What is the best argument against presentism and/or dynamic theories of time? Does it succeed?

1. Introduction

Presentism, a theory of the nature of time, states that the only thing that exists is the present moment, the "now". The past and the future are both not real, the universe is a three-dimensional manifold, there is no fourth temporal dimension. Saunders[1] claims that Presentism is a realist ontological position, meaning that it is thought to be independent from human knowledge or perception.

This essay will examine what I claim to be the strongest argument against Presentism, namely its incompatibility with the theory of Special Relativity. It is important to remember that the presentist faces other issues, including the alleged inability to use tensed language if anything other than the present is not real, or the argument that even the "now" is divisible into temporal parts of the past and the future. However, I claim that presentists manage to save the theory from those undamaging criticisms, and hence this essay will only focus on the *best* argument against Presentism (the incompatibility with Special Relativity), which comes with responses that are not plausible. This will be shown by analysing two separate positions - Brading's different approach to Presentism based on dynamical laws rather than the geometry of Minkowski spacetime, together with Monton's proposition to reject Special Relativity. However, due to the responses posed at both of these positions, it will be concluded that the argument from Special Relativity succeeds in disproving Presentism.

2. The fundaments of Special Relativity

Theodore Sider proposes that the incompatibility with Special Relativity is fatal for Presentism[2]. In order to understand how this conflict arises, it is crucial to first analyse how Minkowski spacetime (on which Special Relativity is formulated) differs from the classical spacetime.

Classical spacetime entails of a four-dimensional manifold of spacetime points, which contains all the spatial and temporal information about any event, that is - the past, the present and the future. Such a concept allows for the existence of absolute simultaneity - a hyperplane of simultaneity is described as a set of all the points simultaneous to another point. The points that occur temporally after the points in the hyperplane are referred to as the future, while the ones that occur before are referred to as the past. What is crucial here is the fact that both of those relations to the hyperplane of simultaneity are *absolute*, they arise purely from the geometrical structure of the classical spacetime and hence are independent of the state of the observer.

On the other hand, Minkowski spacetime does not consist of the classical notion of simultaneity, the geometrical structure is not divided into any sort of hyperplanes of simultaneity. Instead, light-cones are used to describe the history of a given point (p), with each light-cone including three separate sets. The absolute future of p is described as a set of points that could physically be reached from p by a signal which travels at or below the speed of light. The absolute past of p consists of a set of points that p can be reached by a signal which travels with a velocity equal to or lower than the speed of light. Lastly, the set of points spacelike separated from p which is the rest of the points that cannot be reached from p or by p, as doing so would lead to a violation of the speed of light limit (that nothing can ever travel faster than the speed of light). Within the Minkowski spacetime,

[1] Saunders, *"How Relativity Contradicts Presentism"*, page 2
[2] Sider, *"Four-Dimensionalism: An Ontology of Persistence and Time"*, page 26 of chapter 2 *("Against Presentism")*

there is no place for hyperplanes of simultaneity, at least not in the classical sense. A relative notion of simultaneity is introduced by defining reference frames – which propose the idea of relative concepts of past and future. Given an observer that is in motion close to the speed of light, what events are simultaneous to him/her compared to a stationary observer will vary to a large extent. For example, even though a car crash in Berlin and another crash in Toronto appear to happen at the same time to an observer on Earth, the two events would appear to have happened at marginally different times to an observer in a different reference time, i.e., to an astronaut heading towards the ISS, or a different planet. The events might be separated by picoseconds in this example, however, if one places the observer in the second reference frame moving at a velocity close to the speed of light, then the temporal separation of the two events will proportionally increase in magnitude.

The question that naturally arises from the distinction of spacetimes is the following: how is Presentism incompatible with Minkowski spacetime? The "present" moment is fundamental for Presentism, yet the notion of the present time, the absolute simultaneity does not exist in the structure of Minkowski Spacetime. There is no place for the "now" to have any meaningful value. What is considered to be the "now" in one reference frame can be in fact translated as a future or past moment in a different reference frame. Since Special Relativity is derived from the geometry of Minkowski spacetime, it follows that Presentism cannot be compatible with a theory where the present moment does not exist.

In order to defend Presentism, one would have to find a way to formulate a Presentism/Minkowskian hybrid, which would encapsulate the notion of simultaneity, while conserving the geometry of Minkowski spacetime. Sider provides five different attempts of defining this sort of hybrid, including the here-now-ism or the position of retaining an arbitrary 'hyperplane'. However, ultimately, he concludes that none of them are successful attempts[3]. The rest of this essay will evaluate better approaches to unifying Special Relativity with Presentism.

