The Ethics of Human Enhancement:

Key Concepts

Jonny Anomaly (University of Pennsylvania)

Tess Johnson (University of Oxford)

Abstract: The desire to transform ourselves into something better than we are now is as old as humanity. But the possibility of using biomedical technologies to enhance our capacities is new. In this chapter we will distinguish different forms of enhancement – for example, environmental, biochemical, and genetic interventions aimed at improving existing capacities. But we will focus on genetic enhancement. We will ask whether there is a clear or interesting difference between *treating* diseases and *enhancing* existing capacities. We will discuss reasons people may have to enhance their children, and moral concerns that opponents of enhancement have expressed, such as discrimination against disabled or unenhanced people in a world in which enhancement is common. Finally, we will address how to think about human enhancement from a social standpoint, where each person's choices to enhance themselves or their children has network effects on the human population as a whole.

Introduction

Human enhancement occurs when we improve an existing capacity, or create a new capacity, so that we can perform a task better, or our lives as a whole go better. Depending on how we define the term, enhancement can be intentional or accidental.[1] It can be environmental, biochemical, physical, technological, or genetic. And

---

[1] According to Allen Buchanan, "A biomedical enhancement is a deliberate intervention, applying biomedical science, which aims to improve an existing capacity that most or all normal human beings typically have, or to create a new capacity, by acting directly on the body or brain" (2011, p. 23). This is a useful general account. But whether we want to define enhancements as merely *attempts* to improve existing capacities, or as *successful attempts* at improvements will probably depend on the context of debate. We might also want to distinguish between improvements in performing a task that are incidental to the main goal of the enhancement, and those that are fully intended. For instance, the same change to a gene that can confer resistance to HIV (which me might term a 'genetic immunization' enhancement) can also improve memory function (Joy et al 2019). For alternative accounts of "enhancement" see Eric Juengst and Daniel Moseley (2023).

enhancement can be performed on ourselves or on our children in order to make our own life, our children's lives, or even other people's lives go better as a whole. After all, the traits our children have will have profound effects on the ways in which they interact with other people.

In many ways, the story of human progress has been a story of technologies that enhance our ability to survive and flourish. The advent of controlled fire allowed us to keep warm at night and to cook our food, which increased the absorption of nutrients. The invention of tools to build houses and the deliberate breeding of crops for food gave us more security. And the development of written language and mathematics allowed us to think more complex thoughts, control risks associated with climate, and develop the kinds of science and technology that modern humans rely on. These are all examples of altering our environment in ways that affect our bodies and minds. Cultural innovations change the way we think and how we live, and in many cases cultures and genes have co-evolved to alter our capacities, such as the evolution of increased finger dexterity and the connection between this biological change and the increased use of tools to aid in hunting, food preparation, and other areas of life.

Perhaps more importantly, different cultures select for different traits by sifting out bodies and brains that are poorly adapted to those cultures (Henrich 2015). Cultures that reward patience and planning, for example, tend to get more of those traits to the extent that patient and intelligent people have more surviving offspring, or perhaps in some cases, more reproductive opportunities (Clark 2009, Kuijpers et al 2022).

Modern debates over enhancement usually focus on *intentionally* altering ourselves through medicine, surgery, or genetic engineering. Humans have long used medicine to influence their health, and we have selected mates in ways that predictably affect the traits of our offspring. But the scientific revolution that began with the European Renaissance and culminated in modern genetics has enabled us to understand how heredity works, and to use this understanding to transform humanity. We will focus on genetic enhancement because of its ability to dramatically alter our capacities and its potential effects across generations. However, many of the same ethical issues also apply to non-genetic enhancements.

Genetic enhancement can come from selecting between alternative mates with the intention of influencing the traits of offspring, using a sperm or egg donor, or using in vitro fertilization (IVF) and preimplantation genetic testing (PGT) to select against diseases or in favor of desired traits. Another form of genetic enhancement involves gene editing using bacteria-derived enzymes (especially the CRISPR system), which is likely to become much more powerful, precise, and affordable in the current century (Jinek et al 2012). This type of genetic enhancement raises particularly pressing ethical questions, because the changes made are heritable, and so their effects can occur across multiple generations, and because of our limited knowledge about the consequences of attempting to modify our genes.

