AL KITAB
The Renaissance Project

Chapter 6

Lost in Time

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Relativity & Time

Do not underestimate the power of the human mind nor the importance our perceptions play in shaping the world; for what is the world but a social construct? A perception that drives our most basic behavior? Despite our best attempts, reality and perceptions cannot be separated. Every reality is based on a set of ideas and thoughts that are institutionalized in our minds.

Such institutionalization provides us with comfort, but history has shown that comfort is often enjoyed at the expense of progress. It is only when man is brave enough to explore the assumptions underlying perceived realities that he makes giant leaps towards the advancement of mankind.

If I were to think of two assumptions, two constants, two "realities" that my entire sanity is built upon, they would be space and time. Studying physics always makes it harder for me to sleep for I am constantly reminded that my two sacred assumptions are mistaken; space and time are not fixed. Newton proved the former, Albert Einstein in 1905 proved the latter.

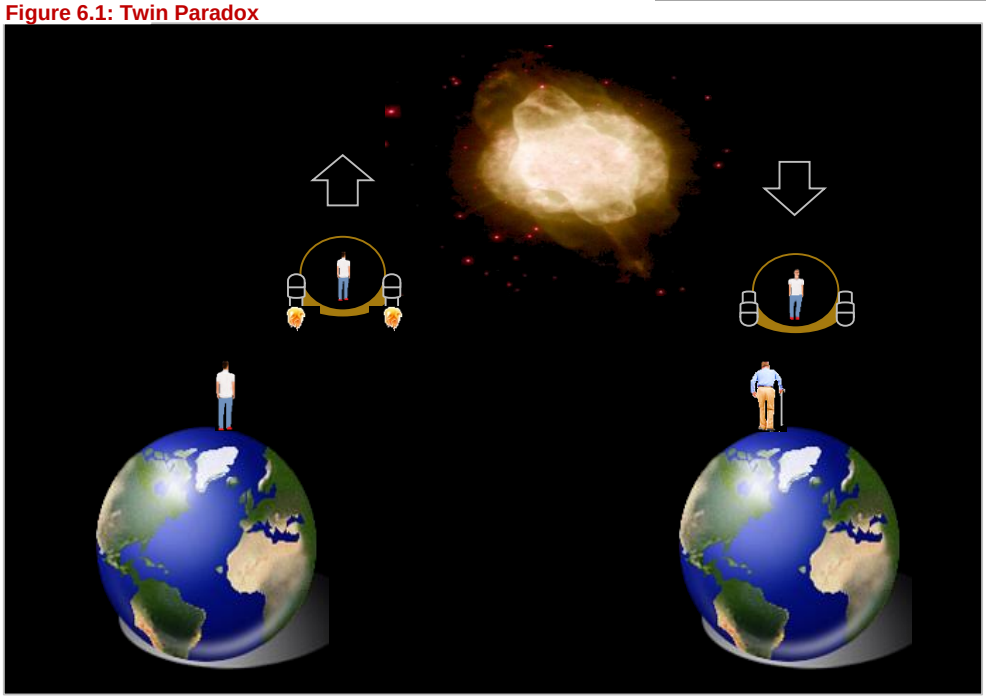
The human mind interprets time as absolute, linear, and independent of spatial dimensions. This means that we expect the clocks of any two observers in the universe, provided they are accurate, to measure time equivalently. A second passing anywhere in the world is experienced as such by everyone.

Einstein proved that this was not the case and that time varies between observers in what is called "time dilation". This means that the passage of time can be experienced very differently from one person to the next. In effect, every observer has his own personal time. A good demonstration of this can be seen in the Twin Paradox example described below:

$E=mc^2$ - The Science

The core principle of Einstein's theory of relativity is that the laws of science should be applicable to all moving observers such as laws associated with the speed of light. All observers should measure the same speed of light. That speed is constant and unchanging. A consequence of this assumption is that nothing can travel faster than this speed, represented by the equation $E=mc^2$. This is because as we try to accelerate any object, it will become heavier and heavier. At a speed close to that of light, the mass of an object would be infinite and we would thus require an infinite amount of energy to further increase the object's speed. As such it is impossible.

Figure 6.1: Twin Paradox



Did you know?

E=mc2 led to the development of nuclear weapons? The equation showed that a small amount of mass is equivalent to an enormous amount of energy.

