

**A Duty Ethics Analysis of the use of the CRISPR-Cas9 Gene Editing Technology on Twin Embryos in China, 2018**

STS Research Paper  
Presented to the Faculty of the  
School of Engineering and Applied Science  
University of Virginia

By

Nathan Tumperi

March 1, 2020

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Signed: \_\_\_\_\_

Approved: \_\_\_\_\_ Date \_\_\_\_\_  
Benjamin J. Laugelli, Assistant Professor, Department of Engineering and Society

## **Introduction**

In November of 2018, the world's first genetically modified embryos were born in China. Dr. He Jiankui had used the CRISPR-Cas9 device to genetically modify the embryos during an in vitro fertilization process (Rana & Fan, 2018). The CRISPR-Cas9 has achieved its capabilities to successfully edit human genes in recent years. This has resulted in several international summits to discuss how to safely move forward with the technology (Rufo & Ficorilli, 2019). These summits have not reached any concrete guidelines but have decided to leave it up to countries to regulate clinical trials with the technology (Cohen, 2019). It has been argued that Dr. Jiankui inappropriately coerced the couple to enroll into the study and did not explain the risks involved in genetic modification (Krimsky, 2019). Since the announcement in late 2018, the scientific community has been up in arms regarding the trial.

Many scholars have discussed the ethicality of Jiankui's actions with mentions of failure to follow protocol/abide to international agreements (Krimsky, 2019) and the potentially dangerous repercussions of passing down artificially modified genes for generations (Cohen, 2019). However, many of these scholars overlook the precedent that such actions set for the scientific community and the fundamental human rights that such a precedent can infringe upon. If these continue to be overlooked, the world may view the case of Dr. He Jiankui incorrectly. But more importantly, we will be unable to appropriately regulate the future use of the CRISPR-Cas9 technology in protecting unborn children and future generations.

I will evaluate Dr. Jiankui's actions through the lens of duty ethics in order to appropriately address these concerns. Specifically, I will argue that Dr. Jiankui did not fulfill his duty to abide by moral norms for three reasons. The first is that by employing the CRISPR-Cas9 device to genetically modify embryos, Jiankui failed to follow the categorical imperative of

following international scientific guidelines. The second reason is that Jiankui disobeyed the equality postulate introduced by Immanuel Kant by willfully endangering the lives of individuals with disregard for their equality as human beings (Poel & Royakkers, 2011). The third and final reason I will argue is that Jiankui failed to treat humanity in all cases as an end rather than a means to an end. I will explain how Jiankui blatantly manipulates the rationality of others in order to achieve his own scientific honor.

## **Literature Review**

Many researchers have discussed the morality of the CRISPR-Cas9 technology and of Dr. He Jiankui's actions in editing the genes of twins. Rufo and Ficorilli discuss valuable background to the case and the numerous international summits relating to regulations of recombinant DNA and CRISPR-Cas9 practice. These summits' failure to acquire advice from non-expert stakeholders has led to their inability to fulfill their moral duty to protect the public, leaving ethical decisions up to individual doctors such as He Jiankui. Researchers have failed to consider how the international summits laid a foundation for Dr. He Jiankui and his failure to act in the best interest of the public. I will extend this analysis to consider Jiankui's lack of moral responsibility as defined by duty ethics.

Fabrizio Rufo and Antonella Ficorilli discuss the case of recombinant DNA in the 1970's and the advancement of the CRISPR-Cas9 device in genetic alteration capabilities. Recombinant DNA is the practice of combining DNA from separate organisms and injecting them into a host to adopt these updated genes. The CRISPR-Cas9 has jumped to the forefront of genetic modifications in recent years due to its cheaper, easier capabilities to act as DNA "scissors" in cutting out and adding in new DNA. Rufo and Ficorilli discuss the concerns and regulations of

both cases and compare and contrast how the former has influenced the discussions surrounding the CRISPR-Cas9 (Rufo & Ficorilli, 2019).

Rufo and Ficorilli suggest a shift in how we address actions and interventions in science: “shifting from a top-down model of knowledge towards a form of public debate and a co-production model.” In the case of recombinant DNA, they explain how the Asilomar conference of 1973 led to a publication holding scientists accountable for risky laboratory behaviors and outlined experiments that must be halted in order to ensure public/environmental safety. This generated interest from the public on the issue and led to more conferences which sought to allow “scientific work [to] be undertaken with minimum risks for workers in laboratories, for citizens in general, and for the animal and plant species that share our ecosystem.” The morality and safety of recombinant DNA practices was no longer confined to the discussions of professionals in the field. One problem that Rufo and Ficorilli identified was the scientists’ exclusion of “a range of ethical-social issues” resulting from the failure to collect opinions from non-experts who are valuable stakeholders in the technology. The summits have prioritized “safety and effectiveness compared with the other dimensions involved, such as economic issues, ethical and cultural values, [and] social relations” (Rufo & Ficorilli, 2019).

