Defining Time

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**Abstract**

The knowledge of the evident qualities of time, such as its all-encompassing unidirectional relentless change, does not provide answers as to what time is or why it occurs. Those qualities do not identify what it is in the universe that intrinsically has those qualities. Thus, previously it has not been possible to achieve an adequate definition of time that includes the answers to those questions. Now, with the discovery that the continuing-existence of space plays the role of time in the universe, a complete definition of time is possible.

**Introduction**

The goal of this paper is to present a realistic definition of the intrinsic nature of time that is based strictly on facts without any appeal to speculation.

The beginning sections deal first with what is required to create such a definition and then the problem with defining time. Because it has been discovered that the continuing-existence of space constitutes the basis of time in the universe, the next sections deal with that discovery and present discussions of the intrinsic natures of space and the continuing-existence of space. The final section deals with actually defining time, which presents a list of the qualities of time that are possible without actually knowing what time is and a second list of those qualities when knowing the intrinsic nature of time.

**On defining**

The most precise type of definition is a descriptive definition. A descriptive definition is a concise statement of those intrinsic characteristics of what is being defined that make it what it is, that determine what kind of thing it is. Added to this defining statement there can be, when necessary, supplementary comparing statements dealing with how what is being defined differs from similar things. There can also be further supplementary role statements dealing with what the subject of the definition does and what relations it has with other things that exist. Thus, to accurately define something it is first necessary to know what it is in order to know which intrinsic characteristics are to be used in the definition.

**The problem with defining time**

Unfortunately, what can be observed about time does not provide enough information to make it possible to identify what time is. That is why it has always been so difficult to define time.

In the absence of knowing what time is, people have proposed unrealistic ideas about the nature of time, such as the growing block theory (Broad), or even that time does not occur (McTaggart). But time is real (Vesterby 2019a). It has observable, measurable, qualities such as duration—how long something exists, or how long a process continues to occur.

It has been observed that time is a form of relentlessly ongoing unidirectional change, with only the current part of the change occurring, the prior part ceasing to exist as the current part occurs, and the following part not existing because it has not yet come into existence.

Time appears to be universal, with one moment of time at one location being the same moment of time at other locations.

New part of time is continuously occurring because when the prior part of the ongoing change of time was occurring the current part did not then exist—it had not yet occurred. When the current part does occur it is newly existing. The consequence is an ever increasing amount of time that has occurred and no longer exists, called the past.

Ever since the distinction was clarified between motion and duration (Aristotle), the distinction between how far a motion continues through space (measured with a ruler of some kind) and how long the motion continues to occur (measured with a clock), we have known that duration is the amount of time something, such as motion or growth, continues to occur. Duration also occurs with how long something exists, for example, the duration of a particular grass plant, how long it exists, from its germination to when it gets eaten by a horse.

So, time has these qualities. It is a relentlessly ongoing form of unidirectional change, with continuous progressive occurrence of new part of that ongoing change. The occurrence of the change is universal, with a moment in one location being the same moment in all other locations. Duration is how long this ongoing change occurs while things such as motion continue to occur and things such as a grass, or a book, or a mountain, continue to exist.

That last paragraph could be used as a limited descriptive definition of time. It tells, for the most part, what is known about time. But such qualities of time do not reveal what time is, why it occurs, or why it is relentless unidirectional change that occurs everywhere. Down through the millennia, as people wondered about time, it has never been possible to provide an adequate definition of time that defined what time is. What is it that exists in the universe that intrinsically has these qualities? The qualities themselves do not answer that question.

**The discovery of the basis of time enables the definition of time**

Fortunately, serendipity came to the rescue. The application of universal factors as a practical approach to transdisciplinary methodology led to an investigation of the qualities of the continuing-existence of space. This investigation found that the intrinsic qualities of the continuing-existence of space are identical to the qualities that can be factually attributed to time. (Vesterby 2019b).

