

Temporal Passage

Does time pass? Philosophers such as Smart and Mellor assert that the flow of time is an illusion.¹ These scholars argue that nothing can move through time. They claim that dates simply coexist, statically, like points in a space. However, other thinkers, including Prigogine and Davies, are unwilling to dismiss the flow of time as an illusion.² They feel that our impression of temporal passage must correspond to a real flow.

Any model of temporal passage must provide a mechanism to allow the present to move from past to future. Although various theorists have tried to explain the phenomenon of time flow, their models provide no such mechanism.³

In this paper, I put forward a new theory of time. I describe the nature of the present and define the mechanism that brings about its motion.

The first section of the paper demonstrates that existence is a dynamic process and shows that time arises from this process. The second section presents a geometric analysis of the present's motion. The third section contrasts space with time. In the last section, consciousness and time are discussed within the context of Einstein's theory of relativity.

I

I must begin, however, with an analysis of existence. A material entity can certainly exist. However, in order to exist, it has to endure for a length of time greater than zero. In the big bang description of the origin of time, time exists at all moments after the big bang but not at the big bang itself.⁴ (I refer to this moment of the big bang as T-0.) Consequently, there is no first moment of time in this description: Every moment of time is preceded by an infinite number of other moments that are still closer to T-0.

Similarly, a material entity cannot have a first moment of existence, since it has a total lifetime of only zero seconds at that initial moment. (A total lifetime of zero seconds means no lifetime at all, and implies non-existence.) However, the entity can be said to exist at all subsequent moments after the initial one. (I refer to this initial moment as t-0.) At these subsequent moments the entity has a lifetime greater than zero seconds. As in the big bang description, every moment of existence is preceded by an infinite number of other moments of existence; and these moments get closer and closer to t-0.

As indicated above, however, t-0 cannot be considered a moment of existence (the entity does not exist at the time t-0). Let us choose any moment after t-0 and call that moment "now." The entity persists over an infinite number of moments between t-0 and "now." It exists "now" as a result of this persistence--as a result of having endured until "now." Existence "now" is therefore preceded by an earlier process of persistence.

I wish to stress that our treatment of "existence" as a notion distinct from "persistence" is based on an erroneous assumption. The assumption is that existence is in some sense more fundamental than persistence. In this view, an entity that currently persists must have existed earlier; but an entity that currently exists need not have persisted earlier. An entity may exist "now" without having persisted prior to "now." In effect, in this view, the initial moment, t-0, is treated as a moment of existence: Existence is assumed possible at t-0 as well as at all subsequent moments. As explained above, however, existence cannot be defined at the initial moment, t-0.

The traditional view maintains that existence is more fundamental than persistence. We now know, however, that every "now" (after t-0) is preceded by a process of persistence. One could just as easily argue, therefore, that it is persistence which is more fundamental than existence.

Clearly, existence is not possible without persistence: An entity cannot exist if it does not endure. Persistence is therefore essential for existence--and it is just as fundamental as existence. In addition, existence "now" implies both prior existence and prior persistence. There is only one explanation that accounts for these facts in a self-consistent manner. Existence must be a process--the process of persisting.

In the analysis above, I make reference to the moment "now." "Now" refers to any one of the infinite number of "nows"/"moments" that come after t-0. The reader should note that there are an infinite number of points ("nows") in the continuum between t-0 and any given "now." This infinite series of points/"nows" is a duration greater than zero.

Let us choose a particular "now" out of the infinite series of "nows" and call it "N." The entity described above persists over the infinite series of "nows" between t-0 and N. Existence at "N" is therefore preceded by a process of persistence. The entity can be defined as "existing" at the "now" N (i.e., at the "moment" N)--but only if the entity has persisted for the duration between t-0 and N. (I reiterate here that "N" represents *any* one of the infinite number of "nows"/"moments" that are subsequent to t-0).

Persistence is a type of motion. The persisting entity described above can be pictured as moving rightward across a horizontal line. As the entity moves, it arrives at successive points (i.e., "nows") on the line. The entity is defined as existing at each point (i.e., "now") on the timeline. However, the entity's existence along the line cannot be described as a series of separate "snapshots."

Let us consider a given point on the timeline (Point-B) that is situated to the right of the initial point (Point-A). Let us suppose that the entity starts at A and moves across the timeline. Eventually the entity arrives at Point-B. When it is at B, the entity has a temporal extension. However, at the initial point, the entity has no temporal extension. When at B, the entity has a history. It has been in existence for a length of time greater than zero seconds.