The prioritization of safety and effectiveness in the regulation of these technologies has led to scientists such as Dr. He Jiankui to take matters into their own hands. Without the proper consideration of ethical values, doctors and the public will continue to view the CRISPR-Cas9 technology as purely a safety problem. Members of the summits that Rufo and Ficorilli describe fail to fulfill their duty to consider the types of moral norms created with regulations for scientists in the field of genetic editing.

Jon Cohen, in his piece *Inside the Circle of Trust*, explores in detail the events leading up to and after the controversial trial performed by Dr. He Jiankui. Through interviews with many friends and scientists close to He, Cohen uncovers the warnings He received of the implications and the need for ethical considerations before proceeding with the trial. In one interview, Cohen writes:

“Mello, who had co-discovered the gene-silencing process called RNA interference, thought that modifying *CCR5* did not address ‘a true unmet medical need’ and warned He that the experiment was ‘risking the health of the child you are editing.’” (Cohen, 2019)

Another scientist close to He revealed his thoughts from January 2018, shortly before the procedure would have taken place. ““OK, it's probably early, and he probably wants to make a splash...It wasn't the right sort of splash, but he made one”” (Cohen, 2019). These accounts reveal He’s lack of concern for the welfare of others and his self-interests in “making a splash” in the scientific community. Interviews with Dr. Jiankui after the birth of the twins reveals his disregard for the guidelines laid out in the international summit in 2017. He felt as if he “absolutely complied with all of the criteria” set forth from the summit. However, all of the scientists involved disagreed with He’s rationale and were confused as to how he could have believed such.

Cohen concludes his piece with a reflection on the other groups involved, including the Chinese government and the authors of the 2017 National Academies of Sciences, Engineering, and Medicine (NASEM) report. With one of the best surveillance systems in the world and non-secrecy of He in his research and trials, a scientist close to He believes the Chinese government was “totally aware” of the situation. Cohen also concludes with an interview with an historian of biomedicine addressing the faults of the NASEM committee in employing an “elite group” to

decide how science should be regulated. This is in agreement with Rufo and Ficorilli's claims regarding the personnel involved in determining these regulations.

In the following analysis, I will explain how duty ethics enables us to identify the lack of moral responsibility on the part of Dr. He Jiankui. Looking at this case through such a lens will allow future summits and regulating committees to more appropriately identify risks and set guidelines for scientists in the field of genetic modification.

### **Conceptual Framework**

The morality of Dr. He Jiankui's actions in editing the genes of two human embryos with the CRISPR-Cas9 technology can be better understood using Immanuel Kant's theory of duty ethics. The central theme to Kant's theory is the idea that all moral actions revolve around a set of objective moral rules. Kant believes that these moral rules should be based on reason and it is our *duty* to obey them. The moral norms should be "unconditionally applicable," which leads us to Kant's idea of the "categorical imperative."

The categorical imperative denotes that for every moral decision, there is a universal law that the decision must adhere to. In other words, no moral decision can be reasoned subjectively within its circumstances. For instance, in a situation where it is more convenient to break a promise, it is only morally acceptable to do so if at the same time breaking promises can be morally acceptable in *all* situations. The categorical imperative implies that, as all human beings have free will, there is an assumption of universal human worth.

Kant's equality postulate states that each person is to be treated with equal concern and respect. All humans have the ability to make rational decisions on their own and thus we must give each human the ability to do so (Poel & Royakkers, 2011). It is important to note here the

rights of the individual for being treated as equal even when it is at odds with the best interests of a group (Duty-based ethics). This will be important as we explore the rights of embryos and the children they become.

Alike the equality postulate, the rationality of humans brings me to the reciprocity principal. This final concept from Kant declares each human being to treat every person as an end, never as a means only. In other words, a person should never “use” someone as a means to selfish reward. This comes back to the unique rationality of each individual human. In Kant’s duty ethics, that rationality must be respected and not misguided due to selfish intentions.

In the following analysis, I use these three principals to evaluate the morality of Dr. He Jiankui in his decision to use the CRISPR-Cas9. The negligence towards scientific guidelines leads me to explore the categorical imperative and ask: “what if everyone did that?” I will then explore the equality postulate and how it pertains to embryos and future generations in the uncontrolled use of the CRISPR-Cas9. Finally, I will discuss how Dr. Jiankui treated those around him as a means to his own selfish end, disrespecting their humanity and misguiding their rationality.

