ChatGPT

Newton on Time

Thesis

Newton's actual theory of time was not the crude doctrine that "time is whatever clocks read," nor was it simply the everyday notion of a universal cosmic clock. In the *Principia* he distinguishes **absolute, true, mathematical time** from **relative, apparent, common time**. The latter consists of sensible motion-based measures such as hours, days, months, and years; the former is **duration itself**, flowing uniformly and existing independently of those measures. In Newton's wider corpus, this doctrine becomes still stranger and deeper: time is not merely a mathematical parameter for mechanics, but part of a metaphysical order paired with space and ultimately connected to God's eternal presence. The usual textbook trope captures one piece of this doctrine, but misses the layered structure that Newton himself insisted on. 1

A historically careful reconstruction has to begin with Newton's own texts, especially the Scholium to the Definitions in the *Principia*; then widen to the *General Scholium*, the later Queries of the *Opticks*, and the unpublished *De Gravitatione*. When read together, these show a four-layer picture: **mathematical time** as the uniform parameter presupposed by mechanics; **measured time** as motion-based worldly proxy; **metaphysical duration** as independent of motion and perception; and **theological grounding** in God's eternal and omnipresent being. The tensions among these layers are real, but so is their coherence as parts of Newton's system. 2

What Newton actually says in the Principia

Newton opens the Scholium by saying that time, space, place, and motion are "very familiar to everyone," but immediately adds that common understanding treats them only in relation to sensible objects; this, he says, generates prejudices that must be corrected by distinguishing the **absolute/relative**, **true/apparent**, and **mathematical/common** senses of these quantities. That opening matters. Newton is not repeating common sense. He is warning that common sense is precisely what must be purified. 3

His definition of time is the center of the whole doctrine. In the Latin first edition, Newton writes: *"Tempus absolutum verum & Mathematicum, in se & natura sua absq; relatione ad externum quodvis, æquabiliter fluit"*— absolute, true, and mathematical time, in itself and by its own nature, flows equably, without relation to anything external. Common or relative time, by contrast, is any sensible and external measure of duration by means of motion, such as an hour, day, month, or year. The Latin is important because it shows that Newton is distinguishing **duration** from **its motion-based measures**, not merely separating "perfect clocks" from "bad clocks." 4

The translation history sharpens the point. Motte's older English version says time "flows **equably**" and that common time may be an "accurate or **unequable**" measure. Cohen and Whitman's later translation renders the same sentence as time flowing "**uniformly**," and glosses Newton's phrase *seu accurata seu inaequabilis* with a note explaining that the Latin is literally "exact or nonuniform." That difference is not trivial. "Imprecise" can sound merely epistemic; "nonuniform" shows that Newton's real contrast is between true

duration and **motion as an uneven proxy**. He is not defining time by clocks. He is subordinating clocks to a more basic duration. [5]

Newton then links time to a universal order of succession. In the same Scholium he says that just as the order of the parts of time is immutable, so too is the order of the parts of space; “times and spaces are, as it were, the places of themselves and of all things,” with all things located in time according to order of succession and in space according to order of position. That is a remarkable claim. Time is not merely an instrument of measurement. It is an ordering framework in which events stand to one another as earlier and later. [6]

Measured time and the astronomy of correction

Newton’s view becomes especially clear when he discusses astronomy. He says that in astronomy, absolute time is distinguished from relative time by the “equation” or correction of common time. Natural days, though commonly taken as equal, are actually unequal; astronomers therefore correct them in order to measure celestial motions by a truer time. He even adds that there may be **no perfectly uniform motion** by which time can be exactly measured. All motions can be accelerated or retarded; the flow of absolute time cannot. This is the opposite of the myth that Newton identified time with celestial motion. He explicitly says that motions are only measures of duration, and imperfect ones at that. [7]

The historical background of this “equation of time” is ordinary astronomy: sundial or apparent solar time does not run evenly against mean solar time, so tables and corrections are needed. The U.S. Naval Observatory still defines the equation of time as the varying difference between apparent solar time and mean solar time. Newton’s appeal to astronomical correction therefore reflects a real observational practice, but he uses it philosophically: the need for correction shows that **measured time is not identical with true duration**. [8]

