McTaggart meets Schrodinger's Cat

Abstract This paper proposes an interpretation of time that is an 'A-theory' in that it incorporates both McTaggart's A-series and his B-series. The A-series characteristics are supposed to be 'ontologically private' analogous to qualia in the problem of other minds, such as in the Inverted Spectrum thought experiment, and is given a definition. The main idea is then that the experimenter and the cat do not share the same A-series characteristics, e.g. the same 'now', to some extent. So there is no *single time* at which the cat gets ascribed different states, one by the experimenter and one by the cat. Also it is proposed one may define an ontologically private 'unit of becoming' that coordinatizes the future/present/past A-series spectrum as well as allow one to calculate rates of becoming with seconds. The latter are taken to measure differences in B-series times.

1 Introduction

References forthcoming

This paper looks at how A-theorism might be implemented in the Schrodinger's Cat thought experiment. The plan of the paper is

Outline of the argument:

1. There are some Dualist models in which Alice's qualia do not determine Bob's qualia (for Alice), as in the Inverted Spectrum or Inverted Qualia thought experiments.

2. In some models McTaggart's A-series is (or is like) qualia.

3. So it could be that in some models the A-series of Alice does not determine the A-series of Bob.

4. For example, Alice's 'now' would not determine Bob's 'now', to some extent, and vice versa.

5. This applies to Schrodinger's Cat in that there need be no single time (shared present) at which the cat gets ascribed different states, one by Alice and one by the cat (Bob) itself, during an experiment. So at no time, given by both an A-series and a B-series, does a contradiction arise.

2 AB-series time

McTaggart (1908) identified two different series that characterize time. There is the B-series

and the A-series.

> "Positions in time, as time appears to us *prima facie*, are distinguished in two ways. Each position is Earlier than some, and Later than some, of the other positions. And each position is either Past, Present, or Future. The distinctions of the former class are permanent, while those of the latter are not. If M is ever earlier than N, it is always earlier. But an event, which is now present, was future and will be past."

I will not follow McTaggart to the conclusion that time is unreal, but suggest that time is real and has both B-series and A-series characteristics, as most A-theorists posit.

The B-series is a series of times ordered by the relation of 'earlier-than' (or 'later-than'). The B-series is usually thought of as going from earlier times to later times. It could be argued the B-series is the kind of time that's most often used in physics. For example, the time parameter of the Schrodinger equation is a B-series. The B-series relations do not change. Also, going 'backward in time' in the B-series just means going to earlier times.

I would argue, as many A-theorists do, the A-series, as not reducible to the B-series, is also a part of a comprehensive view of time. The A-series consists in the *ontologically private* (defined below) *now* and *becoming*. In contrast to the B-series, the A-series values change. Also in contrast to the B-series, going 'backward in time' is undefined, on this view.

It's a Zen observation that

> "Time constantly goes from past to present and from present to future. This is true, but it is also true that time goes from future to present and from present to past."

(Suzuki 1986), p. 17 or 33. The former is the B-series (interpreted as 'earlier-times to later-times') and the latter is the A-series. As in several theories of time, instead of asserting 'time goes from past to present to future', it'd be more appropriate to assert 'time goes from earlier times to later times as it goes from future to present to past'. As later and later times become present, time to go on.

The question is how to incorporate the A-series in physics, while of course retaining the B-series, into what I will for the purposes of this paper call the AB-series, denoting that a single dimension of time has both A-series and B-series characteristics, in a way that is consistent with relativity. The ideas here are related to at least Fragmentalism (Fine 2005). The idea will be to add to each system a 'now' and a 'becoming' (of the A-series) that is 'ontologically private' to that system, while retaining the ontologically public B-series interrelations already in wide use in physics. These are 'private' now's, so, presumably, the apparent 'universal now' that humans live in on earth results from some kind of averaging function over the more-or-less ubiquitous private nows.

3 Ontological privacy

An ontologically private parameter may be defined as one that takes on a definite value when a system S specifies its own ontic state, but does not take on a definite value when a *different* system S' specifies the ontic state of S. This could be because, for S', 1. S has no such parameter, 2. S has such a parameter but it does not have a definite value, or 3. there is a parameter and it has a definite value but it is not known or knowable, for some reason, as might be appropriate in QBism, though to be sure it is the ontological questions that concern us here.