## **Analysis**

Dr. He Jiankui acted immorally according to three distinct principles of Immanuel Kant’s duty ethics: not acting in conjunction with the categorical imperative, not abiding by the equality postulate, and treating those around him as a means to a selfish end. These characteristics of Jiankui become clear when analyzing the information provided to Jiankui before he conducted the trials with CRISPR-Cas9, the interactions between Jiankui and the parents of the embryos he would operate on, and interviews/quotes from Jiankui and those close to him after the news of

the operation was released. By examining the evidence that follows, I will highlight Jiankui's failure to fulfill his moral duty as a scientific professional. Kant claims that humans exhibit goodwill if they follow the categorical imperative. I will support with evidence the ways in which Dr. He Jiankui did not follow the categorical imperative and therefore acted immorally.

### The Categorical Imperative

In the years between when the CRISPR-Cas9 had first showed real potential of successfully editing human genomes and Dr. Jiankui's operation on human embryos, there had been many summits, moratoriums, and reports outlining the concerns with using the device and recommendations for caution. While the discussion of the CRISPR-Cas9 device in these applications did not begin until the mid-2010's, the scientific community had discussed important ethical responsibilities that coincided with genetic editing since 1975 (Rufo & Ficorilli, 2019). A 2015 international summit held in Washington, D.C. (Rufo & Ficorilli, 2019) and a 2017 report published by the U.S. National Academies of Sciences, Engineering, and Medicine (Cohen, 2019) both outlined the concerns the scientific community made with the use of CRISPR-Cas9. The respective committees also noted the responsibility scientists have in protecting humanity from the misuse of this device.

As a notable figure within the genomic science community, Dr. He Jiankui was well aware of these concerns. A New York Times article notes:

“He presented early phases of his Crispr research to American scientists at conferences in the United States, but disclosed to very few people that he was planning to actually create pregnancies by implanting edited embryos in women” (Kolata & Belluck, 2018).



He was in active engagement with scientists regarding his research at the time of his clinical trials and deliberately chose to disobey the recommendations of the scientific community. If Jiankui's actions were presented as a categorical imperative, where all scientists were allowed to act against the guidelines of the scientific community, the world would be a frightening place. While Jiankui claims good intentions and is "proud" of his work (Rana & Fan, 2018) we cannot let that overshadow the ethical dilemma this situation presents. If every scientist could justify clinical trials from their own conscious, we would see human experiments everywhere. We would return to a world of racism and sexism in medical research. We would have no need for hospital Institutional Review Boards to grant approval for clinical trials in protecting basic human rights.

To continue this dystopia, the use of the CRISPR-Cas9 would have no regulations restricting its usage from altering the human genome for generations to come. Joyce Harper states: "Fertile couples may consider it a genetic advantage to determine their healthiest embryos, or those with the characteristics they desire" (Harper & Schatten, 2019). This could create a world filled with eugenics, racism, and inequality (Brokowski & Adli, 2019). Now some would say this is much more extreme than Jiankui's actions, and operations like this are not quite available (but not far off according to Gina Kolata and Pam Belluck of the New York Times, 2018). However, Jiankui saw a potential for risk (contracting HIV) and acted to mitigate that risk via gene editing. I argue that selecting preferred characteristics of children is mitigating the risk of bullying or scholastic failure and can likewise be subjected to the categorical imperative in this sense. A world abundant with irresponsible clinical trials and medical practices would pose a great danger to our children and the future generations to come.

### The Equality Postulate

Dr. He Jiankui acted ignorantly to the rights of unborn children and future generations by acting irresponsibly in the use of the CRISPR-Cas9. Dr. Jiankui was the first to genetically modify viable embryos that resulted in a successful pregnancy. Jiankui modified the CCR5 gene of a child from an HIV+ parent in order to make the child immune to HIV. Scholars in the scientific community warned against such application of CRISPR-Cas9 for the safety of the unborn child. One scholar recalls telling He that modifying the gene “did not address ‘a true unmet medical need’ and warned He that the experiment was ‘risking the health of the child you are editing’” (Cohen, 2019). By risking the health of the child, Jiankui did not allow the unborn child to make a rational decision and thus did not treat him equally. Clearly, the embryo cannot make any decision before birth but human rationality does not change.

Here I propose two avenues to which this rationality can be assumed. One is the logical rationality of an unborn person. Kant argues that each moral decision should be the result of reasoning. In this respect, I argue that the reasonable decision for the sake of the child would be to avoid the CRISPR-Cas9 procedure. There are already safe alternative ways to ensure an in vitro birth does not contract HIV from the parents (Harper & Schatten, 2019) and thus there would be no reason to elect the risk CRISPR-Cas9 procedure. The second avenue to which we can assign the rationality of the unborn embryo is the parents. In this case, Dr. Jiankui inappropriately coerced the couple to agree to his procedure, misguiding the rationality of the parents and the child, which I will discuss in the next section.

