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**Towards Realism about Genetic Enhancement**

In 2018, the first babies with edited DNA – Lulu and Nana – were born in China, under the auspices of now-notorious scientist He Jiankui. The experiment has been widely condemned as unethical on a number of grounds, including risk, lack of necessity, poor consent and absence of oversight.(Dyer 2018) Though the case is not mentioned in his article, Sparrow raises an interesting new question about the procedure: are Lulu and Nana bound to become yesterday’s children? (Sparrow 2019) The purported modification arguably constitutes an enhancement, as their genes were edited contain an immunity to HIV normally found only very rarely in the general population. But the process was relatively crude, and will almost certainly be surpassed in terms of efficacy if scientific progress in gene editing continues. If genetic enhancement were to greatly improve and become widespread in a few generations, Lulu and Nana might when they grow older find their edited genes obsolete – causing, as Sparrow worries, issues of self-worth, social discrimination and being treated as a product whose value is surpassed by the next generation’s new improvements.

However, those are by Sparrow’s own account only serious concerns if genetic enhancements greatly improve and are widely promulgated at a rapid pace. Sparrow does not himself argue that the pace will indeed be rapid (and at several footnotes highlights that he is in fact skeptical that there will be rapid progress). Rather, he is meeting futurist proponents of enhancement where they are – pointing out a problem with their imagined future of rapid genetic improvements.

But if by contrast genetic enhancements progress at a slow, measured pace, successive generations would not be clearly demarcated in terms of genetic quality. Differences would be too slight to merit stratification, and not much of our self-conception would hinge on the relatively small differences between generations.

So which imagined future is the most probable? Here, I would suggest that the slow and steady picture (if genetic enhancement occurs at all) is much more realistic, in light of existing genetic research and the history of genetic progress. This does not completely obviate Sparrow’s concerns about obsolescence, but suggests they may be relatively easily mitigated over time as society adapts to modest changes.

**Slow science**

Futurists are sometimes inclined to paint a dramatic, techno-utopian picture of the future of humanity if enhancement is permitted: one where we become masters of ourselves, able to substantially alter our fundamental nature – including genetics – in order to bring about a host of improvements to our minds and bodies. These in turn would lead to social improvements in terms of a more productive, healthy and well-organized society. (Kurzweil 2005; Harris 2007) These changes are sometimes characterized as so radical that they will engender a new state of being, that of the ‘trans-human’ or ‘post-human’. (Bostrom 2005)

But we should be very skeptical of this picture of our future, at least when it comes to genetic enhancement. In the first place, genetics research has a storied history of overhyping advances; while the sequencing of the human genome was meant to usher in a new, revolutionary era of genetically-informed medicine, (Collins 1999) translation to clinical practice has been mixed. (Hall 2010; Hollands et al. 2016) Like many technological advances, the hype does not live up to the hope – and we can expect the same from genetic enhancement.

A central challenge is the complexity of genetics, with traits like longevity and intelligence influenced by a confounding combination of thousands of genetic interactions. (Capri 2006; Dato et al. 2017). And the expression of those genes can be further influenced by the environment through epigenetic processes, while phenotypes are mediated by gene-environment interactions. (Petronis 2010)

The implications of this for genetic enhancement are sobering. For example, if intelligence is a result of a great confluence of genes and the environment, then single-target therapies like CRISPR will not make a great difference; one would have to target massive numbers of genes to have a large impact. In effect, we would have to translate the emerging, underdeveloped model of polygenic predictive testing, which analyzes the effects of large numbers of genetic variants to predict outcomes later in life, (Chatterjee et al. 2013) into what might be called ‘polygenic editing’, where we edit a large number of genes in one embryo in order to capture a substantial effect on the target trait.

Even assuming that polygenic editing becomes technically feasible, the scale and complexity of such interventions by nature will increase their uncertainty: we will not know until years later, as an adult grows up, whether a polygenic edit really succeeded at improving the target trait. And even then, alterations of such a large number of genes would almost certainly affect traits other than just the one targeted. Assessing the sum of all those effects, which could be quite variable, will require even more careful study and evaluation.

It is therefore unlikely that we will see great advances in particular traits across a five- or ten-year timeline, the timeline Sparrow outlines would lead to problems of obsolescence. We would not know whether one intervention was truly obsolete and superseded by future enhancements until decades later, after careful observation of affected individuals as adults. And even then, the complexity and interactions of multiple dimensions will make all-things-considered judgments of whether one enhancement regime is ‘better’ than another suspect.

**Marginal benefits & trade-offs**

That is not to say that genetic enhancement is just a pipe dream. Instead, we should be realists about enhancement. That is, we should accept that smaller, single-gene targets with marginal and relatively easily measured improvements are the most likely avenues of genetic enhancement in our lifetime. So we might, for example, after years and years of study offer targeted interventions that affect a very small percent of the variance in a child’s IQ. That is nothing to dismiss – every little bit counts, and there might be sufficient reason (if we become confident enough in safety and efficacy based on existing evidence) for some parents to pursue gene editing. But it is unlikely to trigger the broad societal concerns about obsolescence that Sparrow discusses.

Once evidence is accumulated, we will also have to face inevitable trade-offs in altering certain genes. While this is a serious problem as noted above for polygenic gene editing, even single gene targets can have multiple effects. Consider again the HIV-preventing gene He Jainkui targeted: it has also been thought to increase susceptibility to West Nile Virus, (Cyranoski 2018) highlighting that it is unlikely we will often get ‘something for nothing’ in gene editing.

In the case of preventing serious disease, the trade-offs may be somewhat straightforward. But for more subtle forms of enhancement, they will be subject to much more scrutiny and debate – undermining the possibility, raised by Sparrow, that society will come to judge individuals on a uniform ranking of the quality of their enhancements.

Of course, this all presumes that genetic enhancement would be pursued at all. Reactions to the He Jiankui scandal reveal that, despite many prominent bioethical defenses of genetic enhancement, in the broader scientific community there is not much appetite for pursuing genetic enhancement. This appears to be reflected in public polling as well. (Scheufele et al. 2017) So it may be that even marginal gains via genetic enhancement are prevented by social resistance.

Still, this discussion suggests something of a more moderate strategy for proponents of genetic enhancement: focus not on utopian science fiction visions of a perfected humanity, or even the idea of improvements in cognition or longevity by leaps and bounds, but instead on the reality of generating very small but meaningful improvements to a few select traits. This more realistic approach could also assuage fears of a dystopian, GATTACA-esque future as well as Sparrow’s concerns about the risk of genetic obsolescence.

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