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# A4_5 Abolishing Height Inequality

N. Jinnah, J. Terry, B. Henderson, A. Hogan

*Department of Physics and Astronomy, University of Leicester, Leicester, LE1 7RH*

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**Abstract**

In this paper, we use the theory of special relativity to calculate that the tallest man recorded in history must be moving away from the Earth at $0.98c$ in order to be observed on Earth as the same height as the shortest man recorded. We also calculate that for every period of 24 hours that passes on Earth, he will experience only 4.82 hours. Finally, we calculate that the energy needed to accelerate him to this velocity is $4.20 \times 10^{20}$ J. We discuss the feasibility of using this method as a means to homogenise human height.

## Introduction

Taller men and women are likely to be at an advantage when it comes to success compared to their shorter counterparts. Taller people usually gather more votes in elections [1], are more often perceived as "leader-like" [2], and earn more money [3].

Thankfully, special relativity may be able to provide a solution to this inequality: length contraction. The theory predicts that an object moving at a significant fraction of the speed of light should appear to shrink along the axis parallel to its direction of motion.

## Theory

The height of a person moving away from the Earth, as measured by an observer on Earth, would be smaller than the measurement taken in their own reference frame. If $L_0$ is the height as observed in their reference frame and $L$ is their height as measured on Earth then

$$L = \frac{L_0}{\gamma}, \tag{1}$$

where $\gamma$ is the relativistic paramater, defined as:

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

where $v$ is the velocity the person is moving at and $c$ is the speed of light in a vacuum.

Additionally, they would experience time dilation; a clock that is moving will run slower compared to a stationary clock. If $t_0$ is the passage of time experienced by the person moving and $t$ is the passage of time in the stationary reference frame then

$$t = \gamma t_0. \tag{3}$$

Finally, we can calculate the energy required to accelerate a person to a relativistic velocity. The rest energy of an object is given by

$$E_0 = m_0 c^2, \tag{4}$$

where $m_0$ is the object's rest mass. The energy of an object moving at a relativistic velocity is given by

$$E = \gamma m_0 c^2. \tag{5}$$

The difference between equations (4) and (5) therefore gives a value for the energy requirement, $\Delta E$:

$$\Delta E = m_0 c^2(\gamma - 1). \tag{6}$$

**Results**

With a height of 272 cm, Robert Wadlow is the tallest man recorded in history [4]. The shortest person recorded is a man named Chandra Dangi, who was only 54.6 cm tall [5].

Using equations (1) and (2), we calculate that a person with the same height as Robert Wadlow must be moving away from the Earth at $0.98c$ in order to be seen by a stationary observer on Earth as being the same height as Chandra Dangi. We also calculate that they will experience 4.82 hours for every 24 hour time period that passes on Earth using equation (3). Finally, we find that the energy required to accelerate a person with the same mass as Wadlow, at his heaviest mass of 222.71 kg [4], to 0.98c is $7.98 \times 10^{19}$ J using equation (6).

**Discussion and conclusion**

Making use of the theory of special relativity as a means to solve height inequality may seem like a promising idea, however it might not be possible.

Firstly, the ability to to reach the proposed velocity is not viable using current technologies; the velocity we have calculated in this paper is 27,000 times faster than the occupants of the Apollo 10 Lunar Module who achieved the highest velocity any human has travelled at relative to the Earth [6].

Moreover, the energy requirement per person is prohibitively large, and in practice would be made even larger by the need to accelerate most, if not all of the world's population to their unique velocities, each individually tailored to their rest height. This problem would be further exarcebated by the fact that each person would be required to carry additional masses with them in the form of a propulsion system, a life support system and protection from the hazards of the space environment.

In addition, many people would be unlikely to be willing to go through this procedure because of the time dilation they would need to experience; because everyone would be accelerated according to their height, it would only be possible for people of the same height to interact. Their different velocities would also mean people of different heights would be travelling at a range of distances away from the Earth.

To conclude, our proposed method of solving height inequality is theoretically possible, however it is highly unrealistic.

**References**


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