

Analysis of the article:
Einstein's cat: a thought experiment on the
universality of time dilation
by V G Rousseau

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Abstract

There are many articles about the Special Theory of Relativity (SR) and its building blocks and consequences. Most of them defend this theory, but there are those who reject it. In this work, I present a critical analysis of one article that defends SR: *Einstein's cat: a thought experiment on the universality of time dilation* by V. G. Rousseau from the Physics Department, Xavier University of Louisiana, USA. [1] The purpose is not only to review the content but, more importantly, to identify weaknesses, logical inconsistencies, and questionable assumptions in the author's reasoning, and to provide counterarguments based on my own interpretation and understanding of SR.

Introduction

The article [1] argues that the concept of *time dilation* in Special Relativity (SR) applies equally to all clocks, not only to the light clock (see Appendix 1). While this position aligns with SR's postulates, the purpose of the present work is not to restate or promote these postulates, but to critically examine the reasoning presented in [1].

This analysis focuses on identifying and discussing logical flaws, unsupported assumptions, and circular reasoning in the author's argumentation. The goal is to show that the so-called *Sync-or-Die clock* thought experiment, while imaginative, does not provide independent proof of the universality of time dilation, and that its convincing power is limited to those who already accept SR's foundational assumptions.

Summary of the proposed thought experiment

In [1], the author introduces the so-called *Sync-or-Die clock*, a hypothetical device consisting of two components: a light clock and a mechanical stopwatch. The two clocks are designed to operate in synchrony, and the proper functioning of the system depends on maintaining this synchronisation.

The thought experiment is set up such that the survival of a cat depends on whether the two clocks remain in agreement after a period of motion relative to an inertial observer. The author argues that if time dilation did not affect both clocks in exactly the same way, observers in different inertial frames could disagree on the outcome, which would lead to a paradox. From this, [1] concludes that time dilation must be universal.

In the following sections, I will challenge the assumptions underlying this experiment, examine the logical structure of the paradox, and argue why the conclusions drawn are, in my view, not justified.

First point of criticism: assumptions about clock behaviour

The argument in [1] relies on the assumption that the behaviour of the mechanical stopwatch under motion can be analysed in the same way as the light clock. without providing a physical justification for this equivalence. While SR states that time dilation applies to all physical processes equally, this is a postulate-based conclusion, not something that can be directly inferred from the operation of specific clock mechanisms without additional premises.

In particular, the author treats the synchronisation of the two clocks as an unproblematic given in the rest frame, and assumes that any desynchronisation in a moving frame would imply a violation of SR. However, the possibility that different physical processes may be affected differently by motion — an idea entertained in some alternative formulations of relativity — is not addressed. By ignoring this, the article effectively builds its conclusion into its assumptions, a form of circular reasoning (see Appendix 2).

Second point of criticism: definition of the paradox

In [1], the so-called paradox arises from the assumption that if two clocks — a light clock and a mechanical stopwatch — do not experience identical time dilation, then different inertial observers could disagree on the cat's fate. This disagreement is treated as a physical impossibility.

However, the concept of a "paradox" here is based entirely on the framework of Special Relativity itself. The reasoning presupposes that the outcome of a physical

process must be frame-independent, and that all clocks must necessarily register the same elapsed proper time for the same moving system. This is not a logically necessary condition outside SR's postulates; it is a built-in feature of SR's formalism.

Consequently, the so-called paradox is not an independent contradiction of physical principles but rather a contradiction with the specific axioms of SR. If one questions or modifies those axioms, the paradox may not arise at all. The framing of the thought experiment therefore implicitly assumes the very theoretical framework that the article intends to justify.

Third point of criticism: physical feasibility of the experiment

The *Sync-or-Die clock* is presented as a thought experiment, and as such it is not bound by the same constraints as a practical laboratory setup. However, in [1] the scenario is described in a way that suggests it could, at least in principle, be realised physically. This raises questions about the feasibility of synchronising two fundamentally different types of clocks — a light clock and a mechanical stopwatch — with the precision required for the argument to hold.

In reality, even in a controlled laboratory environment, mechanical clocks are subject to influences such as temperature variations, material deformations, and inertial forces that do not affect an idealised light clock in the same way. These differences introduce systematic errors that would overwhelm the minuscule effects of relativistic time dilation at achievable velocities.

Therefore, even if one accepted the premises of SR, the proposed setup could not serve as an empirical test of universality for time dilation. The argument must thus be understood purely as an illustration of SR's principles, not as a demonstration that could be validated or falsified by physical experiment.

Fourth point of criticism: measurement uncertainty and its implications

The reasoning in [1] implicitly assumes that the measurement of elapsed time by both the light clock and the mechanical stopwatch can be performed with arbitrary precision. In reality, any timing device is subject to inherent measurement uncertainty, arising from both the device's construction and the process of observation.

For a light clock, the uncertainty is dominated by the resolution of detecting the light pulse and the stability of the mirror separation. For a mechanical stopwatch, additional sources of error include mechanical friction, spring tension variations, and environmental factors such as temperature and vibration. These uncertainties do not scale in the same way for different clock mechanisms, making perfect synchronisation not only practically impossible but also theoretically undefined beyond a certain limit.

If one takes these unavoidable uncertainties into account, the "paradox" described in [1] becomes untestable in practice. The differences predicted by a non-universal time dilation model could easily be smaller than the combined measurement errors, rendering the outcome ambiguous. This further undermines the claim that the thought experiment provides a definitive argument for the universality of time dilation.