In the following sections, we explore some moral principles and economics concepts from the literature that can be useful in assessing ethical concerns with genetic enhancement. The principles and concepts include positional goods, treatment *vs* enhancement, consent and parental choice, eugenics, network effects, collectivism, and disability.

Positional Goods and Inequalities

Attempting to enhance ourselves or our children does not imply that we will be successful. Cosmetic surgery, for example, can fail to make you more attractive. And even when it succeeds, it doesn't guarantee that you will be happy. Moreover, even if cosmetic surgery succeeds at increasing your attractiveness, if everyone in your social circle gets a similar surgery, there may be no overall improvement in human welfare to the extent that beauty is a positional good. Positional goods, then, may be able to tell us how beneficial an enhancement is for an overall population, and therefore perhaps how morally desirable it is to pursue that enhancement.

A **positional good** is one whose value depends on how many other people have it, and how much of it they have. For example, height is a positional good in the sense that not everyone can be tall, and taller men (up to some threshold) are often considered more attractive to women than shorter men. Height may be a possible genetic enhancement that some parents would pursue for their children. An **all-purpose good** is one whose value does not depend on how it is distributed in a population. For example, a healthy heart is good for us regardless of whether other people's hearts work well. A healthy heart is an all-purpose good because no matter what specific goals we have, all of them depend on crucial parts of our body, including our heart, functioning well. Immunity to a prevalent and serious infectious disease is another example, and 'genetic immunization' as a form of genetic enhancement might be one way parents pursue this all-purpose good in the future.

Positional goods raise interesting ethical problems for enhancement because if one person spends money to increase a positionally valued trait in themselves or their children, this tends to make other people worse off. If only some people can afford to increase the height of their children, for example, this might be considered *unfair* to those who can't afford to enhance. Those whose parents can most afford the height enhancement will be those who receive the added advantage of out-competing those with poorer parents who cannot afford height enhancement in competition for partners. And if each of us selects embryos for taller kids, so that all of us spend resources on increasing the height of our children, the enhancement is collectively self-defeating—no one's position changes much in terms of their relative height.

Such scenarios are often described as a **prisoner's dilemma** or **public goods problem** in economics, or as a **collective action problem** in political science. These terms refer to cases in which it is rational for each of us to act in a way that makes all of us worse off. Such problems are difficult to solve without two things. The first is an ethical appraisal that looks at the collective, social or group-level effects of enhancement. The second is the application of enforceable rules, such as laws or social norms, that prohibit collectively self-defeating or harmful behavior. Examining how groups of people and whole societies may be affected by individuals' pursuit of certain genetic enhancements is a useful way to conduct a thorough ethical appraisal of a genetic enhancement. However, this does not necessarily mean that group-level harms or concerns with genetic enhancement justify the enforcement rules against an enhancement. It is always worth bearing in mind that the cure can be worse than the disease: laws restricting collectively self-defeating behavior might drive the emergence of black markets, leading to worse consequences of enhancement overall than if individuals were left free to pursue the enhancement independently.

When demand for a good is strong and black markets emerge to supply the good (in this case, genetic enhancement), goods are often more expensive and less reliable than they would be on an open market. Such restrictions can have some benefits, such as lowering the demand for certain kinds of enhancements by raising the price of accessing them. But restrictions can also produce new problems. For example, if we worry about inequalities that might emerge from unregulated access to expensive enhancements, banning such enhancements would likely ensure that only the wealthiest people who can pay a high black-market price (at home or abroad) could access them (Anomaly 2020). And this means inequalities would increase.
Whether such inequalities would be *unjust* depends on background moral assumptions about which there is reasonable disagreement (Buchanan 2013). For example, some scholars (Daar, 2017) advocate ameliorating unjust inequalities in access to enhancement technologies with state subsidies for those who can't afford them. Deciding which procedures to subsidize (or penalize) would probably require us to sort out which are likely to produce positive externalities – benefits for other people in a population – and which are likely to negative externalities. And this will depend in part on the choices other parents are expected to make. Whatever intuitions we have about using enhancement technologies, or regulating their use, the *predictable effects* of policies that influence access to such technologies should probably inform our moral view about the desirability of such policies. To the extent that both proponents and opponents of enhancement are committed to promoting desirable outcomes, they should pay attention to the kinds of incentives that policies create within and between countries for people to enhance their children. Such policies have the power to increase or decrease arms races associated with positional goods, and to make access to enhancement technologies more or less equal.