Newton also says something even more radical: the “duration or perseverance of the existence of things is the same, whether their motions are rapid or slow or null.” That means he thinks duration remains what it is whether motions are fast, slow, or absent. The result is unmistakable. Newton does hold that time would still obtain even if motion ceased. This is where he parts company most sharply with Aristotle and Leibniz. For him, change does not create time; change only helps us estimate it. [9]

This also explains why Newton distrusts ordinary temporal measures. Relative time is what “the common people” use, because practical life needs hours and days. But philosophy and mathematical physics require us to abstract from those sensible proxies and distinguish the quantity being measured from the measure itself. Newton says as much again near the end of the Scholium when he warns that relative quantities are not the actual quantities whose names they bear, but common sensible measures used instead of them. [10]

What, then, does it mean for time to “flow equably”? In Newton’s own framework, it means at least this much: duration is not stretched, compressed, accelerated, or slowed by the motions by which we measure it. One can read “equably” as naming the fixed, uniform standard presupposed when mechanics speaks of equal times, constant velocities, and accelerations. That is why recent scholarship emphasizes that absolute time, though imperceptible, is functionally indispensable inside Newtonian dynamics. [11]

Time, space, and true motion

Newton pairs time with space because the two together underwrite place and motion. In his public doctrine, absolute time is the immutable order of successions, and absolute space the immutable order of positions. This pairing matters because the central polemical target is Cartesian relational motion. Descartes had defined motion as change relative to the immediately surrounding bodies. Newton rejects that framework in both *De Gravitatione* and the *Principia*, insisting that motion must be referred to parts of space, not merely to neighboring bodies. [12]

The famous rotating-bucket experiment is Newton's best-known argument here. The water is at first moving relatively to the bucket but remains flat; later it becomes relatively at rest with the bucket, yet the water surface turns concave. Newton infers that the relevant physical effect—the tendency to recede from the axis—does not track mere relative motion between bucket and water. It tracks what he calls true or absolute circular motion. The bucket argument is therefore mainly an argument about **absolute motion and space**, not a standalone proof of absolute time. Still, it indirectly presupposes absolute time, because the very idea of acceleration, rotation rate, and dynamically measurable force in Newtonian mechanics depends on equal temporal intervals. [13]

The unpublished *De Gravitatione* shows that Newton's metaphysical picture had already moved beyond simple mechanicism. There he insists that space is distinct from body and that motion is with respect to parts of space, not merely neighboring bodies. More strongly, he says that the same moment of duration is the same at Rome and London, on Earth and on the stars, and that we cannot think that there is no duration even if we suppose that nothing whatever exists. The extant manuscript is unpublished and its precise dating remains debated, but the Newton Project describes it as an anti-Cartesian tract closely associated with the *Principia*, while recent scholarship often treats the surviving version as a mid-1680s reworking of earlier materials. So one must distinguish carefully between Newton's published doctrine and this manuscript evidence, even though the continuity is plain. [14]

There is also an important nuance here. Newton's own published arguments for time are not as direct or spectacular as his arguments for space. Later interpreters have often noted that within Newtonian mechanics absolute time is easier to motivate than absolute space, because the laws require equal times for equal inertial behavior, while absolute rectilinear rest is not empirically distinguishable from uniform translation. That does not mean Newton himself abandoned absolute space; he did not. But it does mean that the path from the laws to time and the path from the laws to space are not identical. [15]

God, duration, and the metaphysical depth of Newton's doctrine

If one reads only elementary textbooks, Newton's time can look secular and mechanical. His own texts say otherwise. In the *General Scholium*, added to the second edition of the *Principia* in 1713, Newton says of God: he is not eternity or infinity, but eternal and infinite; he is not duration or space, but he endures and is present; and by existing always and everywhere, he constitutes duration and space. Newton immediately continues that every particle of space is always and every indivisible moment of duration is everywhere. This is not a throwaway piety appended to an otherwise neutral theory. It is the explicit theological grounding of Newton's ontology of space and time. [16]

The word “constitutes” requires care. Newton does **not** say that God simply is time or space; he explicitly denies that. Nor does he describe duration and space as ordinary created bodies. The more careful reading is that God’s eternality and omnipresence ground the reality of duration and space without allowing a literal identity between God and either one. That is why good scholarship tends to describe Newton’s space and time not as substances in the usual sense, but as real entities or modes with their own manner of existence, necessitated by divine omnipresence and eternality. [17]