Fifth point of criticism: alternative interpretations beyond SR

The argument in [1] is framed entirely within the formalism of Special Relativity, which prescribes that all ideal clocks measure the same proper time along a given worldline. However, alternative theoretical frameworks exist in which this is not necessarily the case. In such models, different types of physical processes may respond differently to motion or gravitational influence, leading to clock-dependent time measurements.

If one adopts such a framework, the disagreement between the light clock and the mechanical stopwatch in the *Sync-or-Die clock* scenario does not constitute a paradox but rather an expected consequence of the underlying physics. The "paradox" therefore disappears, not because the clocks behave identically, but because the premise that all clocks must behave identically is no longer assumed.

This observation highlights that the thought experiment's force as an argument depends critically on accepting SR's postulates from the outset. For those who question these postulates, the scenario may simply illustrate the difference between SR's predictions and those of competing models, rather than providing a proof of SR's correctness.

Remarks on the validity of SR

In my own research, I have reached the conclusion that Special Relativity (SR) is not merely incomplete, but fundamentally incorrect. This position is supported by both theoretical considerations and interpretations of experimental results that are incompatible with SR's postulates. A detailed exposition of these arguments can be found in my previous works [2, 3, 4]. In light of this, the analysis in the present article is not aimed at refining SR's internal consistency, but at exposing weaknesses in arguments that are often presented as decisive in its favour.

Concluding remarks

The article [1] aims to defend the universality of time dilation in Special Relativity through the construction of the *Sync-or-Die clock* thought experiment. While the scenario is engaging and imaginative, the analysis presented here reveals several serious issues that undermine its argumentative strength.

First, the reasoning contains an element of circularity, assuming from the outset the very conclusion it seeks to demonstrate. Second, the definition of the paradox is tied entirely to SR’s postulates, making it a contradiction only within that theoretical framework. Third, the physical feasibility of the proposed setup is questionable, as maintaining perfect synchronisation between fundamentally different clock mechanisms is beyond practical capability. Fourth, the neglect of unavoidable measurement uncertainties makes the paradox untestable in practice. Fifth, the argument ignores the possibility of alternative theoretical models in which clock-dependent time measurements are natural and non-paradoxical.

Additionally, the author complicates the argument by introducing the notion of “Einstein’s cat,” attempting to draw rhetorical and pedagogical strength from the famous Schrödinger’s cat thought experiment. In doing so, the discussion risks being distracted by conceptual associations that are not essential to the physical question at hand. In my view, both physical and thought experiments should be kept as simple as possible to isolate the core assumptions and implications without unnecessary narrative embellishment.

Taken together, these points indicate that the *Sync-or-Die clock* experiment cannot serve as a conclusive proof of the universality of time dilation. At best, it functions as a pedagogical illustration of SR’s postulates for those who already accept them. For those who question these postulates, the thought experiment offers no independent evidence, and its persuasive power is therefore limited.

Appendix 1: The light clock

A **light clock** is an idealized device consisting of two parallel mirrors between which a pulse of light is reflected back and forth. Each time the pulse of light hits a mirror, it corresponds to a “tick” in the clock’s timekeeping.

The purpose of this model is to use the constant speed of light c (according to SR’s postulate) to analyze how time is measured in different inertial frames. It is particularly useful for deriving time dilation: as the clock moves relative to an observer, the path of light must become longer (in the observer’s coordinates), making each tick take longer.

Mathematically, you can think: if the distance between the mirrors is L , then the time for one tick in the clock’s own rest is

$$\Delta t_0 = \frac{2L}{c} \tag{1}$$

In another frame of reference where the clock is moving, the tick time becomes longer

due to time dilation:

$$\Delta t = \gamma \Delta t_0, \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \quad (2)$$

NOTE: Light clock is used in pedagogical derivations of the Lorentz transformation (LT).

Appendix 2: Circular reasoning in the argumentation

In logical analysis, a *circular argument* (or *petitio principii*) is a fallacy in which the conclusion is assumed in the premises. Such reasoning does not provide independent support for the conclusion; instead, it merely restates the initial assumption in a different form.

A key issue in [1] is that the conclusion appears to be built into the assumptions of the thought experiment itself. The central claim — that time dilation applies equally to all types of clocks — is treated as a given when constructing the *Sync-or-Die clock* scenario.

In logical terms, the reasoning can be summarised as follows:

1. Assume that the principle P holds: all clocks, regardless of mechanism, are equally affected by motion according to Special Relativity.
2. Construct a scenario in which, if $\neg P$ were true, observers in different inertial frames would disagree on a physical outcome (the cat's survival), thereby producing a paradox.
3. Conclude that P must be true.

Since P is already part of the initial assumption in step 1, the conclusion in step 3 is not an independent result derived from the thought experiment, but rather a restatement of the premise. This constitutes a clear case of circular reasoning.

References

- [1] Rousseau, V. G., (2025), *Einstein's cat: a thought experiment on the universality of time dilation*, Physics Education 60(5):5014, DOI: 10.1088/1361-6552/adedf1
- [2] Slovak, J., *A Logical Critique of Length Contraction in Special Relativity*, DOI: 10.13140/RG.2.2.34686.29765
- [3] Slovak, J., *A Logical Critique of Time Dilation in Special Relativity*, DOI: 10.13140/RG.2.2.35978.17600

- [4] Slovak, J., *Light Postulate: The Train and the Light Pulse*, DOI: 10.13140/RG.2.2.20340.67202