Treatment and Enhancement

Many people, especially those with strong religious views, are skeptical of genetic *enhancement* even if they endorse the use of genetic technology to treat disease. While there are big differences between attitudes toward enhancement in different countries, surveys suggest that in all countries people tend to be more wary about *enhancement* than they are about *treatment* (Funk et al 2020). If there is a morally relevant difference between treatment and enhancement, then this might inform how morally desirable pursuing enhancement is.

Take current ethical guidance surrounding uses of gene editing tools in the US. The American Medical Association's Code of Medical Ethics states that "genetic manipulation should be reserved for therapeutic purposes. Efforts to enhance 'desirable' characteristics or to 'improve' complex human traits are contrary to the ethical tradition of medicine" (2016, S7.3.6) There seems to be a strong line drawn between the ethical acceptability of gene editing to treat, and gene editing to enhance, despite the fact that both types of genetic manipulation might improve how well a person's life goes, or their capacity to perform a certain task.

One explanation for this attitude is that people tend to see the human body as the end result of a process in which nature or God has designed us in an optimal way. While there are obvious objections to this view, especially if we look at the world through a Darwinian lens (Powell and Buchanan 2011), there are also perfectly good reasons why some people may be skeptical about radical enhancement—that is, enhancement that significantly changes capacities which we see as core to our humanity (Buchanan 2011, chapter 5, Agar 2013). To the extent that there will always be unanticipated consequences when we try to alter complex traits, some people may oppose enhancement simply because they are risk averse, especially when we have incomplete information about the overall consequences of editing or selecting specific clusters of genes. Of course, present uncertainty would only merit caution, not a permanent fear of genetic enhancement. Moreover, since treating diseases also involves manipulating complex traits, it's unclear why most people fear enhancement more than treatment.

Nick Bostrom and Toby Ord (2005) developed the "reversal test" to probe our intuitions about enhancement. The point of the test is to distinguish when skepticism about enhancement is an irrational or unjustifiable bias toward the present, and when it might be justified. Before explaining the test, consider an example. Suppose a couple is using IVF and selecting from multiple embryos. Suppose also that the embryos are identical except that one has below average intellectual capacities ("intelligence" for short), one has average intelligence, and the other has above average intelligence. If they select the embryo with average intelligence, they are selecting *against* both high and low intelligence. Unless they can provide a reason for doing so, they seem to be exhibiting status quo bias. They might be motivated by a heuristic that leads them to believe average capacities are ideal for living a good human life. Or they might think deviations away from the average tend to be bad for human welfare (which could, of course, be true, given some uncertainty about what large changes will bring). Either way, they need a theory of why they are selecting in one direction or another.

According to Bostrom and Ord (2006, p. 664-5):

> When a proposal to change a certain parameter is thought to have bad overall consequences, consider a change to the parameter in the opposite direction. If this is also thought to have bad overall consequences, then the onus is on those who reach these conclusions to explain why our position cannot be improved through changes to this parameter. If they care unable to do so, then we have reason to suspect that they suffer from status quo bias.

The reversal test is supposed to apply to any trait that people might enhance, using genetic, environmental, or other interventions.

Some philosophers have argued that the treatment / enhancement distinction is neither clear, nor useful (Resnik 2000). On David Resnik's view, we must first settle on a conception of health and disease relative to which we consider a trait enhanced. That is, in order to establish a moral difference between treating a disease and enhancing a trait, we first need to establish a descriptive difference between health and disease. Suppose we stipulate that a "healthy" person has capacities that are normal for our species, whereas an unhealthy person lacks these capacities. As Resnik argues, if we think what is normal is healthy, and what is abnormal is unhealthy, we also seem committed to the view that having crooked teeth (which is normal for our species) is healthy, while a trait like extremely high intelligence (which is abnormal for our species) is unhealthy – a disease. On this view, lowering the intelligence of Einstein or von Neumann would be framed as treating a disease, and straightening crooked teeth would be an enhancement. But this seems counterintuitive, both descriptively in terms of what each intervention involves, and normatively, if we were to say it is morally better to treat the "disease" of abnormally high intelligence than to straighten someone's crooked teeth. At the very least, this is not what people have in mind when they say that treating a disease is morally benign but enhancement is morally suspicious.

