

Gene Editing for ‘Designer Babies’? Highly Unlikely, Scientists Say

Fears that embryo modification could allow parents to custom order a baby with Lin-Manuel Miranda’s imagination or Usain Bolt’s speed are closer to science fiction than science.

By [PAM BELLUCK](#) AUG. 4, 2017

Now that science is a big step closer to being able to fiddle with the genes of a human embryo, is it time to panic? Could embryo editing spiral out of control, allowing parents to custom-order a baby with Lin-Manuel Miranda’s imagination or Usain Bolt’s speed?

News that an international team of scientists in Oregon [had successfully modified the DNA of human embryos](#) has renewed apprehensions that babies will one day be “designed.” But there are good reasons to think that these fears are closer to science fiction than they are to science.

Here is what the researchers did: repair a single gene mutation on a single gene, a defect known to cause — by its lonesome — a serious, sometimes fatal, heart disease.

Here is what science is highly unlikely to be able to do: genetically predestine a child’s Ivy League acceptance letter, front-load a kid with Stephen Colbert’s one-liners, or bake Beyonce’s vocal range into a baby.

That’s because none of those talents arise from a single gene mutation, or even from an easily identifiable number of genes. Most human traits are nowhere near that simple.

“Right now, we know nothing about genetic enhancement,” said Hank Greely, director of the Center for Law and the Biosciences at Stanford. “We’re never going to be able to say, honestly, ‘This embryo looks like a 1550 on the two-part SAT.’”

Even with an apparently straightforward physical characteristic like height, genetic manipulation would be a tall order. Some scientists estimate height is influenced by as many as [93,000 genetic variations](#). A [recent study identified 697](#) of them.

“You might be able to do it with something like eye color,” said Robin Lovell-Badge, a professor of genetics and embryology at the Francis Crick Institute in London.

But “if people are worried about designer babies, they’re normally thinking of doing special — different things than the normal genetic stuff.”

The gene-modification process used in the new study also turns out to be somewhat restrictive. After researchers snipped the harmful mutation from the male gene, it copied the healthy sequence from that spot on the female gene.

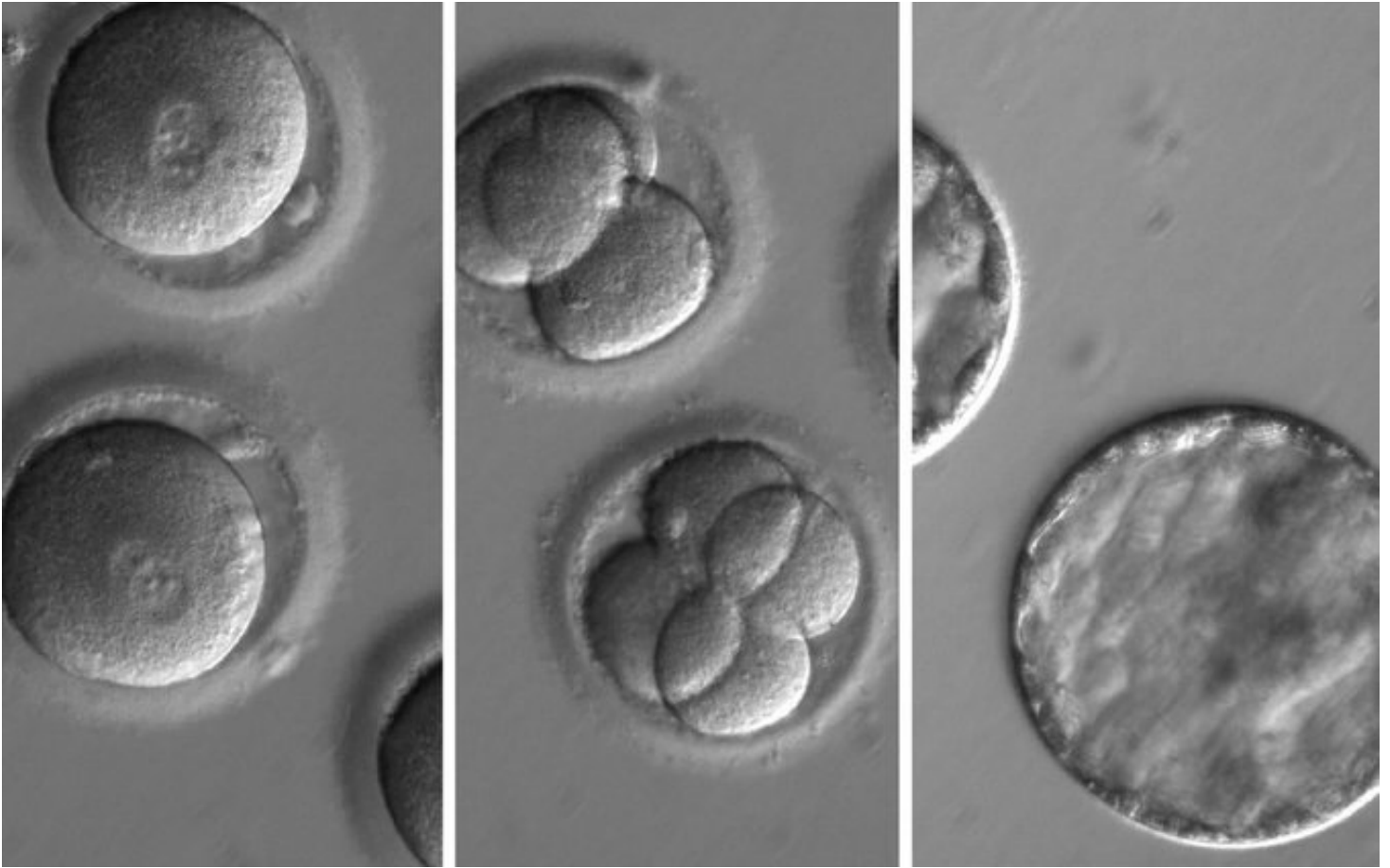
That was a surprise to the scientists, who had inserted a DNA template into the embryo, expecting the gene to copy that sequence into the snipped spot, as occurs with gene editing in other body cells. But the embryonic genome ignored that template, suggesting that to repair a mutation on one parent’s gene in an embryo, a healthy DNA sequence from the other parent is required.