A snapshot existence at Point-B would be, by definition, an existence that is completely self-contained at Point-B--an existence defined at B without reference to an earlier process of persistence. However, as I have explained, the entity's existence at B is defined *because* the entity has a history when it is at B. The entity's existence at B is defined because the entity *has been* in existence for a length of time greater than zero when it is at B.

We can assert that the entity exists at B. However, its existence there is not a self-contained "snapshot." In fact, there is no point on the timeline at which the entity exists as a "snapshot." There are no "self-contained existences" anywhere on the timeline.

If the entity described above were to exist but not persist, it would exist for a total duration of one moment. One moment, however, is by definition only zero seconds long. And zero seconds is no length of time at all. We must realize that if we say the entity exists for *no* length of time, we are stating that it *never* exists. All things that exist necessarily exist for some *length* of time--however short this length may be.

Let me define duration as the length of time for which an entity exists. Let us suppose that the entity I describe above is a brick. And let us suppose that this brick endures for a

period of ten seconds. Certainly, this ten-second period is a duration. The brick itself, however, is obviously not a duration. If it were a duration, the brick would have been definable as a length of time for which an entity exists. Although the brick is not a length of time, it endures *for* a length of time (i.e., *for* a duration). Since the brick is not a length of time, it is temporally non-dimensional.

The "present moment" is the presence of consciousness (i.e., the presence of mind). It is a subjective phenomenon. The reader must understand that the present (i.e., the mind) is an "entity" in the same sense that the brick described above is an "entity." Like all entities, the present (i.e., the mind) persists/endures. The persisting present can be visualized as a point in rightward motion along a horizontal timeline. As the present moves along the line, it arrives at successive points/"nows" on the line.

The reader must realize that the "present" and the "now" are two entirely different things. The present is an "entity." The "now," however, is not an "entity": The "now" is a "location." It is the location that the present *occupies* when the present persists. (As the present moves--as the present persists--it arrives at and occupies successive "nows" on the timeline.) This movement of the present along the timeline visually depicts the persistence of consciousness. The "present" and the "nows" that make up the timeline are therefore aspects of subjective, mental time. (There is a second type of time: Einstein's objective, physical time. I discuss this second type of time in sections III and IV of this paper.)

Let us say the present persists (i.e., endures) for a period of ten seconds. This ten-second period is, of course, a length of time. The present moment *itself*, however, is not a length of time. The present persists *for* a duration. The present *itself*, however, is not a duration.

I see no conceptual difficulty in defining the present moment as temporally non-dimensional. (The present moment is an "entity" in the same sense that the brick is an "entity." The brick is not a "length of time," and is temporally non-dimensional. The present is likewise non-dimensional.) However--and this is a crucial point--in order to exist, this one present moment has to maintain its existence for a length of time (i.e., for a length greater than zero seconds).

It is now clear why time passes. If the present exists, the present has to endure. If the present endures, time has to pass. Therefore, if the present exists, time has to pass.

Time passes, therefore, for the simple reason that the present exists.⁵

II

In the previous section, I discussed the nature of existence and described the mechanism of persistence, which enables the present to move. In this section I present an analysis of the present's motion.

In figure 1, Point-P (i.e., the present) moves rightward along a timeline. This rightward motion visually depicts P's persistence.⁶ As it moves along the line, P is located at each point on the line for a duration of exactly zero. However, P may come to a *halt* at a point on the timeline (say at Point-C). If P comes to a halt at C, P is located at C for a duration greater than zero.

Let us consider any given point to the left of C. P does not only reach that point, P also goes *beyond* that point. P is therefore in a "state of motion" at all points on the line to the left of C. Since P is in a state of motion at these points, P is in a state of persistence at

these points. Since P is persisting when it passes these points, P's existence is defined at these points.

In the description above, P behaves in an anomalous way when it reaches C: P reaches C but does not go beyond C. P is not in a "state of motion" at C: P is "at rest" at C. As already remarked, P's persistence is represented visually as rightward motion. Since existence is persistence, P's *existence* is also represented as rightward motion. If P were in a "state of motion" at C, P's existence would be defined at C. However, P is not in a "state of motion" at C; P is "at rest" at C. P's existence, therefore, cannot be defined at C: P does not exist at C.

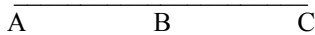


Fig. 1. As P moves along the timeline, P is located at each point on the line for exactly one moment (i.e., for a duration of exactly zero). If P comes to a halt at C, P cannot be said to be in existence at C.