Space exists, and it continues to exist. Space is there, and it continues to be there. The qualities of the existence of space (measured with a ruler) are different from the qualities of the continuing-existence of space (measured with a clock). It is the qualities of the continuing-existence of space that are identical to the qualities of time (also measured with a clock). The continuing-existence of space thereby plays the roles of time in the universe and constitutes the basis of time in the universe.

Understanding the qualities of the continuing-existence of space leads directly into the complete understanding of time—what it is, why it occurs, and why it has the specific intrinsic qualities that it has, and, further, to the understanding of the relations of time to all else that exists, such as the relation of time to other forms of change like motion, emergence (Vesterby 2019c p. 4), and growth.

An understanding of the exact manner in which spatial-continuing-existence plays the roles of time can be achieved by attaining an objective-realist understanding of the intrinsic nature of spatial-continuing-existence. Because spatial-continuing-existence is based on the existence of space, and because certain intrinsic qualities of spatial-continuing-existence are direct consequences of certain intrinsic qualities of space, it is necessary first to achieve an objective-realist understanding of the intrinsic nature of space.

**The intrinsic nature of space**

The first step is to select a sample of space to observe. The easiest sample to observe is the space right in front of the observer. When the observer holds up their hands separated in front of them, there is a space between the hands. When the observer has focused their attention on that sample of space, the hands can be lowered so that the presence of the hands does not distract from focusing the attention strictly on the space that is there in front of the observer.

An assistant can move their hand around in that space, up and down, from side to side, and back and forth, demonstrating that that space is three-dimensional. The assistant can hold an object in the space, demonstrating that that space is a place where something can be. That space is a three-dimensional place where three-dimensional objects can exist and move around. Space is place.

Close inspection reveals that the space is just place, nothing more. There is no evident matter there other than the hand of the assistant and the object that was placed there. Of course, we know there is air there, but the air is not creating the spatial-place—it is occupying that place and moving around there just like the hand and the object. The place is not made out of matter—it is immaterial. It is an immaterial place that matter can occupy—a place where matter can be, a place where matter can exist.

What then are the intrinsic qualities of space that are due to its immateriality? Well, first of all it will have an extraordinary simplicity. There is nothing there that can be complicated. For example, there is nothing there that could be different from one location in space to another location in space—all space is identical in what it is. Being immaterial, space cannot move or change in any way—it cannot expand, contract, bend, or curve.

The simplicity of immateriality means space cannot have complex relations with other things that exist. Space does not have any intrinsic qualities by which it could interact with anything else that exists—immaterial space cannot influence matter. It works both ways. Matter occupies spatial place, but matter cannot interact with the immaterial place it occupies—matter cannot influence immaterial space.

One consequence for science is that when the trajectory of a photon curves when passing a star, that change in the path of the photon cannot be due to an impossible curvature of immaterial space. There is something else in that space around the star that is causing the curved trajectory. Gravity certainly. But what is gravity really—something dark matter is doing? Whatever, it is not immaterial space that is causing the photon’s curving trajectory.

The immateriality of spatial-place goes further. It goes farther—much farther. Space itself lacks any intrinsic qualities by which it could have an edge or limit to its extension. There is nothing else that exists that can influence immaterial spatial-place to give it an edge or limit to its extension. There is nothing that can make space not exist. Thus, there cannot be space here but no space there. Because there is space here, there is space there, everywhere, infinitely.

Because space is immaterial and cannot move or change in any way, the only intrinsic difference from one place in space to another place is their respective locations in space. Every place in space has its unique intrinsic location, which is different from every other place throughout infinite space. Because immaterial space cannot be different in what it is from one part to another, all space exists simultaneously—all infinite space is coexistent.

Space exists as the infinite three-dimensional extension of immaterial place. Space, spatial-place, is the foundational component of the universe. Space provides an existential-context, a place in which to exist, for all else that exists. To not exist in spatial-place is to not exist at all.

