fundamental   267
reality. As long as McTaggart's metaphysics is viable, then the answer to the   268
physicists' queries is "no" — they are free, from a philosophical perspective at least,   269
to explore theories where time is unreal.   270
271

References   272

Albert, D. Z., & Loewer, B. (1988). Interpreting the many-worlds interpretation. *Synthese, 77*, 195–213.   273
doi:10.1007/BF00869434.   274
Barbour, J. (1994). The emergence of time and its arrow from timelessness. In J. Halliwell, J.   275
Pérez-Mercader & W. H. Zurek (Eds.), *Physical origins of time asymmetry* (pp. 405–414).   276
Cambridge: Cambridge University Press.   277
Barbour, J. (2001). *The end of time: the next revolution in physics*. Oxford: Oxford University Press.   278
Bennett, C. L., et al. (2003). First-year Wilkinson Microwave Anisotropy Probe (WMAP) observations: 279
preliminary maps and basic results. *The Astrophysical Journal. Supplement Series, 148*, 1–27.   280
doi:10.1086/377253.   281
Earman, J. (2002). Thoroughly modern McTaggart, or, what McTaggart would have said if he had read the   282
general theory of relativity. Philosophers'. *Imprint, 2*. http://www.philosophersimprint.org/002003/.   283
Gott, J. R. (2001). *Time travel in Einstein's universe*. Boston: Houghton Mifflin.   284
Hawking, S. W., & Ellis, G. F. R. (1973). *The large scale structure of space-time*. Cambridge: Cambridge   285
University Press.   286
Heckmann, O., & Schücking, E. (1962). Relativistic cosmology. In L. Witten (Ed.), *Gravitation: An*   287   **Q2**
introduction to current research (pp. 438–469). New York: Wiley.   288
Linde, A. (2000). Inflationary cosmology. *Physics Reports, 333–334*, 575–591. doi:10.1016/S0370-1573   289
(00)00038-7.   290
McTaggart, J. M. E. (1927). *The nature of existence* (Vol. II). Cambridge: Cambridge University Press.   291   **Q3**
Monton, B. (2007). Common-sense realism and the unimaginable otherness of science. *Principia* 11(2),   292
117–126. See also Monton, B. On dualistic interpretations of quantum mechanics. Preprint 2913 at   293
http://philsci-archive.pitt.edu.   294

JrnlID 11406_ArtID 9212_Proof# 1 - 12/06/2009

NASA. (2007). *Is the universe infinite*? At http://map.gsfc.nasa.gov/universe/uni_shape.html, archived at http://www.webcitation.org/5bnkjQefh.

Spergel, D. N., et al. (2003). First-year Wilkinson Microwave Anisotropy Probe (WMAP) observations: determination of cosmological parameters. *The Astrophysical Journal. Supplement Series, 148*, 175–194. doi:10.1086/377226.

Squires, E. (1990). *Conscious mind in the physical world*. Bristol: Adam Hilger.

Wheeler, J. A. (1994). Time today. In J. Halliwell, J. Pérez-Mercader & W. H. Zurek (Eds.), *Physical origins of time asymmetry* (pp. 1–29). Cambridge: Cambridge University Press.

Witten, E. (2001). Reflections on the fate of spacetime. In C. Callender & N. Huggett (Eds.), *Physics meets philosophy at the Planck scale*. Cambridge: Cambridge University Press.

295
296
297
298
299
300
301
302
303
304
305