De Gravitatione points in the same direction. Newton there says that space is “a disposition of being qua being,” that God is everywhere, created minds are somewhere, and body occupies the space it fills. He also calls space an “emanent effect” of an eternal and immutable being, and says the same can be asserted of duration. These claims are stronger and more explicitly metaphysical than the public *Principia* definitions, but they illuminate them. Newton’s time is not merely a mathematical variable. It is part of a doctrine of being. [18]

The *Opticks* Queries make the theological dimension even more vivid. Newton speaks of an incorporeal, living, intelligent, omnipresent being who in infinite space, “as it were in his sensory,” perceives things by immediate presence. In another passage he says God, being in all places, is more able by his will to move bodies within his “boundless uniform Sensorium” than we are to move parts of our bodies—then immediately warns that the world is not to be considered the body of God and its parts not parts of God. That pairing is crucial. Newton uses sensorium language, but he also explicitly blocks a crude pantheist reading. The best reading is therefore analogical, not literalist: God’s omnipresence is being expressed through a sensory analogy, while identity between God and the material world is denied. [19]

So is Newton’s time a substance, an attribute, a relation, or a mathematical abstraction? His own usage resists any single tidy label. It is **not** merely relation, because he rejects the reduction of time to order among events. It is **not** merely a measure, because motion-based measures are inferior proxies. It is **not** simply a substance in the ordinary sense, because Newton and later interpreters distinguish it from body and mind. The most faithful summary is that Newton treats time as a **real quantity of duration**, mathematically indispensable, metaphysically independent of change, and theologically grounded in God’s perpetual existence. [20]

Myths and common tropes

Myth: Newton thought time was just what clocks measure. Newton says the opposite. Relative or common time is only a sensible external measure of duration by means of motion, commonly used instead of true time; natural days themselves are unequal and need astronomical correction. More strongly, he says there may be no perfectly uniform motion by which time can be measured exactly. [21]

Myth: celestial motion creates time. Newton treats motion as a measure of time, not its source. The duration of things remains the same whether motions are rapid, slow, or null. That clause is central, because it shows that on Newton’s view time would not vanish if motions ceased. [9]

Myth: Newton’s time is merely common-sense time. Newton begins the Scholium by saying that common sensory conceptions generate prejudices. The whole point of the distinction between absolute and relative time is to separate philosophical analysis from ordinary practice. [3]

Myth: Newton thought absolute time was directly observable. He repeatedly treats the common measures of time as what we actually use, and he infers true duration from them through correction. Modern Newton scholarship likewise emphasizes that absolute time and space are imperceptible in Newton's own framework, with their empirical credentials coming indirectly through the physics that presupposes them. [11]

Myth: Newton had no metaphysical or theological doctrine of time. The *General Scholium* says God constitutes duration and space by existing always and everywhere. *De Gravitatione* calls duration and space dispositions or attributes of being, and the *Opticks* Queries tie omnipresence, the "sensorium" language, and divine agency together. One can dislike or reject this doctrine, but one cannot honestly remove it from Newton's own view. [22]

Myth: Newton's universe was just a dead, deistic machine. Newton's public and private writings are saturated with divine omnipresence, dominion, design, and sustained agency. He explicitly says the world is not the body of God, but he also says God is substantially omnipresent and that natural philosophy belongs to discourse about God from the appearances of things. [23]

Myth: Newton's absolute time is the same as modern spacetime. It is not. Newton distinguishes time from space and gives time a uniform independent flow. Minkowski, by contrast, says space by itself and time by itself are shadows, and only their union has independent reality; Einstein then denies absolute simultaneity and writes that each reference-body has its own particular time. Newtonian time and relativistic spacetime are therefore not the same ontology. [24]

Myth: Newton believed time and space are literally God. Again, Newton explicitly denies this. He says God is not duration or space, but enduring and present, and he immediately rejects the idea that the world is God's body. The doctrine is closer to grounding than identity. [25]