3. Defending Presentism – an attempt to resolve the incompatibility

Katherine Brading proposes an empirical hypothesis that, as she claims, resolves the conflict between Presentism and Special Relativity. As it will be later shown, her position is highly hypothetical and of a rather metaphysical nature – the process of testing her empirical hypothesis is met with physical impossibility.

Brading firstly establishes the following argument:

(P1) All and only things that exist now are real.

(P2) Special Relativity is a complete account of spatiotemporal structure[4].

(P2) seems to be incompatible with (P1). If one agrees that Special Relativity gives a correct account of space and time, then the first premise can be falsified, based on the argument of having no absolute simultaneity. Brading reinforces her awareness that the *traditional* approach to Presentism is false. With Einstein's Special Relativity, even if one could claim the existence of the "now", we would have no empirical access to it, no human experience would ever provide the evidence needed to verify the validity of Presentism. What Brading does is offer an alternative approach to Presentism by building the theory on dynamical laws instead of the geometry of Minkowski spacetime. She claims that "the present is a spatiotemporal region of whatever size is necessary to sustain the dynamical system in question"[5]. The dynamical laws ground the ontological principle of unity - of what exists. Based on this approach, it follows from (P2) that:

[3] Sider, *"Four-Dimensionalism: An Ontology of Persistence and Time"*, pages 28-33 of chapter 2 *("Against Presentism"*)

[4] Brading, *"Presentism as an empirical hypothesis"*, page 1

[5] Brading, *"Presentism as an empirical hypothesis"*, page 12

> (1) Special Relativity can be understood as an epistemic principle of unity, it is the best way of organizing our knowledge that reaches beyond the here-now.
> (2) Ontologically, what exists is grounded in the dynamical laws, and these include the spatiotemporal characteristics of things[6].

In order to save Presentism, (P1) has to be rewritten:

> (P1*) For each and every thing, that thing exists only presently, where the spatiotemporal extent of that "present" is dependent on dynamics, and it is something to be determined empirically[7].

The present moment can then be understood as a region of spacetime of whatever size is necessary to sustain the dynamical system we are concerned with. In other words, "what is "present" depends on what is real (the genuine unities), and what is real depends on the dynamical laws"[8]. Since Brading is deriving the "now" from dynamical laws rather than the structure of the Minkowski spacetime, there seems to be no tension between Special Relativity and Presentism, it seems as if the intrinsic incompatibility can be resolved.

However, Brading herself also proposes a possibility that her attempt to unite Special Relativity with Presentism might not be correct. She questions the very fundamental aspect of her premise, the *size* of the spatiotemporal region needed to sustain the dynamical system. She argues that if the entire spatiotemporal history of the universe[9] is required to sustain such dynamical system, then Presentism cannot be correct, and she reaches out to an alternative theory of the nature of time, namely the Growing Block. Brading still argues that the "present" can be defended by claiming that the size of the subsystem does not in fact include the entire spatiotemporal history of the universe. Such "present" moment would be a local concept, as she argues: "being present is relative to the dynamical system in question: it is localized to the spatiotemporal region necessary to sustain that system and is not transitive among systems and their subsystems"[10]. There is no global "present" moment that would be shared across multiple systems in Brading's version of Presentism. She concludes that as far as philosophy goes, this version of Presentism is compatible with Special Relativity, however, the debate is not completely settled as the necessities of sustaining a dynamical system are still not clear. Establishing how far back we must go in the spatiotemporal history in order to define what is needed to sustain a dynamical system is rather an empirical question, and Brading is aware that experimental data might refute her position[11].

Branding's argument seems to be plausible at first, however, I claim that her hypothesis can still be refuted. The questioning of what is needed to sustain a dynamical system is indeed an empirical question, but I argue that it is not within the reach of physics to determine the answer. Each dynamical system is dependent on another system, there is not a single system in the entire universe that would exist independently from other systems. In order to defend Brading's position, we would need to isolate one dynamic system from all the other systems to show that the entire spatiotemporal history of the chosen system is not necessary in sustaining it. Such a process is not within the physical possibility, as it is not testable within our universe, because we are confined within the same spatiotemporal region that we want to test. There is no way for physicists to test one separated dynamical system, as even testing it enforces the consequences of us being the observers of it. This entire response to Brading can be tied closely to the debate about determinism, which questions

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[6] Brading, *"Presentism as an empirical hypothesis"*, page 11
[7] Brading, *"Presentism as an empirical hypothesis"*, page 13
[8] Brading, *"Physically locating the present"*, page 13
[9] Brading, *"Physically locating the present"*, page 13
[10] Brading, *"Physically locating the present"*, pages 13-14
[11] Brading, *"Physically locating the present"*, page 18

whether all systems do in fact depend on and are causally connected to other systems. However, this is beyond the scope of this essay, yet I argue that the reasoning above is enough to invalidate Brading's position. Consequently, the empirical hypothesis can be discarded as it is not testable. Therefore, her attempt to unify Special Relativity with Presentism fails.