Space exists as universally coexistent static extension. Extensionally adjacent to any place in space there is a coexistent adjacent place, and sequentially adjacent to that place is another coexistent place, and so on, infinitely. Because space is immaterial, there is nothing that marks or sets off one place in space from the adjacent place other than their respective intrinsic unique locations.

Each part of this sequentially existing coexistent extension is individually uniquely distinct, different from all other parts of space. The (a) coexistent, (b) sequentially occurring, (c) individually different parts of the extension of space constitute *coexistent-sequential-difference*.

**The intrinsic nature of the continuing-existence of space**

Both space itself and the continuing-existence of space exist as forms of sequential-difference. But the *sequential-difference of the continuing-existence of space* occurs in an entirely different manner from the *sequential-difference of spatial-place*.

Space itself is static, unchanging in any way. The sequential-difference of the extension of spatial-place is coexistent—it is measured with a ruler of some kind.

However, the continuing-existence of space occurs as a form of continuously ongoing change. The continuing-existence of space, occurring as change, does not have any quality of extension—it cannot be measured with a ruler of any kind. The sequential-difference of the continuing-existence of space is noncoexistent—it is measured with a clock of some kind.

There is a convenient way to observe this difference between the two forms of sequential-difference. Both hands can be held up in the space in front of the observer, each occupying a different part of that space. Coming from either side there is sequential-difference from the location of one hand to the coexistent location of the other hand—coexistent-sequential-difference.

To observe noncoexistent-sequential-difference requires only one hand to be held up in the space in front of the observer. First hold the hand closed. Then open the fingers. When the hand was closed, the opened hand could not be observed. It was not there because the hand had not yet been opened. When the hand was open, the closed hand could not be observed. It was no longer there because as the hand continued to exist, it changed into the open position. Coming from the closed hand there is sequential-difference to the noncoexistent opened hand—*noncoexistent-sequential-difference*.

Noncoexistent-sequential-difference is required for the occurrence of change. Change is noncoexistent-sequential-difference. Thus it is with all forms of change.

With every continuously ongoing change only the current occurrence of change is happening. Prior part of any ongoing change ceases to exist as the current part of the change occurs—consequently the prior part is not coexistent with the current occurrence of change. With every ongoing change the part that will follow the currently occurring part of the change is not coexistent with the current part because that following part does not exist, having not yet occurred.

That is sequential noncoexistence in general. Therefore, with the specific case at hand, the parts of the continuing-existence of space are not coexistent because only the current part of the continuously ongoing change exists, is occurring now. When the current part of the continuing-existence of space is occurring, the prior part no longer exists, having ceased to exist as the current part came into existence. When the current part of spatial-continuing-existence is occurring, the following part does not exist because it has not yet come into existence, has not yet occurred.

Because the parts of spatial-continuing-existence are noncoexistent, they are existentially uniquely distinct. The (a) noncoexistent, (b) sequentially occurring, (c) individually different parts of the continuing-existence of space constitute *noncoexistent-sequential-difference*.

The foundational origin of newness in the universe is a consequence of the continuing-existence of space. When the prior part of the continuing-existence of space was occurring, the current part did not then exist, it had not yet occurred. When the current part does occur, it is newly existing.

Because space constitutes the foundational component of the universe, the form of change that occurs with spatial-continuing-existence constitutes the foundational form of change in the universe. The form of newness, then, that occurs with the ongoing change of spatial-continuing-existence constitutes the foundational form of newness in the universe.

All forms of change occur concurrently with the continuing-existence of the spatial-place where the change occurs. Everything that exists occupies spatial-place. The continuing-existence of each and every thing that exists occurs concurrently with the continuing-existence of the spatial-place those things occupy, and therefore concurrently with the continuing-existence of infinite space. All forms of material change, such as motion, emergence, and growth, occur concurrently with the change of the continuing-existence of the spatial-place where the changes occur, and therefore concurrently with the continuing-existence of infinite space. All forms of newness occur concurrently with the newness that occurs with the continuing-existence of the spatial-place where the newness occurs, and therefore with the newness that occurs with the continuing-existence of infinite space.