Given the counterintuitive implications of the treatment / enhancement distinction, and the blurry line between the two categories, Resnik thinks we should not place too much weight on how we define heath and disease, or how we try to demarcate treatments and enhancements. Instead, he thinks, we should ask whether particular interventions are likely to promote the welfare of the person or respect the autonomy of the person who gets them. On this view, whether we classify an intervention as a treatment or enhancement, is not a morally interesting question.

Others disagree. For example, Norm Daniels (2000) argues that although the line between treatment and enhancement isn't always sharp, or morally significant, it is clear enough to use in the context of public policy. For example, he thinks that certain disabilities tend to have an especially deleterious effect on people's prospects, and that "fair equality of opportunity" requires that we prioritize eliminating these deprivations more than implementing enhancements when governments design a health care system. Daniels does not oppose enhancement and he does not think treatments of serious disabilities should always trump enhancements. Instead, Daniels argues that the treatment / enhancement distinction often tracks how scarce medical resources should be allocated in a government health care system in which allocation decisions must be made.

Consent and Choice

Let us say, then, that the treatment / enhancement distinction does not provide a knock-down argument against genetic enhancement. In that case, there is at least some room for discussing its ethical acceptability. We might be concerned with two levels of ethical decision-making. First, at the individual level, is it ethically acceptable for parents to undertake genetic enhancement for their future children? Second, is implementation of policies permitting access to genetic enhancements acceptable in a future society? In this section, we explore some useful concepts for examining individual couples' decisions.

While certain types of genetic enhancement might be performed in people who are already born, many of the modifications we might think of as enhancements create changes across whole systems of the body, and must occur when the future person is still an embryo. In a way, then, genetic enhancement is a reproductive choice, and can be an expression of parents' **reproductive autonomy.** Choices concerning whether to have a child and what kind of child to have might constitute fundamental rights. As a starting point, the claim that individuals have a prima facie right to reproduce seems uncontroversial. But what about possible extensions of that claim? If we support a positive right to reproduction, this might include ensuring that those who want to reproduce have access to services that would allow them to, including fertility services, and perhaps genetic selection or genetic enhancement.[2] Whether a state could be obliged to provide expensive services like this is a controversial question (Daar 2017).

A second consideration when it comes to individual cases of genetic enhancement is the future child's choice. Embryos are not decision-makers. That is, they cannot conceive of their own interests, make decisions, or communicate their decisions

---

[2] Depending on the theory, this right might also include state-supported access to abortion.

to consent to an enhancement. **Informed consent** is usually considered a core principle of medical ethics. When considering the genetic enhancement of people already alive, in many cases they may be able to give informed, voluntary consent. To secure the best interests of future people, however, we might rely on proxy consent. Proxy consent occurs when a representative accepts or refuses an intervention on behalf of someone who cannot.

One complication in this case is that it is unclear whether the embryo is a person who can be represented through another, or whether rather the parents simply have a decision to make that accords with what would be considered the usual standards of parental responsibility. This second view is more common in the literature, and has given rise to concepts like that proposed by Julian Savulescu. His principle of **procreative beneficence** holds that "couples should select the child, of the possible children they could have, who is expected to have the best life…based on the relevant, available information" (2001, p. 413). We might apply the principle to the genetic enhancement context, and say that parents should have a genetically enhanced child, if this would lead to them having a good life compared to the life that child might lead if born unenhanced. The implications of procreative beneficence in terms of whether parents should genetically enhance their future child in a particular way might then be balanced against their decisions based only on their own reproductive autonomy, where their reproductive desires and the best interests of their future child conflict.

Eugenics, network effects, and collectivism

With this section, we move on to assessing genetic enhancement at the group level. There are three particularly useful moral concepts in evaluating the pursuit of genetic enhancement: eugenics, network effects, and collectivism.