4. Denying the fundamentality of Special Relativity in the hopes of saving Presentism

Brading's argument has suggested that the metaphysical approach to solving the incompatibility might not be the best method. In order to defend Presentism, both Monton[12] and Crisp[13] propose the idea of rejecting Special Relativity and finding a theory which is successful in doing both – explaining the universe as well as being compatible with the presentist theory of time. Such rejection would be on a rather scientific basis rather than just purely philosophical, it would consist of finding another theory that would agree with the existence of absolute simultaneity.

Monton attempts to prove the above by claiming that the following is *not* valid:

> (P1) Presentism is incompatible with Relativity theory (usually the focus is on Special Relativity).
>
> (P2) Relativity theory is our most fundamental theory of physics.
>
> (P3) Presentism is incompatible with our most fundamental theory of physics (from (P1) and (P2)).
>
> (C) Presentism is false (from (P3))[14].

Monton argues that (2) is false, as there are other fundamental theories of physics, which are compatible with Presentism. One of those theories, he claims to be Quantum Gravity. He proceeds to argue for the statement that if we can find theories as fundamental as Special Relativity, theories which would be compatible with Presentism, then Presentism could be defended. "Even if Presentism is incompatible with Special and General Relativity, it in no way follows that Presentism is incompatible with our most fundamental physics"[15]. This argument seems to be implausible, as it proposes to discard of a fundamental theory, which appears to be compatible with a lot of our current experiments and other theories, other than Presentism. Monton argues that Presentism can be true if it's compatible with at least one fundamental theory, but it seems as if he is cherry-picking his theories to protect Presentism at all costs.

Wüthrich argues that the fallacy committed by Monton is denying the fundamentality of Special Relativity, i.e., denying the second premise, which in turn means that Monton is implying that Special Relativity is false. Since non-fundamentality does not entail falsehood, Monton commits a fundamental error, which allows him to 'save' Presentism. In other words, Presentism being incompatible with a *false* theory is not a problem, but it is clear that Monton's reasoning here is highly unconvincing[16]. The fallacy of the argument can be reinforced by reaching for empirical evidence. If physicists agree that the judgment over which theory is preferred over a different theory comes from how much the theory has been experimentally tested, it would be much more reasonable to claim that Quantum Gravity is false, instead of claiming that General Relativity is false.

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[12] Monton, *"Presentism and Quantum Gravity"* (2005)
[13] Crisp, *"Presentism, Eternalism and Relativity Physics"* (2008)
[14] Monton, *"Presentism and Quantum Gravity", page 264*
[15] Monton, *"Presentism and Quantum Gravity", page 269*
[16] Wüthrich, *"No Presentism in Quantum Gravity"*, page 8

A reasonable response here would be to argue for a possibility of coming up with a theory of Quantum Gravity which would not be compatible with Presentism. Given that our current understanding of Quantum Gravity is not as developed as our understanding of other fundamental theories, it is conceivable that once there is more data conducted from testing Quantum Gravity, it might turn out that it is not compatible with Presentism either. Monton states that there is no simple answer to such a question, and it seems clear to me that by giving a vague response[17], it seems almost impossible to defend his rather illogical position.

Even if it is not convincing to argue for Quantum Gravity, it is still possible to claim that one day physicists will discover a fundamental theory that would either falsify Special Relativity or prove the correctness of Presentism. However, such proposals are of a rather speculative nature, and it seems clear to me that with the current understanding of the universe that physicists bring to the debate, it is much more reasonable to disagree with the presentist and instead adopt a different theory of time, such as Eternalism or the Growing Block.

5. Conclusion

In conclusion, it has been shown that Presentism does not provide a convincing response to the argument from Special Relativity. Whether the incompatibility is attempted to be resolved from a metaphysical approach or by rewriting our current theories of physics, both of those efforts have been shown to lead to implausible results. Therefore, as Rovelli summarises "Special Relativity teaches us something about time which many of us have difficulties to accept. […] There is no physical meaning in the idea of 'the state of the world right now'"[18]. Thus, the best argument against Presentism is its incompatibility with Special relativity, and it succeeds in disproving the presentist theory of time.

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[17] Monton, *"Presentism and Quantum Gravity",* page *274*
[18] Rovelli, *"Quantum spacetime: what do we know?"*, page 11

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