Have humans reached the end of evolution? Not under these 3 scenarios

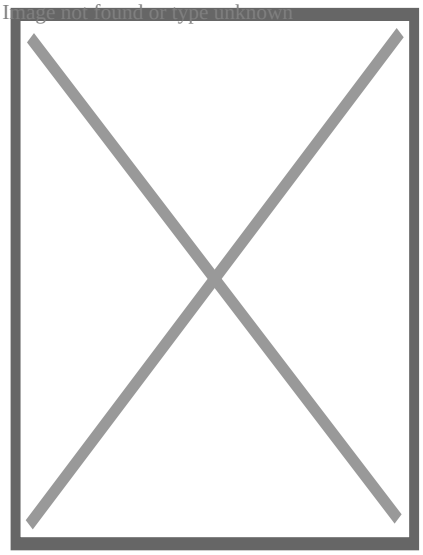
Is natural selection still a major force in human evolution? As far back as high school biology, we've been taught to think the answer must be yes. But is it really true?

Charles Darwin published his groundbreaking *On the Origin of Species* back in 1859, around the same time that Charles Dickens was making a name for himself writing about social conditions in England. Dickens' stories emerge from a period in which only 50 percent of British children survived to adulthood — a number not so different from animals in the jungle. In that vein, Darwin was right when he said natural selection was operating on humans full force.

Yet the forces that came into play in the 1850s are far different from those we experience today, prompting some high profile biologists to suggest that our advanced medical capabilities have, in effect, blunted natural selection. In a 2013 Radio Times interview, science communicator David Attenborough described it this way:

> "We are the only species to have put a halt to natural selection, of its own free will, as it were. We stopped natural selection as soon as we started being able to rear 95–99 percent of our babies that are born."

Lower child mortality rates are largely due to vaccines, water purification, modern medical care and other technological advancements that have allowed the human population to approach the 7.5 billion mark. Why does this matter for natural selection? It's a simple matter that dying before producing offspring is the most effective filter for a gene pool. Lesser traits are weeded out, while stronger ones are passed on.



Charles Darwin

And since natural selection is the most notable evolutionary force, there is a question about whether any

significant human evolution will continue far into the future. There's no clear answer yet, but compiling various proposals and hypotheses leads to a handful of future scenarios:

Scenario I: No major changes on the horizon

This is the boring scenario, so we'll get it out of the way first. While death before reproduction is an effective tool for culling out undesirable traits, there is a flip side to the equation. In the Stone Age, being less intelligent than one's peers would put an individual at higher risk of premature death — by animal attack, for instance. But natural selection also promoted the development of valuable traits. Our smarter ancestors could hunt better and find more food — leading to the development of farming and a host of other advances that enabled them to stay alive and reproduce.

But then a strange thing happened. Human society developed a sense of ethics and justice that led us to protect the weak. Today, we heal the sick. Infant mortality is low. And children of low intelligence are put into special education classes. As a result, many individuals who would have been weeded out in the Stone Age are growing up to pass on their genes.

Finally, human populations are no longer genetically isolated. Along with natural selection, reproductive isolation such as founder effects and population bottlenecks are major evolutionary processes that have shaped humanity. But today, there is substantial gene flow as people from different continents frequently join to mate. The so-called 'races' are blending, so humanity is evolving in that sense. But it is happening so quickly that within a couple of generations there won't be much left to blend. The planetary gene pool will be mixed about, leaving little room for human physical characteristics to change in any significant way.

Scenario II: Natural selection continues

The main argument here is that currently we're in a peaceful time, biologically speaking. Yet we could be on the verge of disease pandemics causing a Darwinian selective sieve. The jet-set age — the very factor underlying the gene flow that's blending human races — also can be a driving factor for the spread of a pandemic. The notorious influenza epidemic of 1918 came right at the end of World War I, claiming more lives than battlefield injuries. Today, we are much better at monitoring infectious disease threats — the containment of the 2014 Ebola virus outbreak in West Africa is one example — but we also have a growing human population. Furthermore, there is some concern that antibiotic resistance could outpace the development of new anti-microbial drugs.

Alongside premature death, evolution is also powered by sexual selection. This means that although we support the survival of nearly every newborn to reproductive age, those who are better 'fit' in terms of intelligence, ability to generate income, and physical attractiveness, could be more likely to attract mates who share those features.

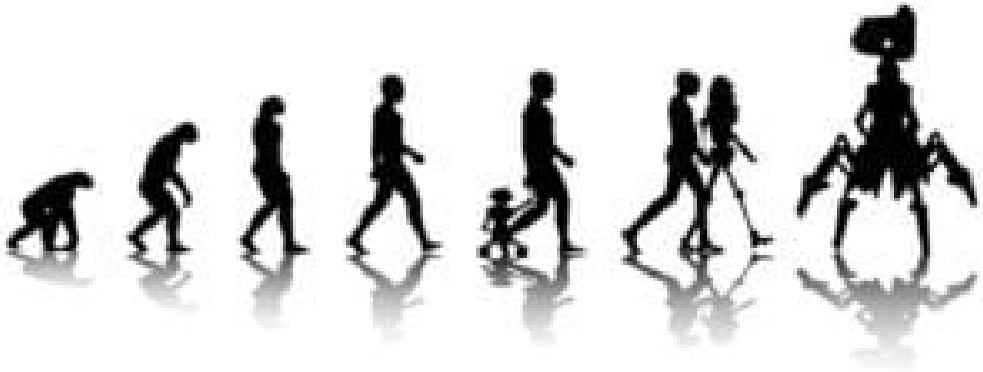
Scenario III: Evolution shifts to off-world human colonies

In scenario I, we noted the absence of reproductive isolation in modern times. But there is serious talk about sending humans to colonize other worlds. This could involve building freespace colonies (miniworlds constructed from asteroid material and shaped to rotate to provide gravity), floating cities in

the atmosphere of Venus, or homes on the surface or below ground on various worlds. The most popular idea — one promoted by Elon Musk who hopes relocate thousands of humans within decades — is to colonize Mars. Unless the colonists are placed completely underground, the Martian radiation environment could have a significant selective effect on human genetics. This is not because it would kill off colonists themselves, but it could render many of them sterile, or at least put significant selective pressure on reproductive cells.

Since we don't yet understand how human embryos would fare in fractional gravity — gravitational pull at the Martian surface is only 38 percent that of Earth — there's a possibility of selective pressure in this regard too.

All of this is without assuming any isolation, because, of course humans would be arriving regularly from Earth, thereby adding to the Martian gene pool. On the other hand, should humans successfully colonize planets of other star systems, some biologists think that the reproductive isolation could be complete nan populations.



Scenario IV: Transhumanism will drive evolution

We're already seeing humans using gene therapy to alter their genes. Transhumanists seek to change themselves through a range of technologies, including robotics, bionics, computer mind uploading, artificial wombs and genome editing. These technologies are potentially strong enough to give humans the power to essentially take over their own evolution.

With a desire to improve both human performance and appearance, the transhumanist factor makes it hard to predict where this could go. The artificial womb, for example, could remove constraints on fetal head circumference. It's not impossible to think we could see humans sporting heads like the science fiction alien, *ET.* The TV science fiction cloning thriller *Orphan Black* included a transhumanist character with a tail. Will there be people like that in real life? Or should we merely expect body additions that are practical, such as wings for colonists on low-gravity planets?

Importantly, the four scenarios outlined above are idealized. Each has its merits, and so all can occur. It could be that human evolution will continue, based on a combination of each of these scenarios.

A version of this article originally ran on the GLP on February 22, 2017.

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