takie jest życie

First and Foremost: Laughter

How wonderful it is that there is one day in the year when joking is mandatory. Because even if forced, laughter is healthy, and this truth applies not only to humans.

All people on Earth, regardless of their origin and culture, laugh in a similar way. We can unmistakably identify laughter among a wide range of behaviors – despite language barriers and physical differences. We begin to laugh (producing sounds known as laughter) at about 3 months old, and we continue laughing throughout our lives, doing so far more often than we realize.

The positive effects of laughter on health have been known for centuries. Nowadays, more and more information is available about specific changes in the human body that occur when we have a good laugh.

Rapid expulsion of air caused by muscle contractions improves lung ventilation, muscles contract and relax. In the brain, the reward center is activated, and the endorphins released have pain-relieving effects, while growth hormone is secreted. The levels of stress hormones, cortisol and epinephrine, decrease, thereby protecting blood vessels and the heart from the effects of stress.

However, if we were to look at it entirely from the outside, laughter is a strange phenomenon. The loud, high-pitched sounds that accompany it are hardly human. The face distorts, the jaw drops loosely, the body bends and bounces. A sudden burst of laughter takes control: over posture, the ability to perform most activities, speech, and breathing. One can reel from laughter, fall off a chair, cry, develop a sore throat and stomach ache. One might even wet themselves. It is even possible to die laughting. Overall, this behavior is quite dangerous; however, it has been strongly ingrained in the evolutionary process. Where did it come from?

Charles Darwin, in his book 'The Expression of the Emotions in Man and Animals' from 1872, devoted considerable attention to laughter. He described laughter as a state in which the eyes become *bright and sparkling*. Darwin visited the London Zoo, where he observed great apes being tickled by their caretakers. Chimpanzees, bonobos, gorillas, and orangutans have ticklish spots and react to them in a strikingly similar way to humans—also with a kind of laughter, resembling loud and rapid panting.

But not only apes can laugh. In the 1990s, it was discovered that rats have ticklish spots on their backs and bellies. Further research revealed that tickled rodents emit short squeaks in a frequency range inaudible to humans (50 KHz). Rats willingly submitted to tickling, and they greeted the researcher entering the laboratory with their laughter-like chirping.

The described sounds are also made by rodents during play, including interactions with humans. By studying rat vocalizations and ticklish spots, researchers even taught rats to play hide-and-seek. Both the animals and the scientists took turns being the seeker and the hider. It turned out that rats mastered the game brilliantly and were eager to play, even though the reward was belly tickling rather than, as is usual in animal research, a treat. When the rodents hid, they remained completely silent, only emitting joyful squeaks once found by a human. However, these squeaks were absent when the hider did not follow the game's rules, such as always hiding in the same spot.

Scientists believe that human laughter originates from play-related behavior, evolving from loud panting. All young mammals play, and some species retain this ability throughout life. Play-related vocalizations have also been observed in some bird species. Laughter (specific sounds) and body posture, as well as facial expressions, signal an invitation to play and convey the message: what is about to happen is not serious—let's have fun. Play serves as a way to train physical skills in a safe environment and as a means to build social relationships, making it particularly important in social species.

In animals, laughter only occurs during direct physical contact, such as tickling or play (wrestling, rolling, nibbling, etc.). Human laughter, however, is unique in several ways. Humans have a sense of humor and laugh not only during play; they find images, situations, and words amusing. Additionally, only in humans is laughter contagious.

Everyone has likely experienced the dreadful feeling of being overcome with uncontrollable laughter at the most inopportune moment, such as during a solemn ceremony, and being utterly unable to suppress a completely senseless giggle. This affects everyone, even professionals like radio and television announcers. It serves as a way to relieve tension, originates from the oldest regions of our brain, and is very difficult to control. One person's laughter can easily spread within a group, as the brain loves laughter. Studies show that when we hear laughter, we enter a state of readiness—and we start laughing, often without even knowing why.

Although we believe we laugh when something is funny, research indicates that we laugh 30 times more often in company. Laughter is an evolutionarily ingrained, powerful tool for shaping social relationships. Through laughter in conversations, we express sympathy, understanding, and a sense of belonging. We invite listeners to engage, signaling good intentions. Shared laughter helps navigate difficult situations, relieve tension, and strengthen bonds.

Recently, the world has not been particularly conducive to laughter. In times of frustration and uncertainty, one day a year is not enough. Starting today, let's take laughter seriously.

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Kąt Otwarty $2°$: $14 = 2 \cdot 7$

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A few years ago, recreational mathematics found its way under snowy rooftops thanks to a curious property of the number 2020. Specifically, the first digit of this number indicates the count of the digit 0 in its decimal representation, the second digit represents the count of the digit 1, while the third and fourth digits correspond to the counts of digits 2 and 3, respectively. Numbers possessing this self-descriptive property are called *autobiographical*. Naturally, the total number of autobiographical numbers is finite, as they can have at most ten digits. There exist precisely seven such numbers, the largest of which is 6 210 001 000.

More about autobiographical numbers can be found in the article by Piotr Zarzycki and Ryszard Kubiak, *On Autobiographical Numbers*, Δ_{20}^{12}.

Let us examine numbers that also, in a certain sense, describe themselves, but their method of self-description is somewhat subtler. First, let us recall the first nine prime numbers:

$$p_1 = 2,\ p_2 = 3,\ p_3 = 5,\ p_4 = 7,\ p_5 = 11,\ p_6 = 13,\ p_7 = 17,\ p_8 = 19 \quad \text{oraz} \quad p_9 = 23.$$

The factorization of the number 14 is $14 = 2 \cdot 7$. Notice that 2 is the first prime number, while 7 is the fourth. Thus, we have:

$$14 = 2 \cdot 7 = p_1 \cdot p_4.$$

Among numbers that do not contain the digit 0, there are three more known cases where each digit in the decimal representation corresponds to a single factor in their prime factorization:

$$\begin{aligned} 154 &= 2 \cdot 11 \cdot 7 = p_1 \cdot p_5 \cdot p_4, \\ 1196 &= 2 \cdot 2 \cdot 23 \cdot 13 = p_1 \cdot p_1 \cdot p_9 \cdot p_6, \\ 279\,174 &= 3 \cdot 17 \cdot 23 \cdot 2 \cdot 17 \cdot 7 = p_2 \cdot p_7 \cdot p_9 \cdot p_1 \cdot p_7 \cdot p_4. \end{aligned}$$

Unlike classic autobiographical numbers, here there is no natural upper bound on the size of the sought numbers—multiplying n prime numbers together can yield an n-digit number. So, do more such numbers exist? Are there infinitely many, or at least one more? Currently, **we do not know**—and that is unfortunate, because I would love to find out.

The problem under consideration can be extended to numbers containing the digit 0 in their decimal representation—for example, by assuming $p_0 = 1$, which results in ignoring every occurrence of this digit. Alternatively, one could explore this property in different numeral systems. The final question regarding the total count of numbers possessing this property remains open in these variations as well.

I personally verified that a fifth such number does not exist among numbers with up to 23 digits. However, I am not the record holder in this regard, as indicated by information in the *OEIS* encyclopedia—the sequence is listed under A097227. As it turns out, a much larger range was checked by Chai Wah Wu, an American researcher from IBM.