Myth: Einstein simply made Newton stupid or obsolete. Einstein rejected absolute simultaneity and the independent uniform time of classical mechanics, but he also said a successful physical theory can live on within a more comprehensive theory "as a limiting case." Modern relativistic practice still uses Newtonian and post-Newtonian approximations when gravity is weak and velocities are small compared to light speed. Newton was not refuted into foolishness; he was superseded under broader conditions. [26]

Newton against Aristotle, Leibniz, Descartes and after Einstein

The sharpest premodern contrast is with Aristotle. Aristotle defines time as the number of change with respect to before and after; he also says we become aware of time by marking off change and that time measures motion and, derivatively, rest. Newton breaks decisively with that framework. For him, time is not some aspect of change, but duration itself, of which changes are only measures. Where Aristotle ties time to change, Newton allows duration even when motion is null. [27]

Leibniz is the most direct rival. In the Leibniz–Clarke correspondence, Leibniz says time is an order of successions; Clarke replies, defending the Newtonian side, that the order of things succeeding one another is not time itself, because the same order can occur faster or slower. This disagreement goes straight to the heart of Newton's doctrine. If time is merely relational order, then one can ask what remains when all events

are shifted uniformly. Newton's camp says: a real quantity of duration remains. Leibniz says: nothing over and above the order of events is needed. [28]

Descartes is different again. On the Cartesian picture, motion is defined in terms of change relative to contiguous bodies within a plenum. Newton attacks precisely this point in *De Gravitatione* and builds the *Principia* Scholium to avoid it. His claim is that a physics of laws, inertia, and true motion cannot be grounded in mere change of neighborhood. That is why his time and space doctrine is inseparable from his anti-Cartesian theory of motion. [29]

Augustine and Kant differ from Newton in another direction. Augustine relocates the past and future into the soul as memory and expectation, and Kant later makes time the form of inner sense rather than a thing in itself. Newton's theory is not psychological in either way. It is objective, mind-independent, and explicitly not grounded in human awareness. Yet the contrast is illuminating: Newton asks what time must be for mechanics to work; Augustine and Kant ask how temporality is present to consciousness. [30]

Mach's critique helps explain what later changed. Mach attacked Newtonian absolute space and time as excessive metaphysics, and the Stanford Encyclopedia notes that his criticism inspired Einstein. Einstein's special relativity breaks with Newton most fundamentally over simultaneity: events simultaneous in one frame are not simultaneous in another, and each reference-body has its own particular time. Minkowski then radicalizes the picture by declaring that separate space and separate time fade into shadows, replaced by a four-dimensional world of world-points and world-lines. In that setting, Newton's independent universal time no longer survives. [31]

Still, Einstein himself is useful here because he avoids the cheap triumphalism of later textbook caricature. In his popular exposition of relativity, he says that the hallmark of a significant theory is that it points the way to a more comprehensive one in which it survives as a limiting case. Modern relativistic practice confirms the point: in weak gravitational fields and at low velocities, Newtonian gravity remains extremely effective, especially in the solar system, while post-Newtonian methods systematically add relativistic corrections where needed. So Newton's framework was not merely an error; it was an immensely successful approximation built on metaphysical commitments that later physics partially retained and partially replaced. [26]

Final assessment

What Newton got right was not just mechanics. He saw, with unusual clarity, that one must distinguish the **quantity measured** from its **sensible measure**. Hours, days, and celestial cycles do not automatically tell us what time is. They are empirical proxies. That insight remains philosophically powerful even after relativity. So does his insistence that the ontology of time cannot be settled by common speech alone. [10]

What Newton assumed, and what later physics overturned, was the existence of a single uniform global time independent of all observers and all physical states of motion. Einstein's relativity rejects that assumption at the level of fundamental theory, and Minkowski's spacetime dissolves Newton's sharp separation of time from space. Yet relativity did not erase the historical depth of Newton's position; it revealed more clearly which parts were empirical, which mathematical, and which metaphysical. [32]

The deepest lesson is that Newton's time was never just a ticking backdrop. It was a doctrine of **true duration**—uniform, independent of motion, indirectly accessed through correction and dynamics, paired with absolute space, and ultimately grounded in divine eternality and omnipresence. The popular trope of Newton as the theorist of a universal clock is not wholly false, but it is radically incomplete. The real Newtonian doctrine is mathematically cleaner, metaphysically bolder, and theologically more exposed than the caricature usually allows. [33]

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