In one way, genetic enhancement might be considered a form of eugenics, with which we have past policy experience. While eugenics is often considered a loaded term, it has been employed more recently in the literature on enhancement in a neutral way (Veit et al 2021). 'Classical' or 'old' **eugenics** tended to focus on the welfare of populations, and historically some eugenic practices strayed from this goal and were implemented in unacceptable ways that have influenced how we view eugenics today. By contrast, 'liberal' eugenics in modern academic discussions of genetic enhancement tends to focus on individuals and their free pursuit of genetic changes that will improve their or their offspring's lives. However, these dividing lines are not always clear, and an exclusive focus on individual autonomy would be odd, since ethics tends to focus on obligations toward other people, including future people. Moreover, individual welfare is often a function of group traits, and the welfare of groups depends on the composition of the individuals who comprise them. While the idea behind liberal eugenics of considering the individual benefits of genetic changes is useful, to consider broader beneficial effects of genetic changes to an individual or population, we might want to employ another concept that captures the broader social effects of genetic changes to an individual or population.

To take a simple example, some proponents of cognitive enhancement emphasize that if only some people in a population were to enhance themselves or their children, the enhanced would likely develop technological breakthroughs that would benefit everyone, including the unenhanced (Bostrom and Sandberg, 2009). Others have argued that apart from improving material welfare, having more intelligent people in a population tends to have positive externalities – or **network effects** – because groups of smarter people tend to produce societies that are less corrupt and more cooperative than societies with a lower average IQ (Anomaly and Jones 2020).

Network effects occur when, as more people adopt a technology, the gains (or losses) to a group of people increase exponentially. Having a few smart or virtuous people in a population, for example, may be good. But the more such people there are in a population, the more gains there will be in terms of cooperation and innovation. Because our reproductive choices influence the welfare of many future people, not just our individual children, a narrow focus on individual obligations toward our children has seemed insufficient to many—both for individual decision-making concerning enhancement, and for developing ethically-informed policy. Allen Buchanan et al (2000, p. 210) observe that "the costs and benefits of having children are externalized in virtually all societies—that is, borne by others besides the parents (or children). The more this happens, the greater claim these others might make to have some say in, or control of, the costs imposed on them." Ethically informed policy may need to take these costs and benefits into account.

Turning to the parents' individual decision-making, we might build on the concept of procreative beneficence introduced above. Because procreative beneficence doesn't address how our own children might affect the welfare of other children, Thomas Douglas and Katrien Devolder coined a corresponding principle that includes the welfare of future people more broadly. According to **procreative altruism** "parents have a significant moral reason to select to select a child whose existence can be expected to contribute more to (or detract less from) the well-being of others than any alternative child they could have" (2013, p. 400). Perhaps, then, parents should only undertake genetic enhancement if it will help (or at least not hinder) others to secure their own wellbeing. Yet these principles are not incompatible. Enhancements might be available that both benefit the future child and others. These principles illustrate the ways in which proponents of enhancement think we should weigh the welfare of our own children against the ways in which other children will likely be affected by our children.

Ethical policymaking and ethical individual decision-making do not always align. Modern proponents of enhancement tend to reject the more coercive policies advocated by eugenicists. It would be going too far to force or require parents to undertake enhancement in order to provide the most benefit to other people, or have a child with a particularly high level of wellbeing. Yet, on an individual level, they still think about **moral obligations** that parents considering enhancement may have toward individuals *and* groups. For example, Chris Gyngell (2012) has discussed some ways in which we might owe future people as a whole a range of potential traits that are likely to result in humans surviving population-level catastrophes. Similarly, many philosophers have argued that we should morally enhance our children in ways that make future people flourish, and survive existential threats like extreme changes to the climate or pandemic diseases (Powell and Buchanan 2016, Persson and Savulescu 2017, Anomaly 2020, Crutchfield 2021).

The kind of ethical analysis that particularly focuses on this idea of enhancements that are collectively beneficial and might be implemented on the population-wide scale might be termed **collectivism** (Johnson, 2021). We might distinguish this approach from one that focuses primarily or purely on individual-level concerns and effects of genetic enhancement, termed **individualism.** Individualism risks not recognizing problems that come from enhancements that confer positional goods, or that cause negative externalities. Yet, to avoid going too far in the other direction, a collectivist analysis needs to consider the limits of burdens that can be imposed on individuals as part of fulfilling a moral obligation to benefit (or not harm) others through their pursuit of genetic enhancement.

Disability

One potential harm that might not be reasonably bearable and may be a consequence of human enhancement concerns the birth of disabled people. There are several different concerns here. They are not specific to human enhancement insofar as this is differentiated from therapeutic uses of gene editing, but they deserve consideration, nonetheless.