4 Panpsychism

I am conscious, and this is certain to a degree even greater than the certainty that there are physical laws. But there is, in one sense, nothing special about my composition—I'm made of electrons and quarks etc. Thus there is good reason to think that the basic elements that make up my brain are accompanied by the basic elements of subjective experience—qualia. One is lead to the hypothesis that an electron is accompanied by a quale—a subjective experience—for example, the color green. Perhaps a muon is accompanied by a blue quale. There's been an amount written about this and surrounding ideas but the basic idea is clear enough and is called (Dualist) Panpsychism. (Stanford 2017). (Other correlates to qualia such as complexity could be entertained.)

'Ontological privacy' in the sense of the above is basically what happens with the Inverted Spectrum, familiar from the philosophy of mind (Stanford, 2018). Suppose Alice looks at the leaves on a tree and she experiences the color green. She cannot know, in some ontological sense, that if her friend Bob looks at the same leaves he experiences the same (color) quality.

Now suppose they look at a color circle. Alice's color spectrum does not determine Bob's color spectrum, for Alice. Bob could have a systematically 'opposite' color experience. This is basically the Inverted Spectrum (Wikipedia 2019). Indeed, it may be that Alice has a single definite spectrum, whereas Bob's spectrum can *vary* over a wide range of spectrums or even other possibilities, for Alice. Alice's (qualitative) experience while looking at the leaves, in some ontological sense, leaves Bob's experience without a definite value (for Alice), and therefore this color-parameter is 'ontologically private'.

The theory of time explored in this paper posits that the A-series characteristics of time are (or could be) ontologically private. A consequence would be that Alice's '*now*' does not determine when the Cat's '*now*' is, to some extent. One wants ontological parsimony. It may indeed be Alice's 'green' is the same as Bob's 'green'. But that doesn't imply that a brain b_1 can *verify* the experiences of an *other* brain b_2. Suppose, for example, Alice is able to verify that the experiences of Bob are the same as hers, perhaps by bringing together the brains as part of a larger brain b_3. But then the larger brain b_3 still can't verify the contents of an *other* brain, b_4, outside of b_3. There is no experiment b_1 can do, even in principle, to determine what b_2's qualia are. So that result should be in the ontology, if possible.

5 Definitions and rates

Mathematicians were taking square roots of positive numbers, e.g. finding x in the equation $x^2 = 1$. But one wanted to generalize to equations like $x^2 = -1$. There was no real number that did it, so to a real number mathematicians added a non-real parameter *i.* That is, *i* is a kind of standardized place-holder for a would-be root, whatever kind of creature that is.

One thing to try, then, is to start with a parameter t whose unit is change in B-series, an interval, in for example seconds. Add a parameter τ whose unit is not an interval in B-series clock time: in AB-theory, τ is part of the A-series, and "e" will be a unit of what temporal becoming is like per second, as a kind of standardized place holder, whatever kind of creature it is. Let τ be the future-present-past spectrum. e coordinatizes τ.

Define an *indexical clock* to be a clock that's not accelerating, has relative velocity 0, and is spatially local, to a centered inertial reference frame, all in terms of a B-series.

Define

1 *e* is what becoming is like for 1 second of indexical clock time

If becoming is indeed phenomenal in the way that qualia are, then, it could be argued, it *must* be 'defined' or 'referred to' in this curious 'what it is like' way, on salient views. E.g. a green quale is defined as 'what it is like' to experience green. The necessity of doing this has to do with their ineffability. *e* can be well-defined across systems. 1 second is well-defined across systems such as Alice and a protozoan, even though the protozoan doesn't have the mental capacities Alice does. It's plausible that it's the same way with 1 *e* of A-series time. Just the way one can re-define seconds to be longer or shorter than the usual seconds, one can re-define *e*s to be further or closer into the future than the usual *e*s. The physically significant stuff should be invariant under these changes.

Define

1 sec./*e* = d(Alice's B-series)/d(Alice's A-series)

is the change in 1 second of indexical clock time per change in *e*. For example, the position of a particle at 1 sec. *later than* t = 0 is also 1 *e* closer to the present from the future (or further into the past).

Consider the rate *r* = 2 sec./*e.* This can be interpreted as meaning there are 2 seconds of indexical clock time per unit of becoming. Presumably, the 2 seconds are in a series. That would seem to imply that, for 1 *e*, 2 seconds go by, so earlier-to-later relations would appear to go by faster.

