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P5_3 Probability of Meeting a Doppelgänger

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Abstract

This paper investigates the idea of doppelgängers and the probability of meeting an unrelated but biologically identical person in an average lifetime. The probability is calculated to be 1.5×10^{-17} , showing that the probability of meeting a doppelgänger is highly unlikely yet theoretically possible.

Introduction

The idea of everyone having a doppelgänger, derived from the German “Doppel” meaning double and “Gänger” meaning walker [1], is defined as the “apparition or double of a living person”, and is embedded deep into mythology and folklore around the world.

This paper evaluates the probability of finding an unrelated and biological doppelgänger within the lifetime of an average person, and the significance of this answer.

Assumptions

There are several assumptions that must be made in order to arrive at a reasonable and feasible answer for the probability. Firstly, it is assumed that the current human population on Earth is 8 billion people, of whom only 1 may be a doppelgänger with identical DNA.

It is also assumed that the theory of a multiverse is ignored for this scenario, and the only reference frame is for an observer in their current lifetime on Earth as we know it.

It is assumed that the average person lives for roughly 73 years [2], meets 3-4 new people everyday [3], and could meet their doppelgänger in their childhood years of which they have little to

no recollection.

Finally, it is assumed that meeting a doppelgänger is a completely random event, with no prior knowledge to them existing or having met them before.

Theory

The human genome is the sum total of the DNA base pairs which make up the genetic makeup of humans. Encoded within 23 chromosome pairs in all cells, there are 3 billion DNA base pairs [4]. It is common for humans to have 2 copies of each chromosome, inherited from both the father via the sperm, and mother via the egg, during fertilisation in the fallopian tubes.

Each human can carry up to 13,500 different DNA variants, however only 300 of them are responsible for gene function [5]. This indicates that only 2% of our DNA is actually responsible for encoding proteins with genes.

A recent study [6] linked the human genome to exhibit different states of matter, such as liquid and solid. It suggests that undifferentiated chromatin, a substance within a chromosome consisting of DNA and protein [7], acts like a Maxwell fluid, and differentiated chromatin undergoes both fluid-like and solid-like phases.

In order to calculate the probability of meeting a doppelgänger, the current total number of possible genetic variants will need to be determined using the following equation:

$$g = d_p * h_p * g_v \quad (1)$$

Where g is the total genome variants, d_p is the number of DNA base pairs, h_p is the human population in the Earth, and g_v is the number of genome variants.

The probability of meeting a person with the same genetic variant within an average lifetime is computed using the following equation:

$$p = p_m * p_d \quad (2)$$

Where p_m is the people met in an average lifetime, and p_d is the probability of a person having the same DNA.

Results

First the total number of genome variants possible are calculated using equation (1). Taking values of 3 billion for d_p [4], 8 billion for h_p as assumed and 300 for g_v [5], we get an answer of $g = 7.2 \times 10^{21}$.

Thus, the probability of meeting someone with the identical DNA is 1 in 7.2×10^{21} , or in other words, $p_d = 1/7.2 \times 10^{21} = 1.4 \times 10^{-22}$.

Next, the amount of people met during an average lifetime must be calculated using equation (2). Taking the upper bound of meeting 4 new people everyday for 73 years, the average person can be expected to meet approximately 106,000 people over the course of their lifetime, and taken to be p_m .

Finally, the probability of finding an unrelated and biological doppelgänger within the lifetime of an average person is computed. From this, it can be determined that $p = 1.5 \times 10^{-17}$.

Discussion

It can be justified, given the current population of the world, that the probability of meeting a doppelgänger is almost impossible. This result also shows the large diversification of genetic variation there is in the human species, and the

uniqueness of humans when compared to each other.

An increase in the people met in an average lifetime is the simplest way to increase the likelihood of meeting a doppelgänger, however this will have a negligible effect on the end probability. The best course of action would be to increase the probability of a person having the same DNA variant, however this would require further work to discover new DNA variants in the field of genomics.

Conclusion

From our results, the probability of meeting a doppelgänger is evaluated to be 1.5×10^{-17} , which is extremely small, yet theoretically possible. This indicates that despite being a strong theme in mythology and folklore, the idea of biological doppelgängers is something which is highly unlikely according to statistics and science.

References

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