The continuing-existence of space provides an existential-context, a continuously changing place, in which other forms of change can occur.

Just as space provides an existential-context, a place in which to exist, for all else that exists, and just as the change of spatial-continuing-existence provides an existential-context, a change context for all other forms of change, the foundational form of newness that occurs with the change of spatial-continuing-existence provides a context of newness for all other forms of newness.

All forms of change—such as continuing-existence, motion, emergence, caused change, developed process—occur as noncoexistent-sequential difference, with the occurrence of the new parts of those changes.

**Defining time**

Because it was discovered that the continuing-existence of space plays the roles of time in the universe and thereby constitutes the basis of time in the universe, the first part of this essay was concerned with presenting the realist understanding of both the intrinsic nature of space and the intrinsic nature of the continuing-existence of space. With that knowledge at hand, the following part will be concerned with pointing out how the continuing-existence of space plays the roles of time in the universe and thereby constitutes the basis of time.

First, for reference, there is as complete a list of the intrinsic qualities of time as could be achieved prior to the discovery of the basis of time. Only the observable facts, and what can be derived from those facts, are included—no speculation, no theory or hypothesis.

Following that there is a presentation of why each of those temporal qualities and roles are what they are because they are, in reality, qualities and roles of the continuing-existence of space.

**Time when not knowing what it is**

1. Time is universal in that it occurs everywhere.
2. Time is a form of continuously ongoing change.
3. A moment at one place is the same moment everywhere.
4. The ongoing change of time is unidirectional.
5. During the prior part of time the current part was not there, it had not yet occurred. When the current part, the present part, does occur it is new, newly occurring.
6. The present is continuously new, newly occurring, newly existing.
7. As a form of change only the current part of the change is happening now—only the current part of temporal change, the present, is happening now.
8. The prior part of ongoing temporal change ceases to exist as the current part occurs. The past part of time no longer exists.
9. The following or future part of ongoing temporal change does not exist currently because it has not yet occurred. The future part of time does not yet exist.
10. All forms of change, such as motion, emergence, and growth, take time to happen, occurring during and concurrently with ongoing time. That is the relation, the role time plays in relation to other forms of change—a universal form of change to which all other forms of change conform.

That is time without actually knowing what it is, or why it occurs, or why it has the specific intrinsic qualities that it has—Why it is universal; Why it is relentlessly ongoing; Why it is unidirectional; Why it is continuously new; Why all other forms of change take time to occur.

Recognizing that the continuing-existence of space *is time* factually answers these questions because the continuing-existence of space is what exists in the universe that has those qualities and plays that role.

**Time as the continuing-existence of space**

1. Time is universal, occurring everywhere, because it is the continuing-existence of space, the continuing-existence of the infinite foundation of the universe.
2. Time is a relentlessly ongoing change because continuing to exist, as with spatial-continuing-existence, occurs as a relentlessly continuous ongoing change.
3. A moment at one place in one part of space is the same moment everywhere throughout infinite space because all infinite space is coexistent and thereby continues to exist simultaneously.
4. Time is unidirectional because continuing to exist is unidirectional.
5. The current part of time, the present, is new because during the prior part of the continuing-existence of space the current part was not there, it had not yet occurred. So, when it does occur it is newly occurring.
6. The present is continuously new because spatial-continuing-existence is a continuously ongoing form of change with continuous new part occurring.
7. The present is the only part of all time that exists, that is happening now, because the present is the current occurrence of spatial-continuing-existence.
8. The prior part of time ceases to exist as, by way of continuing-existence, it becomes the current part—the past does not currently exist.
9. The following part of time does not yet exist because the current part has not yet by way of continuing-existence become the following part—the future does not currently exist.

1. All forms of change take time to occur because the continuing-existence of an ongoing change occurs during and concurrently with the continuing-existence of the spatial-place where the change is occurring, and thereby during and concurrently with the universal continuing-existence of space.

That is time when actually knowing what it is.

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