“If you can’t introduce a template, then you can’t do anything wild,” Dr. Lovell-Badge said. “This doesn’t really help you make designer babies.”

Talents and traits aren’t the only thing that are genetically complex. So are most physical diseases and psychiatric disorders. The genetic message is not carried in a 140-character tweet — it resembles a shelf full of books with chapters, subsections and footnotes.

So embryonic editing is unlikely to prevent most medical problems.

But about 10,000 medical conditions are linked to specific mutations, including Huntington’s disease, cancers caused by BRCA genes, Tay-Sachs disease, cystic fibrosis, sickle cell anemia, and some cases of early-onset Alzheimer’s. Repairing the responsible mutations in theory could eradicate these diseases from the so-called germline, the genetic material passed from one generation to the next. No future family members would inherit them.



A composite image showing the development of embryos after injection of a gene-correcting enzyme and sperm from a donor with a genetic mutation known to cause hypertrophic cardiomyopathy. Credit Oregon Health & Science University

But testing editing approaches on each mutation will require scientists to find the right genetic signpost, often an RNA molecule, to guide the gene-snipping tool.

In the study reported this week, it took 10 tries to find the right RNA, said Juan Carlos Izpisua Belmonte, a co-author and geneticist at the Salk Institute.

Dr. Greely noted that while scientists work to get human embryonic editing ready for clinical trials (currently illegal in the United States and many countries), alternate medical treatments for these diseases might be developed. They may be simpler and cheaper.

“How good one technique is depends on how good the alternatives are, and there may be alternatives,” he said.

The authors of the new study do not dismiss ethical implications of their work. In fact, Dr. Belmonte served on a committee of the National Academies of Science, Engineering and Medicine that in February [endorsed](#) research into gene editing of human embryos, but only to prevent serious diseases and conditions, and as a last resort.

“In theory this could lead to the kind of intervention which, of course, I’m totally against,” said Dr. Belmonte. “The possibility of moving forward not to create or prevent disease but rather to perform gene enhancement in humans.”

For example, soon “we will know more and more about genes that can increase your muscle activity,” he said. The hormone EPO, which some athletes have been disciplined for taking, “is produced by a gene, so you could in theory engineer yourself to produce more EPO.”



Researchers studying in vitro fertilization in Cambridge, England in 1969. Some of the concerns surrounding gene editing echo concerns in previous decades about in vitro fertilization. Credit Central Press, via Getty Images

That is the kind of genetic engineering that raises alarm.

“Allowing any form of human germline modification leaves the way open for all kinds — especially when fertility clinics start offering ‘genetic upgrades’ to those able to afford them,” Marcy Darnovsky, executive director of the Center for Genetics and Society, said in a statement. “We could all too easily find ourselves in a world where some people’s children are considered biologically superior to the rest of us.”

Scientists and ethicists share the concerns about access. “Any intervention that goes to the clinic should be for everyone,” Dr. Belmonte said. “It shouldn’t create inequities in society.”

Unequal access is, of course, a question that arises with almost any new medical intervention, and already disparities deprive too many people of needed treatments.

But there is a flip side to ethical arguments against embryo editing.

“I personally feel we are duty bound to explore what the technology can do in a safe, reliable manner to help people,” Dr. Lovell-Badge said. “If you have a way to help families not have a diseased child, then it would be unethical not to do it.”

Genetic engineering doesn’t have to be an all or nothing proposition, some scientists and ethicists say. There is a middle ground to stake out with laws, regulation and oversight.

For example, Dr. Lovell-Badge said, Britain highly regulates pre-implantation genetic diagnosis, in which a couple’s embryos are screened for certain harmful mutations so that only healthy ones are implanted in the woman’s womb.

“They allow sensible things to be done, and they don’t allow non-sensible things,” he said. “And every single embryo is accounted for. If someone tries to do something they shouldn’t have done, they will find out, and the penalties for breaking the law are quite severe.”

According to a 2015 [article in the journal Nature](#), a number of countries, including the United States, restrict or ban genetic modification of human embryos.

Other countries, like China, have guidelines — but not laws — banning or restricting clinical use, the article noted. Chinese researchers have conducted the only previously published gene editing experiments on human embryos, which were much less successful.

In the future, will there be nations that allow fertility clinics to promise babies with genetically engineered perfect pitch or .400 batting averages? It’s not impossible. Even now, some clinics in the United States and elsewhere offer unproven [stem cell](#) therapies, [sometimes with disastrous consequences](#).

But R. Alta Charo, a bioethicist at University of Wisconsin-Madison, who co-led the national committee on human embryo editing, said historically ethical overreach with reproductive technology has been limited.

Procedures like I.V.F. are arduous and expensive, and many people want children to closely resemble themselves and their partners. They are likely to tinker with genes only if other alternatives are impractical or impossible.

“You hear people talking about how this will make us treat children as commodities and make people more intolerant of people with disabilities and lead to eugenics and all that,” she said.

“While I appreciate the fear, I think we need to realize that with every technology we have had these fears, and they haven’t been realized.”

Nicholas Wade contributed reporting from New York.

A version of this news analysis appears in print on August 5, 2017, on Page A14 of the New York edition with the headline: ‘Designer Babies’ Still Seem Unlikely.

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