SUMMARY

HACKING DARWIN

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Summary of “Hacking Darwin” by Jamie Metzl

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How technology can help us to hack our genetic makeup.

Introduction

What do you know about genetic engineering? For some, the phrase calls to mind images of test-tube babies and sci-fi-like theories about manipulating genetics to such a degree that we can choose our baby's eye color or even their IQ before they're even born. Others might associate genetic engineering with fictional travesties like Jurassic Park or with helpful advances in technology, like using IVF to help those who are desperate to become parents. Therefore, it is unsurprising that the opinions of genetic engineering might be as varied as the theories about what it really does.

Some people might equate it with the rise of a hopeful future, the dawn of a new age of modern technology. Others, by contrast, might regard it as being problematic and approach the possibility with trepidation. And as is the case with most hotly debated topics, the truth lies somewhere in-between. So, over the course of this summary, we're going to unlock the science behind what many are calling "the genetic revolution." We'll learn what genetic engineering really is and how it works and we'll consider the ethical and political issues which surround this possibility.

Natural Selection Meets Artificial Intelligence

We all know about natural selection, right? Whether you agree with Darwin's theory or not, we've all learned about it throughout our entire educational careers. We know about survival of the fittest and how organisms evolve and adapt traits that will further the survival of our species. We know about DNA and our genetic code and the fact that every single human has a set of unique fingerprints. Even if our everyday knowledge of genetics is mostly informed by episodes of the latest crime shows, these concepts are familiar to us in one form or another. And because most of us aren't interested in a refresher course from high-school biology, we won't go into too much detail or expect you to remember everything you've ever learned about genetics. But here's what you do need to know.

Ever since Darwin published his theory of evolution, the Darwinian model has been our foundation for everything we know about genetics, natural selection, and evolution. This was the fundamental principle we used as our starting point when scientists first uncovered the secrets of our genetic code. Through this discovery, we learned that our genetic code is comprised of deoxyribonucleic acid (what we know as DNA) and those molecules form a specific sequence. We also know that those molecules are formed of four different types of nucleotides and that each pair of nucleotides contains one molecule from our mother and one molecule from our father. Put simply, DNA is inherited and those molecules come together to form our individual genetic codes.

Because we know our DNA is inherited and because we've operated on the Darwinian principle that our genetic code is passed from parent to offspring to preserve the survival of their species, we've assumed that the genetic code can't be changed. This assumption occurred partly because geneticists have had a long and arduous journey in their quest to understand the genetic code. For example, even though DNA was discovered in the early 1950s, it wasn't until the late 1970s that scientists

Frederick Sanger and Alan Coulson learned how to read the human genetic code and interpret what it meant. From that point, it was another twenty years before the Human Genome Project would be launched in the 1970s, founded with the sole aim of investigating our genetic code and uncovering new insights in the field of genome sequencing.

Fortunately however, we've come a long way since the 1990s. Today, we know more about genetics than the founding fathers of evolution could ever have dreamed! We know, for example, that certain conditions like Down Syndrome occur because of genetic mutations. We also understand that singular mutations in a gene can determine things like eye color. And we know that we can use genetics to determine whether you're a carrier for a certain disease and if you'll pass that genetic mutation on to your child. But until now, we've never realized that it might be possible to hack and alter that genetic code by fusing science with technology-- specifically, artificial intelligence.

So, what does that look like in practice? Many companies like Google have partnered with Chinese companies that specialize in genetics-- like the contract genomic organization WuXiNextCODE-- to learn how we can employ AI in our study of genetics. One program currently being utilized by these organizations is a type of software that uses AI to analyze patterns in genetic sequencing. So, while that doesn't mean that we're trying to fuse humans with robots (yet!) at the moment, these programs are seeking to enhance our understanding by speeding up the process. If we can develop faster ways to further our knowledge of genetic sequencing, we can arrive at new discoveries in a shorter amount of time and create new scientific breakthroughs that will make the world a better place.

