Modal time theory: Understanding human existence through time travel and music

August 22 2019, by Florian Meyer

Credit: CC0 Public Domain

Time is a fundamental dimension of human existence and comes in many forms. Using a comparative approach, philosopher and physicist Norman Sieroka looks at what distinguishes them, using time travel and music.

Have you ever come face-to-face with yourself before? Obviously not.

But it is the kind of thing that might happen during time travel in science fiction—for example, in films such as *Back to the Future*. In this 1980s blockbuster, Marty McFly travels back in time from 1985 to 1955. This is the year when his parents fell in love. When Marty intervenes in the plot, he changes the past—and runs the risk that his parents will neither fall in love nor get married. If that had happened, he never would have been born. But how could Marty have travelled through time if he doesn't exist?

It is from these contradictions that the film gets its entertainment value. "*Back to the Future* is a good example of the internal conflict that stories about time travel have to struggle with," says Norman Sieroka. As a physicist and philosopher, he has studied the concept of time extensively. "Contradictions such as those Marty McFly experienced occur in particular when the sequence of cause and effect is reversed. The question of whether this is even possible makes the subject of time travel an interesting philosophical issue."

Traveling through time-like loops

In physics, for example, there are theories in which time travel is possible in principle. For example, under certain conditions, the general theory of relativity allows closed, time-like loops. In this theory, space and time are not independent of each other, but are defined by geometry. You can think of space-time like a marble run: similar to how marbles roll along a track, the planets orbit the sun on a course that prescribes how they move through space-time.

In some parts of the universe, the geometry could bend so much that the space-time curves bend back to their starting point, forming time-like loops. Astronauts who travel through such a loop would then return to a point in time where they "had already been" or which "had already existed."

What does time travel say about theories of time?

Such descriptions of time travel reflect basic positions of time theory. Sieroka says, "If an individual is convinced that—by definition—the past no longer exists and the future is still to come, then they will presumably consider time travel to be physically impossible, since the destinations do not actually exist." To a certain extent, such an individual considers only the present to be real.

Sieroka calls this position regarding philosophy of time a "modal time theory" (or in philosophy jargon, A-theory), because its fundamental order is that of the past, present and future. He differentiates this from the "positional theory" (B-theory), which orders events according to whether they will occur earlier or later. Typical examples of this theory can be found in physics. For example, when a ball rolls down an inclined path, you measure the time between an earlier point t1 and a later one t2—it doesn't make a difference whether you measure it yesterday, today or tomorrow.

Absolute simultaneity does not exist in the theory of relativity, which is why in this theory no point in time can be clearly determined as present. "Modal time" theories are therefore hardly represented in physics. However, for human perception and subjective experience, the present and the "modal time" are of paramount importance: "People can remember the past, but not the future. They can also influence the future, but not the past," Sieroka explains. "On the other hand, we have the 'earlier-later relation,' because there is cause and effect in the world, and effects follow their causes and not the other way round."

There is no one single "real" timeline

Back to the Future portrays this in a comical way. "Once I have been born, this fact is essentially established and can never be undone even if

I travel through time—at least not within a single world as described in classical physics," Sieroka concludes. During his time as a Privatdozent at ETH Zurich, he published a book on the subject entitled Philosophie der Zeit (Philosophy of Time).

Norman Sieroka has been full Professor for Theoretical Philosophy at the University of Bremen and a member of the directory board for ETH's Turing Centre Zurich since April. Together with Renato Renner, ETH Professor for Theoretical Physics, Sieroka is also researching the concept of time in quantum physics and the requirements for quantum clocks.

But what really is the present? Is it a point in time or can it be expanded? Different sciences and areas of application have plausible answers to this question. That's why Sieroka is following a comparative approach: "There isn't an elementary or 'real' time that all others can be reduced to. You can have a deeper understanding of time only if you seriously consider its different forms and the cross-connections among them."

For a long time, mathematics regarded time as a prime example of a continuum that supposedly consists of individual points. "Upon closer examination, such a continuum turns out to be a theoretical requirement rather than a fact," Sieroka admits, "and leads to considerations as to whether time is instead possibly composed of overlapping intervals."

Hearing is time perception

The transition from rhythm to audible notes neatly illustrates this (see film 2): if the frequency is very low, you can hear a rhythm or "staccato," individual clicks. As soon as the frequency picks up, you no longer hear a rhythm, but a tone at a particular pitch. In the film example, even two pitches can be distinguished over time. Typically, the transition does not occur at a specific point in time, but flows in a short,

temporally extended "moment." Likewise, you do not hear separate successive notes in pieces of music, but a full melody.

"Just as the power of sight shapes our perception of space, so hearing shapes our perception of time," Sieroka says. People can usually estimate the duration of sounds more accurately than the duration of how long an image is shown to them (see film 1). For Sieroka, hearing is an example of why one time form should not be put before another: "Time is such a fundamental dimension of human existence that it encompasses and structures physical and biological as well as social and spiritual characteristics."

More information: Norman Sieroka. Time and Suffering: False Metaphors, (De-)Synchronous Times, and Internal Dynamics, *Space, Time and the Limits of Human Understanding* (2016). DOI: 10.1007/978-3-319-44418-5_30

Provided by ETH Zurich