Immortality, Space Travel, and Einstein's Time Dilation

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If I told you that I had the secret to everlasting life, how much would you be willing to pay for it?

For some, immortality and all the implications that come with it might be more frightening than appealing. But for many others, the possibility of overcoming death is tantalizing.

Immortality Has Fascinated Humanity for Millennia

The concept of eternal life is a regular feature in human culture, with the earliest references in millennia-old religious stories about timeless gods and spirits. We still embrace this idea today. For example, sci-fi stories about immortality are featured in the original *Twilight Zone* TV series and in movies such as the *Highlander* series and *Age of Adaline.*

Our fascination with immortality isn't limited to stories of fiction, either. Real scientists are doing real work to understand the mechanics of aging and disease and stop them from cutting our lives short. Many gerontologists believe that aging and disease are totally surmountable obstacles with proper medical research and technology.

And most of these experts agree that if we simply continue to make progress in combating disease and slowing or stopping aging — no matter the rate of such progress — we will, one day, reach a point where death can be prevented altogether. But such a day might take centuries or longer to arrive.

So if you were offered the means to beat death *today*, what would it be worth to you? The possibility of immortality could really exist within our lifetimes. But many might consider the price that one would pay for eternal life would be far too steep.

The Concept of Time Dilation

Albert Einstein was among the brightest minds our species has ever produced. During his life, he revolutionized our understanding of physics and the mechanics of the universe at large.

Among his many discoveries, Einstein showed that time itself is a relative concept and that objects experience time differently dependent upon their relative speeds. This means that time moves more slowly if you're going faster.

For example, let's say that I'm standing still and you're driving in circles around me with your car. Time is actually moving more slowly for you than it is for me because your speed is faster than my own.

This is not a trick. It is not an optical illusion or a frailty of the mind. It really happens. It is a phenomenon that Einstein referred to as "time dilation."

Time dilation is actually a necessary balancing effect that prevents violation of one of the most fundamental laws of our universe: Nothing can travel faster than light.

Without getting into the specifics of Einstein's special and general relativity theories, suffice it to say that as an object moves faster and faster, two things happen to prevent speeds that exceed that of light. First, the object becomes more and more massive (requiring more and more energy to continually accelerate).

Secondly, time actually slows down for the object relative to slower-moving observers. In fact, Einstein's work shows that at lightspeed, time stops altogether (take a moment to pick up the pieces of your brain before reading further).

Time Dilation and Human Activity

Fortunately for us, the effects of time dilation are so minuscule at the speeds we humans regularly move on and around the Earth that they are far from noticeable. We're talking fractions of seconds in difference over the course of entire lifetimes.

This is because as humans, we don't regularly move anywhere near the speed of light. Light travels at approximately 186,000 miles *per second*. To put that in perspective, light travels at a speed such that it could circle the entire Earth more than seven times per second.

By comparison, some of the fastest vehicles mankind has ever created — orbiting spacecraft — travel at roughly 17,500 miles *per hour*. That is about two-thousandths of one percent of light's speed.

Even at these modest speeds, however, the effects of time dilation begin to reveal themselves. In fact, this was how Einstein's time dilation theory was first demonstrated. For many satellite functions, including communication and global positioning, precise time synchronization between clocks onboard spacecraft and clocks on the ground is required. However, when we began launching the first satellites into orbit in the mid-twentieth century, engineers began noticing that the clocks onboard the spacecraft would tick more slowly than the clocks on Earth, despite precision equipment and calibration.

The problem wasn't with the clocks, batteries or ground stations; it was time dilation. To fix this problem, scientists wrote an algorithm into the clocks on orbiting spacecraft that actually *speeds them up* to compensate for the effect of time dilation, so that they remain in sync with clocks on Earth. This same algorithm is used on virtually all satellites in operation to this day.

What Would Happen if Humans Could Travel Near the Speed of Light?

What if humans could travel much closer to lightspeed? What would the observable effects be like then? Fortunately, Einstein gave us an equation for measuring the relative effects of time dilation, and it turns out that the implications are mind-shattering.

$$T = \frac{T_0}{\sqrt{1 - v^2/c^2}}$$

The formula here is relatively simple. T_0 represents experienced time, c is the speed of light, and Trepresents dilated time. Then, we simply plug in the velocity of our moving object for v and solve the equation.

Suppose we built a spaceship that could travel at 99.9 percent of lightspeed. Let’s say you blasted off in this spaceship and did laps around the Earth for one year. Remember that for time dilation, it’s not necessary for you to *go anywhere* in terms of space; you must simply be *going faster* than the stationary observer.

When you returned to Earth, you would end your journey one year older (through the one year that you experienced on your spaceship). But everyone that you left behind on the planet would have aged by more than 22 years!

Again, this is not a trick. This effect really happens, and there is no theoretical limit to the dilation offset.

Imagine that you decided to travel at 99.99% lightspeed and ran the numbers through Einstein’s equation again. When you returned from your year-long trip this time, almost 71 years would have passed back on Earth. When you think about it, what this hard-to-believe phenomenon really means is that time travel (into the future) is theoretically possible.

Time Dilation and Its Potential Link to Immortality

So what does time dilation have to do with immortality? Suppose that today, you are diagnosed with a form of cancer for which we currently have no treatment. You’re given a prognosis of only a few years to live.

If you had your near-lightspeed spaceship standing by, you could climb aboard, spend a year whizzing around the Earth at 99.99% lightspeed. Then you could return in 71 years (on Earth) to ask whether a cure for your disease has been found.

Is there no cure yet? No problem. Get back in your spaceship and turn up the dial to 99.9999% lightspeed, where six more months would get you 350 more years of progress back on Earth.

The discovery of cures for almost every disease and ailment is believed by many experts to be an inevitable eventuality given enough time. And with near-lightspeed travel, time is something that you would have in almost infinite supply.

But what about the cost I mentioned? The unfortunate catch to traveling centuries into the future via time dilation is that everyone you knew and cared about would obviously be long since dead when you return.

You might be tempted to try to take some of your closest friends and family with you, but would they agree to make that sacrifice, leaving behind all others that *they* care about? Maybe everyone wants to board the spaceship to immortality, but someone has to stay behind and do the work so that the time travelers can benefit from it in the future. The pursuit of everlasting life might require unthinkable heartache and loneliness.

For better or worse, we haven’t quite worked out the mechanics of near-lightspeed travel yet, so this question is more of a thought experiment than a realistic dilemma for now. But it’s worth keeping in mind that nothing in the laws of physics prevents us from achieving this feat eventually. So one must ultimately consider, in light of the costs: would immortality be worth it?

About the Author

Dr. Gary Deel is a Faculty Director with the School of Business at American Military University. He holds a JD in Law and a Ph.D. in Hospitality/Business Management. Gary also holds a bachelor's degree in space studies and is an avid student of the astronomical sciences.