The first concern might be raised by those who are born disabled, despite their parents' best efforts (using embryo selection or gene editing) to have them born without that particular disability. Attempts to avoid disability are not always successful, and people born with a disability which makes their life go less well or which decreases their capacity to perform certain tasks may blame their parents for failing to prevent their disability. In other cases, parents may deliberately refrain from genetically enhancing their future child, similarly limiting their capacities. These points have been raised in connection to the choice whether to genetically select against disability (Purdy, 1996). Whilst it may be an expression of parents' reproductive autonomy or their values to have a child with a particular disability—say, if they are active members of Deaf communities— this benefit will in many cases be outweighed by the harms of disability for the child.

One common objection to this type of claim is that it rests on the wrong model of disability, a medical/functional model rather than a social one (Shakespeare, 2014, Chapter 2). While social models see disability as similar to illness, social models see the harms of disability as arising not from a physical impairment, but from the limitations of the environments in which disabled people live. If these environments were altered, so the argument goes, then disabled people would not experience harm from their disability, and so it is the environments that should be changed, rather than the people who are (or might otherwise be) born with impairments. A middle-ground approach adopts a welfarist stance, which neither assumes disabilities are harmful in the way illnesses are, nor that it is only the context surrounding disabilities that is harmful. On this view, each person's welfare is affected differently by a disability, and some disabilities will harm someone, whilst others may in fact benefit them (say, for a deaf person, by giving them more opportunity to learn and appreciate a sign language). In this sense, gene editing for certain disabilities for certain people may constitute an enhancement. However, given the difficulties of judging this case-by-case and in advance of the child being born, we think it is more often likely to be the case that a disability will not constitute an enhancement.

A final concern surrounding genetic enhancement and disability is the negative externalities of editing out disabilities for those currently living with them. This objection to enhancement has been called the 'expressivist objection', and it claims that editing against disabilities expresses disvalue of the lives of those living with a disability (Shakespeare, 2014, Chapter 6). The potential effects of reducing the number of people living with disabilities are important to consider, but the objection rests on a controversial foundation: that a disability is part of a person's identity, thus that eliminating disabilities expresses disvalue toward those identities. Where disability is a state and not a part of identity, this objection to pursuing enhancement may not apply.

Conclusion

Human enhancement is an old aspiration. But tools that will enable us to genetically enhance ourselves and our children in dramatic and long-lasting ways are new. These tools create exciting opportunities but also raise profound moral questions that can be clarified by invoking some core concepts from ethics and economics.

Bibliography

Agar, Nicholas. 2013. *Humanity's End: Why We Should Reject Radical Enhancement*. Cambridge, MA: MIT Press.

American Medical Association. 2016. Code of Medical Ethics Opinion 7.3.6, Research in Gene Therapy & Genetic Engineering. In *AMA Code of Medical Ethics*, < https://www.ama-assn.org/delivering-care/ethics/research-gene-therapy-genetic-engineering>, accessed 20 May, 2022.

Anomaly, Jonathan. (2020). *Creating Future People*: *The Ethics of Genetic Enhancement*. London, UK: Routledge Press.

Anomaly, Jonathan and Garett Jones. (2020). Cognitive Enhancement and Network Effects. *Philosophia* 48: 1753-1768.

Bostrom, Nick and Anders Sandberg. 2009. Cognitive Enhancement: Methods, Ethics, Regulatory Challenges. *Science and Engineering Ethics* 15(3): 311-341.

Bostrom, Nick and Toby Ord. 2005. The Reversal Test: Eliminating Status Quo Bias in Ethics. *Ethics* 116: 656-679.

Buchanan, Allen. 2011. *Beyond Humanity*. Oxford, UK: Oxford University Press.

Buchanan, Allen. 2009. Moral Status and Human Enhancement. *Philosophy & Public Affairs* 37(4): 346-381.

Buchanan, Allen, Dan Brock, Norm Daniels, and Dan Wikler. 2000. *From Chance to Choice: Genetics and Justice*. Cambridge, UK: Cambridge University Press.

Clark, Gregory. 2009. *A Farwell to Alms: A Brief Economic History of the World*. Princeton, NJ: Princeton University Press.