AI and Embryo Screening

At first glance, that might sound like pretty advanced technology, but the truth is that we're only in the infancy stages of our attempt to integrate AI with genome sequencing. So, although we're not yet able to screen embryos for certain traits or predict that your child will grow up to be the next Mozart, we are in the process of developing that technology. At the moment, our advances in reproductive technology aren't in the realm of sci-fi novels, but they're still capable of orchestrating ordinary miracles. For example, our current technology allows us to screen for the possibility of certain genetic traits that will lead to a lifetime of pain and suffering.

You might be familiar with an episode of Law & Order: Special Victims Unit which highlighted a rare and painful condition called Tay-Sachs disease. Tay-Sachs is a recessive genetic disorder that occurs when two parents both possess the recessive mutated gene. As is the case with most rare genetic disorders, Tay-Sachs is primarily found in people with certain ancestry; in this case, it happens to be Ashkenazi Jews. Although it is very rare and affects a shocking four percent of the Ashkenazi Jewish population, the effects of this mutation are horrific. Tay-Sachs manifests as a slow destruction of nerve cells in the brain and spinal cord. It is most commonly diagnosed when a patient is between the ages of 3 and 6 months old because parents will notice when babies suddenly lose abilities they had recently acquired, like being able to sit up or crawl. Following the onset, Tay-Sachs progresses quickly, destroying the sufferer's ability to see, hear, swallow, or move. In many cases, the afflicted person might also suffer from severe seizures or struggle to breathe at all. Death almost always occurs before the child reaches the age of four.

Unsurprisingly, no parent wants their child to suffer that way. No one wants to bring a baby into the world only to watch it die a slow and painful death over the course of its very young life. That's why it's amazing that advances in genetic screening have helped us to identify parents who are potential carriers and encourage them to avoid reproducing with other

carriers. And since scientists learned how to screen for Tay-Sachs in 1985, it's been almost completely eliminated from the Ashkenazi Jewish community, ensuring that the chances of any child suffering in this manner are extremely unlikely. That's the power -- and the beauty-- of genetic screening!

But with time and additional advances in technology, we'll be able to achieve far more. The author posits that within ten years, we'll possess the capability to learn new things about our embryos or even identify privileged traits. And although it's easy to see how this can be a problematic and heavily politicized issue, we can't deny the potential benefits of screening embryos for debilitating diseases or their potential susceptibility to cancer. And with regard to the potentially problematic options, it's unlikely that we would ever be able to screen an embryo so thoroughly as to have the option of designing a "perfect" child in the same way we might design a Facebook avatar. Instead, rather than possessing the ability to say, "Do you want a smart child? A tall child? A child with blue eyes?" we might soon be able to see a percentage indicating their future traits. For example, we might be able to assess with reasonable certainty that your child is 70% likely to be tall.

“Natural” Conception

What’s your stance on “natural” living? Do you prefer to live as sustainably as possible, eschewing drugs, vaccinations, and products that are heavily processed? Are you in favor of herbal remedies and green living and living your life as healthily and organically as possible? If so, you’re not alone, and your viewpoint is great for the environment! But the desire to live a “natural” lifestyle can often clash with advances in new technology, especially when it comes to genetics. For example, many people might balk at the idea of IVF because they’d prefer to conceive a child “naturally” instead. By this, of course, people mean that someone with a vagina becomes pregnant through intercourse with someone who has a penis. As a result, an embryo is fertilized and carried to term in that person’s body. Many people are suspicious of reproductive options which do not follow this method and therefore believe that this option is only viable for those who are older or infertile.

But that’s not necessarily the case! Although IVF births currently account for only 1.5% of all births in the United States, the author posits that by 2045, IVF will actually replace “natural” conception as the primary method! That might sound mind-boggling, so let’s pause here to consider a few reasons why that might be the case and why our current mode of living isn’t quite as “natural” or organic as we might like to think it is. For example, unless you fall under the highly controversial anti-vaxxer category, pretty much every person reading this will have had a vaccine at some point in their life. In fact, most of us will have faithfully taken our flu shot every year. Did our bodies come into the world with vaccines? Of course not. Our ability to safeguard against diseases like polio, measles, and the flu are successes of modern science and they were created in a lab. Yet, even if we prefer a more organic lifestyle, we cheerfully opt to protect our bodies against avoidable diseases.