Relativity & Time

Bob, 24 years of age, is an astronaut who leaves Earth and travels at a speed close to the speed of light. His journey is over in 10 years and makes his return to Earth. He is shocked to find his identical twin brother in his eighties! While Bob had only experienced and aged a few years, his twin had lived a long healthy life (Bob counted 10 years on his journey while his twin brother counted 60 years or so[(1)]). The difference in time observed can be attributed to the twins moving at different speeds relative to one another.

Time is also expected to vary when an observer is situated closer to a larger object. For example, time will appear to run slower the closer the observer is to Earth: a clock at sea level will record a slightly different time than one placed in the outer atmospheres of Earth.

Figure 6.2: Time Dilation

Did you know?

A plane flying from east to west will record more time than its twin flying in the opposite direction! This is because the first plane travels against the Earths orbit while the other travels in the same motion as Earth

Relativity of time and “time dilation”, might seem like science fiction or a crazy idea conjured by physicists. However, the theory has been tested successfully. Experiments show identical clocks measuring time differently while travelling at different speeds (they gave slightly different readings).

Did you know?

As described above, when an observer gets closer to a massive object, time appears to slow down. When an observer gets close to a very heavy object, time might come to a complete stop. This is observed in black holes (See Chapter 5) and is also the case when considering the early stages of the Universe (See “singularity” in Chapter 2).

The relativity of time is a very complex idea. It is simple at heart, but it is certainly not how human beings are used to interpret their surroundings. It is revolutionary indeed, which makes it all the more extraordinary to be mentioned in the Quran millenniums before Einstein was born.

Theory of General Relativity - The Science

There is an apparent problem with the theory of relativity. If nothing can travel faster than the speed of light, doesn’t this conflict with Newton’s theory of gravity (all objects exercise a gravitational force on one another instantaneously and over infinite distances)? If nothing can travel faster than light, then how is gravitation exercised as such? In Einstein’s theory of General Relativity, he proposed that space-time was not flat. Rather, gravitation was just an expression of the fact that the space-time dimensions were geometrically curved.

Notes (1): This is only a hypothetical example; the numbers used here do not reflect any calculation made by myself

1000 Years of What we Count

As a young boy, my Islamic Studies teacher taught me that time was measured differently between observers. She taught me that “a day”, as described by God, may equate to thousands or millions of years here on Earth. On the relative nature of time, the Quran states:

”وَيَسْتَعْجِلُونَكَ بِالْعَذَابِ وَلَنْ يُخْلِفَ اللَّهُ وَعْدَهُ ۚ وَإِنَّ يَوْمًا عِنْدَ رَبِّكَ كَأَلْفِ سَنَةٍ مِمَّا تَعُدُّونَ“ (22,47)

“They ask you to hasten the punishment. Allah will never break His promise; a day of your Lord is like a thousand years of what you reckon!”

In this verse, it is quite clear that time is deemed relative; a day in hell is counted as 1000 years(2) here on Earth. This time dilation can be explained by the Islamic belief that both heaven and hell are massive bodies. As we have seen, the laws of physics expect time to pass a lot slower in these regions.

The Quran also makes mention of time dilation in various other verses. In the case of verse 5 in Chapter 32, the Quran describes time dilation and attributes it to differences in speeds between observers:

”يُدَبِّرُ الْأَمْرَ مِنَ السَّمَاءِ إِلَى الْأَرْضِ ثُمَّ يَعْرُجُ إِلَيْهِ فِي يَوْمٍ كَانَ مِقْدَارُهُ أَلْفَ سَنَةٍ مِمَّا تَعُدُّونَ“ (32,5)

“He manages the affair from the heavens to the Earth; then it ascends to him in one day whose measure is a thousand years of what you reckon!”

In this verse, it is said that “it/he ascends to him” in a day that is measured as a 1000 years(2) here on Earth. Most ancient scholars agreed that “it ascends” refers to angels. Angels according to Islamic principles are made of light and thus travel at high speeds. Again, according to the laws of physics explained in this chapter, one would expect that the people on Earth would measure time differently by counting more years than observers like angels moving at such high speeds, just as the verse describes.

In conclusion, the fact that the Quran accounts for the relative nature of time, whether it is caused by massive objects or high velocities is nothing short of incredible.

Notes (2): Some authors (both ancient and modern) have argued that the 1000 years mentioned in these verses may not actually equate to 1000 years. The reason behind this is linguistic in nature: during the 7th century, Arabs frequently used the number “1000’ to express any large number (which could be different than a 1000). It is thus plausible that 1000 was used here as an expression only rather than a representation of an actual number

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Photo and Figure Sources

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Editors

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