Crew, Fae et al. 1939. Social Biology and Population Improvement. *Nature* 144: 521-522.

Crutchfield, Parker. 2021. *Moral Enhancement and the Public Good*. London, UK: Routledge.

Daar, Judith. 2017. *The New Eugenics: Selective Breeding in an Era of Reproductive Technologies*. Yale University Press.

Daniels, Norm. 2000. Normal Functioning and the Treatment / Enhancement Distinction. *Cambridge Quarterly of Healthcare Ethics* 9(3): 309-322.

Darwin, Charles. 1874. *The Descent of Man and Selection in Relation to Sex*. 2nd ed. John Murray Publishing.

Douglas, Thomas and Katrien Devolder. 2013. Procreative Altruism. *Journal of Medicine and Philosophy* 38: 400-419.

Funk, Cary et al. 2020. Biotechnology Research Viewed with Caution Globally, But Most Support Gene Editing of Babies to Treat Disease. Pew Research Center. https://www.pewresearch.org/science/2020/12/10/biotechnology-research-viewed-with-caution-globally-but-most-support-gene-editing-for-babies-to-treat-disease/. Accessed 4/15/2022.

Gyngell, Chris. 2012. Enhancing the Species: Genetic Engineering Technologies and Human Persistence. *Philosophy and Technology* 25(4): 495-512.

Gyngell, Chris and Thomas Douglas. 2015. Stocking the Genetic Supermarket. *Bioethics* 29(4): 241-250.

He, Jiankui. 2018. About Lulu and Nana: Twin Girls Born Healthy After Gene Surgery as Single-Cell Embryos. *Youtube* https://www.youtube.com/watch?v=th0vnOmFltc&app=desktop, accessed 20 May, 2022.

Henrich, Joseph. 2015. *The Secret of our Success*. Princeton, NJ: Princeton University Press.

Jinek, Martin; Chylinski, Krzysztof; Fonfara, Ines; Hauer, Michael; Doudna, Jennifer; Charpentier, Emmanuelle. 2012. A programmable Dual-RNA Guided DNA Endonuclease in Adaptive Bacterial Immunity. *Science* **337** (6096): 816–821.

Johnson, Tess. 2021. Enhancing the Collectivist Critique: Accounts of the Human Enhancement Debate. *Medicine, Health Care, and Philosophy* 24: 721–730.

Joy, Mary et al. 2019. CCR5 is a Therapeutic Target for Recovery after Stroke and Traumatic Brain Injury. *Cell* 176: 1143–1157.

Juengst, Eric and Dan Moseley. 2023. Human Enhancement. The Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/entries/enhancement/.

Kujipers, Yunus et al. 2022. Evolutionary Trajectory of Complex Traits in European Populations of Modern Humans. *Frontiers in Genetics*, 13, article 833190. https://www.frontiersin.org/articles/10.3389/fgene.2022.833190/full

Persson, Ingmar and Julian Savulescu. 2017. Moral Hard-Wiring and Moral Enhancement. *Bioethics* 31(4): 286-295.

Powell, Russell and Allen Buchanan. 2011. Breaking Evolution's Chains: The Prospect of Deliberate Genetic Modification. *Journal of Medicine and Philosophy* 36: 6-27.

Powell, Russell and Allen Buchanan. 2016. The Evolution of Moral Enhancement. In *The Ethics of Human Enhancement: Understanding the Debate*. Steven Clarke and Julian Savulescu (editors). Oxford, UK: Oxford University Press.

Purdy, Laura. 1996. Loving Future People. In *Reproducing Persons: Issues in Feminist Bioethics.* Ithaka, NY: Cornell University Press.

Resnik, David. 2000. The Moral Significance of the Therapy-Enhancement Distinction. *Cambridge Quarterly of Healthcare Ethics* 9: 365-367.

Savulescu, Julian. Procreative Beneficence: Why We Should Select the Best Children. *Bioethics* 15: 413-426.

Savulescu, Julian and Ruud ter Muelen and Guy Kahane. 2011. *Enhancing Human Capabilities*. London, UK: Wiley-Blackwell.

Shakespeare, Tom. 2014. *Disability Rights and Wrongs Revisited.* New York, NY: Routledge.

Veit, Walter et al. 2021. Can ‘Eugenics’ Be Defended? *Monash Bioethics Review* 39: 60-67.