As regards the movement of the present moment, there are four possible scenarios (see figure 2). If P begins at A and moves across the timeline, it could:

1. come to a halt at some point (any point) before C (we will call this point "B");
2. come to a halt at C;
3. come to a halt at some point (any point) after C (we will call this point "D"); or
4. continue moving across indefinitely, never coming to a halt.

In scenarios 1 and 2, P does not exist at C. In scenarios 3 and 4, P does exist at C. P exists after C in scenarios 3 and 4. Existence at C, therefore, implies existence *after* C.

We conclude the following:

If the present moment exists "now" (at C), it must continue to exist after "now" (after C). P may continue existing for a finite length of time (CD) or an infinite length of time (C-Infinity).

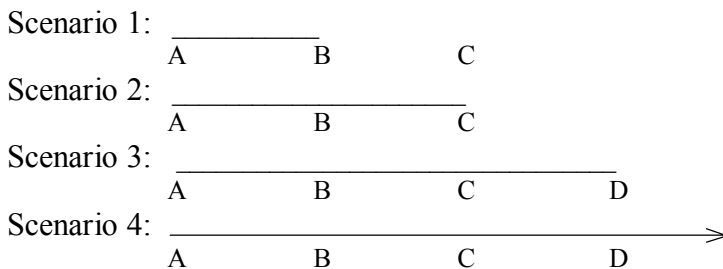


Fig. 2. Four possible scenarios for P's motion across the timeline.

In figure 3, Point-P cannot exist at the initial point, A. Point-P has a total lifetime of zero seconds at A. (A total lifetime of zero seconds means no lifetime at all and implies non-existence.) However, P can exist at all points on the line to the right of A: P has a total lifetime greater than zero seconds at these points.

Let us say that P exists at a point on the line. This point cannot be the first point on the line, since existence is not possible at the first point. Point-P must be located at a point to the right of A. Let us refer to P's location as Point-B. There is a continuum of points to the left of B extending back to A. P must have been located at these points before arriving at B. P must have existed at these points before existing at B. Existence at B therefore implies existence before B.

We conclude the following:

If the present moment exists "now" (at B), it must have existed before "now" (before B). P must have existed over the interval AB.

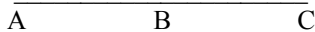


Fig. 3. P cannot exist at the initial point, A. If P exists "now" (at B), P must have existed before "now" (before B).

To sum up:

1. If the present moment exists now, it must have existed before now.
2. If the present moment exists now, it must continue to exist after now.⁷

III

In the previous section, I described the motion of the present in considerable detail. I now turn to a discussion of space and explain how space differs from time.

Spatial distances are made up of points that exist concurrently. Duration, in contrast, is made up of points that exist non-concurrently. Clearly, "duration" is an entirely different notion from "space." Duration is not an "entity" like space. Duration arises when the present persists--when the present endures; and it allows us to speak of earlier and later "nows."⁸ Spatial distances, in contrast, do not emerge from a persisting present and do not accommodate the notion of "earlier and later."

In section I, I defined duration as "the length of time for which an entity exists." However, duration can also be defined as "a period of elapsed or elapsing time."

If we were to characterize the distance between two points, A and B, as "a duration of one year," we would be claiming the following: "The time that elapses when an individual relocates from A to B is *precisely* one year. One cannot relocate from A to B in an elapsed period that is less than one year. One cannot relocate from A to B in an elapsed period that is greater than one year."

Let us consider two points in the fourth physical dimension--the point "January 1, 2010 AD" (Point-X) and the point "January 1, 2011 AD" (Point-Y). It is, of course, possible for an individual to relocate from X to Y in exactly one year of *elapsed* time. But

this period can be reduced. An observer may accelerate to a velocity much higher than that of the earth, and eventually decelerate. This physical scenario, as we know from Einstein's relativity, permits relocation from 2010 to 2011 in an elapsed period that is less than one year.

The time from the beginning to the end of a duration does not vary.⁹ This is true by definition. However, in the example above, the time between X and Y varies. Clearly, X and Y cannot be endpoints of a duration. (If X and Y were endpoints of a duration, the time between them would not vary.¹⁰) We are forced to the following conclusion: The separation between January 1, 2010 and January 1, 2011 is not a duration--it is not "an elapsing period of time."

The distance between these dates is actually a type of space. If we wish to understand the relationship between these dates, we need to understand the nature of the spatial separation between them. A spatial distance is like a duration in that it is a continuum of points. However, a spatial distance differs from a duration in that a spatial distance is made up of a *concurrently* existing group of points. There are no non-concurrent points in a space. Non-concurrent points together do not define a space: They define a duration.

