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P5_10 Jogging Can Save Your Life

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Abstract

A recent study has shown that jogging can add at least 5 years to a person's life. This paper calculates how much time is added to a person's lifetime due to relativistic effects if they jog. We assumed that on average a person jogs 32,000 km in a lifetime at a speed of 2.7m/s. At that rate for 62 years, a person's life will be prolonged by 0.95ns.

Introduction

According to a recent study, going jogging on a regular basis can add 6.2 years to a man's life and 5.6 years to a woman's [1]. In this paper we explore how much longer you live due to relativistc effects if you regularly jog compared to if you do no jogging at all.

How far will you run?

It is recommended that you should jog for 30 minutes three to five times a week [2]. In this paper we will assume a person jogs for 30 minutes four times a week. Furthermore, according to a BBC health article a jog is defined as no faster than 2.7ms^{-1} (6mph) [3]. From these values we can determine that on average a person should jog 19 km in a week, approximately 1000 km in a year.

In 2011, the World Health Organization said on average men and women in the United Kingdom lived for 80 years [4]. In this paper, we will assume that a person starts this regular jogging activity at 18 years old, after they have left Senior School and hence have no more compulsory physical education lessons. Therefore, in this paper, we determine that on average a person will jog roughly 62,000km (38,688 miles) in their lifetime. Using the relation $t = d/v$, assuming the velocity is constant, we calculate that the person will jog for approximately 6,500 hours, that is, 23,200,000 seconds in their life.

The Twin Paradox

To analyse the situation, we will make use of the Twin Paradox. This thought experiment puts forward a situation with identical twins, where one twin travels into space in a high-speed rocket then returns and finds his twin who stayed on Earth has aged more [5]. In this paper we will look at identical twins who live the exact same lifestyle, for example eat and sleep the same amount. The one exception is that one twin will jog 62,000 km in their lifetime whilst the other jogs 0 km.

We use the time dilation relation

$$\Delta t = \Delta t' \gamma \tag{1}$$

to determine the time difference experienced between the two twins. Δt is the time it takes for the twin to jog 62,000 km observed by the twin who is at rest, that is, in the Earth's reference frame; $\Delta t'$ is the time taken to move the same distance by the twin who jogs but in that twin's reference frame; and γ is the Lorentz factor defined as

$$\gamma = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}}, \tag{2}$$

where v is the speed that the jogging twin is moving in relation to the twin at rest and c is the speed of light. As $v = 2.7$ms^{-1} and is much smaller than the speed of light, the value of v^2/c^2 is $\ll 1$. Under these condition it is appropriate to use the binomial expansion,

$$\gamma = (1+x)^{\alpha} \approx 1 + \alpha x, \quad (3)$$

where $x \ll 1$. From equation (2) we take $\alpha = -\frac{1}{2}$ and $x = -\frac{v^2}{c^2}$. Equation (3) now yields γ. Substituting this value back into equation (1) and using the value $\Delta t = 23{,}212{,}800$s, we calculate that the interval $\Delta t - \Delta t' = 9.5 \times 10^{-10}$s. That is to say the lifetime of the jogging twin is extended by 0.95ns.

Conclusion

Jogging 62,000 km over 62 years at an average pace of 2.7ms^{-1} will relativistically add 0.95ns to your life. This value is not comparable to a human's lifetime. Therefore, we can conclude that the speeds we jog at induce negligible time dilation.

References

[1] http://www.escardio.org/about/press/press-releases/pr-12/Pages/regular-jogging-increases-life-expectancy.aspx accessed on 08/11/2013.

[2] http://www.fitday.com/fitness-articles/fitness/weight-loss/jogging-to-lose-weight.html accessed on 08/11/2013.

[3] http://news.bbc.co.uk/sport1/hi/health_and_fitness/4286146.stm accessed on 08/11/2013.

[4] http://apps.who.int/gho/data/node.main.688?lang=en accessed on 08/11/2013.

[5] P.Tipler & G.Mosca, *Physics for Scientists and Engineers*, W.H. Freeman and Company, New York, 2008, 6th edition.