The author argues that we might soon do the same when it comes to genetic screening. For example, if we develop the ability to screen embryos for

diseases like cancer, diabetes, and other harmful genetic conditions like Tay-Sachs, it stands to reason that-- if given the choice-- we would prefer to choose embryos that won't suffer painful conditions. If these diseases therefore become avoidable, genetic screening and IVF would soon be viewed as the most practical and humane option; "natural" conception might come to be viewed as risky, unsanitary, and possibly even cruel. After all, just think about the stigma and public backlash that results whenever someone says they refuse to vaccinate their child. The same might soon be true of those who want to conceive the "natural" way!

But of course, that all sounds very easy and straightforward; the truth is that we'll face a lot of complications on the road to mainstreaming IVF. One unsurprising roadblock is funding. At the moment in the United States, a single IVF procedure carries a price tag that ranges between $12,000 and $30,000. If you've ever known someone who has attempted to conceive through IVF, you also know that most people go bankrupt through the process. The attempt to mainstream this technology therefore comes with a sort of catch-22: in order to make this option widely available to the public, it would have to be more affordable. But in order for government funding to make it more accessible, it would have to be a more popular option. This, of course, creates some unique barriers that would have to be addressed before IVF could be considered a viable popular option.

There is hope, however. For example, many progressive companies such as Apple and Google have invested in the quest for equal reproductive rights and are subsidizing the costs for female employees who wish to extract and freeze their eggs. Because this is a wonderful option that enhances women's rights, expands female freedom, and furthers a woman's career options, it might be possible that this too would become commonplace as more employers might be willing to foot the bill for this procedure.

Ethical Questions Which Surround Genetic Engineering

But of course, the future isn't all hope and shining possibilities; a number of ethical questions remain which we have to answer in order to achieve successful and ethical genetic engineering. For example, the use of performance-enhancing drugs is hotly debated around the world. This is especially true when it comes to events like the Olympics, where countries such as Russia and China have been known to secretly boost their contenders' performance through steroids. This is, understandably, considered to be unethical, so it's no surprise that people might have concerns about genetically modified athletes being given an unfair competitive advantage.

This in turn raises questions about how we would regulate the use of genetic modification, especially in relation to sporting events. How would we confirm that someone's genes have been altered? How would we prove motive? What kind of regulations would need to be in place for sports to maintain any kind of hold on fairness and morality? All of these are questions that we can't fully answer yet, but they will present new problems when that technology becomes widely available. Another concern is how countries around the world would use their understanding of the human genome as a power grab.

For example, world powers such as China and Russia have already indicated a strong interest in making their nations the most powerful in the world and China is especially aggressive in its efforts to understand the human genome. Would the availability of enhanced technology spark a global genetic arms race in a quest to engineer a modified "superrace?" The author believes that this is certainly possible and this is one significant concern to bear in mind as we develop our understanding of the human genome and genetic modification. Similarly, we may also ask-- and wisely so-- if some world leaders will aim to use genetic modification for additional selfish reasons.

Although our purpose for “hacking” the genetic code should simply be to better humanity, like all good things, it’s possible for this power to be abused. Rather than using our advances to prevent cancer or painful diseases, it’s possible that people might use it to engineer a race of genetically modified warriors or a racist society which only privileges people with certain abilities or features. Because all of these unpleasant abilities are possible, our study of genetic modification comes with a variety of concerns that must be safely addressed before we can proceed.

Final Summary

Our understanding of the human genetic code has advanced tremendously through the years and today, we are on the cusp of exciting new technology. As we continue to advance in our study of the human genome and genetic modification, we have the opportunity to screen embryos for fatal and painful diseases and replace “natural” conception by making IVF the safer, healthier, and more affordable option. We may even be able to make exciting predictions about our future generations, like how tall they might be or whether they will be academically or athletically gifted. One thing is for certain-- the possibility for advancement in this area is infinite and we can achieve amazing things! But there are also a number of ethical concerns to be aware of and we must keep these in mind as we move forward so that we can use our understanding of genetics to engineer a healthy and safe future for humanity.