Let the rate *r* be in units of sec./*e*. The general idea is

- $r > 1$ B-series time appears sped up (earlier-times to later-times appear to be going by faster than normal)
- $r = 1$ the change in B-series information per change in A-series information is given by 1 second of indexical clock time per unit *e* of becoming. This unit *e* is assumed to be invariant across all panpsychist systems, the way 1 second of indexical clock time is invariant across such systems as Alice and a protozoan.
- $0 < r < 1$ B-series time appears slowed down, as in relativistic dilation between Alice's B-series and Bob's B-series, according to either Alice or Bob
- $r = 0$ B-series time appears stopped (but the appearance goes on [ref.])
- $r < 0$ one appears (from *future* to *now* to *past*) to be going backward in B-series time, e.g. time-reversal

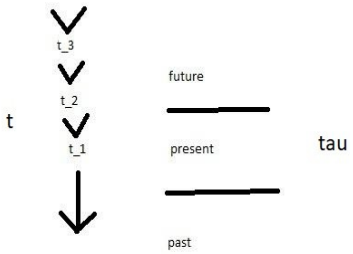
One may define d*r*/d*e*. e^2 would have something to do with the rate of becoming accelerating. e^{-2} would be something like *"*per unit of becoming, per unit of becoming".

6 Picture of AB-series time

One doesn't need to suppose the present is a single infinitesimally small point centered at, for example, $\tau = 0$. For each τ there could be a degree of 'existence' or 'actuality' or 'presentness' $p = p(\tau)$, so the *now* is spread out in A-series time somewhat. (Smith, 2010). One attractive example is for p some Gaussian function of τ. Also non-symmetric functions. A place on τ is thus assigned a degree of existence/actuality/presentness $p(\tau)$, and there's no reason to make the assumption that the present is at $\tau = 0$ only (in the obvious coordinatization). The growing-block theorist supposes the past is real,

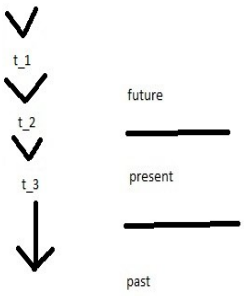
which might be defined as $p(\tau) = 1$ for $\tau < 0$ and $\tau = 0$, for a particular system. The block theorist would have $p(\tau) = 1$ for all τ. A presentist (like me) has $p(\tau) > 0$ on the support of τ.

This is the model



t_1 is earlier than t_2 which is earlier than t_3... The earlier-times to later-times timeline stays in one ordering (of one kind or another), but the whole timeline moves from future to present to past, with the present staying put. (The present does not 'move up the B-series' as in some spotlight theories because ipso facto the presents wouldn't be ontologically privileged.) As later and later B-series times become present, time goes on.

Time-reversal goes as



t_3 and then an earlier time t_2 and then an even earlier time t_1 become from Alice's future to her present and then to her past. As earlier and earlier times become present to her, time appears to be going in reverse. Time-reversal invariance obtains only for a B-series, on this view. Time-reversal for an A-series is undefined. There's no unit of going from past to future defined in the A-series.

7 McTaggart meets Schrodinger's Cat

I will take this opportunity to become somewhat speculative. We ask the question of how McTaggart's insights might apply to Schrodinger's Cat. Here is one idea.

I will assume the reader is already fluent with the paradox. Suppose the experimenter is Alice. At some point (time) during the experiment, Alice describes the cat's state as a superposition, in obvious notation, [psi> = [meowing> + [purring>. Yet at that time the cat describes its own state as being in one or the other states 'meowing' or 'purring', and not in the superposition [psi>. What's going on?

The problem from the perspective of the AB-theory is that we assumed the A-series values of the cat are the same as the A-series values of Alice. Suppose Alice's clock reads 7:10 pm. This clock-time could be interpreted as 7 hrs and 10 min *later* than noon, which is the B-series information. Yet the 'now' of Alice and the 'now' of the cat are taken to be ontologically private. Therefore the 'now' of Alice does not determine (fix) the 'now' of the cat, if they are separate systems, analogous to the case of qualia in the Inverted Spectrum. The ontology ought to reflect that, if possible. In this case, to some extent, Alice cannot determine when the 'now' of the cat is. This is so from the beginning of the experiment (when she closes the box) until the end of the experiment (when she opens the box).

But if, during the experiment, Alice and the cat never are in a shared present, or shared 'now', then there is never a *single time* at which the cat gets ascribed different states, one by Alice and one by the cat. That is how the paradox is resolved in this interpretation.

8 Time T(τ, t)

This is not a theory of two time dimensions but one time dimension that has two closely related parameters τ and t, such that the time T is given by T(τ, t). τ is how far *in the future* an event is and t is how much *later than* an event is, compared to a reference system, e.g. 'Alice'. There might be functions f given by $f(T(\tau, t), x_a)$ for a = 1, 2, 3.

More References forthcoming

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