Let us consider two points, X and Y. If X and Y are concurrent, they must exist as points in a static space. One can take many paths through this space to get from X to Y. Since the lengths of these various paths can vary, the time it takes to get from X to Y can also vary. (It varies depending on the length of the path taken.) If X and Y are not concurrent, however, they cannot exist as part of a space. If they do not exist as part of a space, there can be no *spatial* separation between them. Clearly, in the absence of a spatial separation, the only possible "distance" that can be defined between X and Y is *duration*.

The distance between dates such as January 1, 2010 and January 1, 2011 is the "time" that is described by Einstein's theory of relativity. However, this distance, as I indicate above, is not a duration, but is, instead, a type of *space*. Being spatial in nature, Einstein's "time" can never flow. We should never confuse this type of spatial "time" with duration, which does flow.

IV

In the previous section, I contrasted static (spatial) "time" and dynamic (temporal) time. In this section, I briefly discuss the relationship between these two types of time.

Dynamic time is the subjective time of the mind. This is the time that I represent as rightward motion along a horizontal timeline. Subjective time (i.e., the timeline) is a single, independent dimension.

Static time is the objective time of Einstein's relativity. This time does not exist as an independent dimension. Static time is simply the fourth dimension of a unified 4-dimensional structure known as "spacetime."

An individual mind, as we know, perceives a succession of concrete, 3-dimensional slices out of this abstract 4-dimensional structure. Let us consider two individuals: Ann and Betty. Ann and Betty observe a succession of 3-dimensional slices of spacetime. Ann perceives a given 3-dimensional slice at the moment "now." I call this moment "A1." Ann perceives another 3-dimensional spacetime slice a little while later at the "now" A2.

A2 and A1 are not the same "now." The now A2 occurs after the now A1 during the course of Ann's subjective time flow.

Betty perceives a 3-dimensional slice at a moment "now." I call this moment "B1." Betty perceives another 3-dimensional spacetime slice a little while later at a "now" B2. B2 and B1 are not the same "now." The now B2 occurs after the now B1 during the course of *Betty's* subjective time flow.

As we know, according to the theory of relativity, simultaneity is relative. Spacetime points that are simultaneous in one reference frame are, in general, not simultaneous in other reference frames.¹¹

In the example above, the points A1, A2, B1, and B2 are not spacetime points or slices. They are "moments" (i.e., "nows") that arise within the context of the two subjective time flows.¹² In the example, we say that A2 occurs after A1 because A2 occurs after A1 during the course of Ann's subjective time flow. Similarly, we say that B2 occurs after B1 because B2 occurs after B1 during the course of Betty's subjective time flow. We can see that Ann's subjective "nows" (A1 and A2) can be temporally coordinated with one another and that Betty's subjective "nows" (B1 and B2) can be temporally coordinated with one another. However, since there is no objective/universal flow of time, Ann's nows (A1 and A2) cannot be coordinated temporally with Betty's nows (B1 and B2).¹³

Since Ann's "nows" cannot be coordinated with Betty's "nows," Ann's "nows" must be regarded as temporally independent of Betty's "nows."¹⁴ Ann's time stream must be regarded as temporally independent of Betty's time stream. Thus, Ann and Betty's streams exist independently of each other.¹⁵ However, as we can see in the example above, their streams do not exist independently of physical (i.e., static) time. The two observers' minds maintain contact with 4-dimensional physical reality.

From the example above, we can see that Ann and Betty experience the world as a dynamic succession of 3-dimensional events (i.e., slices). The reader must realize, however, that spacetime itself does not unfold. This 4-dimensional structure remains static at all times.

Summary

In this paper, I argue that the present can move, and I define the mechanism that brings about its motion. This mechanism is persistence (i.e., existence)--a dynamic process. In addition, I describe the motion of the present, demonstrating that existence "now" implies both prior existence and continued existence. This moving present brings about time flow. I then contrast this dynamic time with Einstein's static time. Finally, I suggest that the relationship between these two different kinds of time gives rise to our impression of an unfolding universe.

The question of time's passage has been a long-standing source of debate among scientists and philosophers. I hope the arguments presented in this paper contribute to a better understanding of the nature of time.

Notes

¹ J. J. C. Smart, "Time and Becoming," in *Time and Cause*, ed. P. van Inwagen (Dordrecht: Reidel Publishing Company, 1980), 3-15; D. H. Mellor, *Real Time* (Cambridge: Cambridge University Press, 1981), 5-7.

