

Personal genomics and gene editing revolutions beg for global regulatory rethink

Under current regulations, location determines the changes we can make to human genomes and the degree to which we can sequence them. While it may seem like there is some ethical middle ground to which all countries would naturally converge, when one looks at the specifics, that is certainly not the case.

In the United States, we allow screening of embryos for sex, and are comfortable letting parents pick gender before implantation. [American parents seem to pick girls more, citing health concerns](#). In India and China, it's unlawful to find out the sex of an embryo because parents historically selected male children out of preference.

The United Kingdom has gone beyond the question of screening and is now undertaking consideration of so-called "[three parent babies](#)." In reality, this is IVF using a two eggs, one that contains the nuclear DNA of a child's mother and a donor egg that contains mitochondrial DNA from a second woman. There are some extremely rare and severe genetic disorders affecting mitochondria, the energy generators of all our bodies' cells. Using donor mitochondria allows women with these diseases to have children. Critics say the use of donor genetic material in the creation of an embryo is unethical.

And here is where it starts to get complicated because [genetic editing is going far beyond donor mitochondria and fast](#). We can already readily alter the genomes of organisms for experimentation and agriculture in the lab. We use the technologies to create food and medication. But there is little to stop us from turning that capability to editing our human genomes likely beginning with single-gene diseases like cystic fibrosis, then moving on to more complicated poly-genetic disorders and potentiality traits, like intelligence.

And without an international regulatory framework, [will culture-specific norms also guide what is permissible for editing human genomes asks Foreign Affairs Jamie Metz](#):

As the stakes increase, these types of differences will only be exacerbated. Although Christian-majority countries like the United States may join the Vatican and others in pushing for strong restrictions, and countries like Germany may have strong reservations for historical reasons, others, such as China and Korea, whose worldview is based less on the concept of a divine plan, will continue to be more comfortable moving forward with human genetic engineering, as polling data has shown.

Metz uses Chinese company BGI as an example. [The company's goal is to identify genes associated with extremely IQ, then offer technologies to parents who want to make sure their potential children have them](#). So far, the [genetics of intelligence has been a difficult problem](#) to work out. But there is the potential this will happen within decades. And, once these edits enter the gene pool, they will be heritable Metz notes, [creating generations of higher IQ individuals](#):

It doesn't take a gene-ius to realize that if China started enhancing its population and the

United States did not, there could be serious competitive repercussions. That doesn't mean that international competitive pressures would force societies to take up genetic enhancement against their will, just that those who don't enhance, like those who do, will need to face the consequences.

In the past, I've considered the discrepancies that the relatively high-cost of human embryonic genetic engineering would create within a society, likely falling on wealth and class lines and furthering societies' inequality. But Metz's point brings up the very real possibility of huge shifts in the balance of world power between first adopter societies and reluctant followers. The United Nations has a preliminary and vague guidelines for use of human genetic technologies that center around 'protecting the dignity of the genome', but it is already outdated.

Based on the pace that these technologies are coming on line, [the time to think about the international impacts is now](#), Metz says:

While this issue may seem far off to some and there are still serious scientific hurdles to be overcome, it is approaching far faster than most people think. Maybe we have five years to get serious, maybe ten. But given the velocity of scientific progress, we don't have 20... Although shorter-term issues such as terrorism and regional crises dominate today's headlines, the ongoing revolution in human genetics will ultimately prove far more significant to our future. It deserves much more attention than we are affording it currently and a global process that can, over time, help us avoid dangerous conflict and guide us in a positive direction.

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Additional Resources:

- [Disruptive genomics: Is China's BGI the epicenter of the world's biotech revolution?](#) Genetic Literacy Project
- [Call it what it is: Mitochondrial replacement does not a three-parent baby make](#), Genetic Literacy Project
- [Three parent baby debate: FDA ponders mitochondrial manipulation and, perhaps, germline modification too](#), Genetic Literacy Project