² Ilya Prigogine, *From Being to Becoming: Time and Complexity in the Physical Sciences* (San Francisco: W. H. Freeman and Company, 1980); Paul Davies, *About Time: Einstein's Unfinished Revolution* (New York: Simon & Schuster, 1995), 275.

³ See Prigogine, *From Being to Becoming*, xi-xix; M. M. Schuster, "Is the Flow of Time Subjective?," *Review of Metaphysics* 39 (1986): 695-714.

⁴ Davies, *About Time*, 187.

⁵ Time passes because our non-physical, subjective mental states persist for brief durations. The duration of each state can, in principle, be arbitrarily short; but it cannot logically be zero. Each mental state is a "present" of time; each present persists for a very brief period of time.

⁶ The passage of time is simply the existence of the present moment, and is necessarily a one-way affair. Persistence (i.e., existence) is an activity that has no "opposite" process. Thus, a "reversal of the passage of time" is not a definable concept.

"South" may be considered the opposite of "north"; but what could we consider to be the opposite of persistence? It is true that we can distinguish between persistence and non-persistence (i.e., non-existence). But non-persistence/non-existence cannot really be considered the "opposite" of persistence: There is neither directionality nor motion involved in non-persistence.

⁷ The flow of a person's consciousness can be thought of as a sequence of mental states. Each state in the sequence necessarily persists for a duration greater than zero. This sequence of states cannot be represented by a continuous timeline. (A continuous timeline implies that one mental state persists for the duration of the line.) The sequence of states has to be represented by a timeline that has discontinuities on it (i.e., a line that has points missing from it). These "gaps" on the line serve to separate the individual mental states.

In a certain sense, the discontinuities or "gaps" between states can be ignored. We can ignore them because "memory" is present within an individual's mental states on the line. The presence of memory within individual states allows one to *experience* mental life as a coherent *succession* of states.

A discontinuity on the timeline can never be *experienced* by a person. This is because only one point is missing at the "gap" between states (i.e., because the gap between states has zero length). An experience cannot "occur" if it does not persist for a duration greater than zero. An "experience of discontinuity," therefore, cannot "occur," by definition.

⁸ Duration gives rise to the relation "earlier-later."

⁹ Note: Relativistic "time dilation" effects do not in any way affect the steady, normal flow of (subjective) time.

¹⁰ An *elapsed* duration (say, one second) is a *fixed* quantity. The endpoints of a one-second duration are precisely one second apart regardless of the frame of reference. Being an absolute quantity, this period does not get shorter or longer depending on the reference frame.

¹¹ Albert Einstein, *Relativity: The Special and General Theory*, trans. Robert W. Lawson (New York: Crown Publishers, 1961), 26.

¹² Let us suppose Ann is in a given reference frame, R1. In this reference frame, Ann experiences a particular sequence of subjective "nows": n1, n2, n3, n4. In addition, in this frame she observes a particular sequence of spacetime slices: s1, s2, s3, s4.

Ann can enter a different reference frame by changing her velocity through 3-dimensional space. In the new reference frame, Ann experiences the same sequence of subjective "nows" (i.e., n1, n2, n3, n4) that she experiences in the first reference frame. However, she does not observe the same sequence of spacetime slices. (According to Einstein's theory of relativity, an observer's view of spacetime changes when the observer changes reference frames.)

¹³ In a relativistic universe, there can be no objective/universal flow of time. Time flow has to be subjective and mind-dependent. Vesselin Petkov discusses this point in a paper entitled, "Does the Theory of Relativity Relativize Existence As Well?" (This paper was presented at the Montreal Inter-University Seminar on the History and Philosophy of Science, Montreal, Canada, January 29, 2002.)

¹⁴ The two series of "nows" are unrelated to one another temporally. Ann's subjective nows do not occur "before," "after," or "simultaneously with" Betty's subjective nows.

¹⁵ Events in separate time streams cannot be coordinated with one another. Temporal inconsistencies therefore cannot arise between events in separate time streams. This suggests that self-consistent time travel scenarios are possible.

We tend to believe that backward time travel (e.g., from the 20th to the 19th century) is impossible. But our ideas regarding time travel and causality are rooted in the incorrect assumption that the "present" and the "flow of time" are objective phenomena. We need to be clear about the fact that "time flow" and the "present" are subjective. And we should reconsider the possibility of time travel from this new perspective.