Dr. Jiankui also did not treat future generations equally by putting them at risk of artificial faulty genetic modifications. Unlike genetic editing in terminally ill patients, “any changes in embryos are likely to pass onto future generations, meaning a tiny blip could have far-reaching consequences” (Rana et al., 2018). By the same logic explained above, Jiankui does

not allow future generations to make rational decisions regarding the assumption of the CRISPR-Cas9 risk. He forces this risk of inheriting undesirable genetic traits from his clinical trials.

Some may argue that these trials are for the betterment of society, as a few blips in the genetic modification process can result in major breakthroughs in the eradication of disease. However, according to Kantian theory, *all* humans have the right to exercise their own rationality and deserve to be treated as equals. Thus, this reasoning is unsound and we cannot sacrifice healthy embryos for the sake of science.

### The Reciprocity Principal

Jiankui enrolled seven couples into his study, all HIV-positive men and HIV-negative women, in order to test his procedure on in vitro embryos (Harper & Schatten, 2019). However, Jiankui's motivations behind attracting these couples in particular are questionable. Sperm washing was a trusted process to eliminate the risk of father-to-child transmission of HIV and thus protecting offspring from this risk was unnecessary for Jiankui. Instead, "He sought couples who had endured HIV-related stigma and discrimination and wanted to spare their children that fate by dramatically reducing their risk of ever becoming infected" (Cohen, 2019). With these couples, Jiankui could appeal to emotions rather than reason in convincing the couples to agree to the procedure. Thus, it becomes clear that Jiankui misguides the rationality of the parents (and of the child if we are to assume rational decisions to the parents as mentioned before). According to duty ethics, this is an infringement upon human rights to treat others as a means to a selfish end. In Jiankui's case, I argue that this selfish end was fame and honor in the scientific community.

To set the climate at the time of Jiankui's decision to use the CRISPR-Cas9 technology, Rana et al. write "The international race to bring human genome editing into widespread use in clinical medicine is moving fast" in January 2018, around the time when Jiankui would have performed the procedure (Rana et al., 2018). This race to be first surely influenced Jiankui in accelerating a dangerous procedure that scientists around the world condemned. China had already proven itself in the application of CRISPR-Cas9 to treat 86 cases of various diseases (Rana & Fan, 2018). Jiankui wanted to make the next step for his country. In his press conference shortly after the news of the babies was released, he said "I feel proud" (Rana & Fan, 2018). In piecing this information together, it is clear that Jiankui had selfish motivations in encouraging the parents of the unborn twins to enroll in his genetic editing procedure. This manipulation is morally unacceptable in the framework of Kantian duty ethics as it misguides the rationality of persons worthy of equal treatment.

## **Conclusion**

The actions of Dr. He Jiankui to operate on a human embryo with the CRISPR-Cas9 device during an in vitro fertilization are deemed immoral through the Kantian duty ethics framework. If Dr. Jiankui's actions were to create a categorical imperative of disregarding guidelines for scientific research or the unregulated use of the CRISPR-Cas9 device, many children and future generations would be subject to physical dangers along with more prevalent racism, classism, and inequality. Jiankui also did not treat all persons equally by denying them their human right of rational decision-making. Lastly, Jiankui treated people around him as means to his own selfish ends in order to gain fame and honor in the scientific community.

It is too late to go back and change the outcome of Dr. Jiankui's unethical trials. However, it is not too late to save future children and generations from the risks that the

improper regulation and use of the CRISPR-Cas9 pose. Understanding Jiankui's case through the lens of duty ethics will help us to better create regulations and hold scientists and politicians accountable for their actions.

Word Count: 3398

## References

- Brokowski, C., & Adli, M. (2019). CRISPR Ethics: Moral Considerations for Applications of a Powerful Tool. *Journal of Molecular Biology*, *431*(1), 88–101.
- Cohen, J. (2019). Inside the circle of trust. *Science*, *365*(6452), 430–437.
- Duty-based ethics. (n.d.). Retrieved from [http://www.bbc.co.uk/ethics/introduction/duty\\_1.shtml](http://www.bbc.co.uk/ethics/introduction/duty_1.shtml)
- Harper, J. C., & Schatten, G. (2019). Are we ready for genome editing in human embryos for clinical purposes? *European Journal of Medical Genetics*, *62*(8).
- Kolata, G., & Belluck, P. (2018, December 5). Why are scientists so upset about the first crispr babies? *The New York Times*.
- Krimsky, S. (2019). Ten ways in which He Jiankui violated ethics. *Nature Biotechnology*, *37*(1), 19–20.
- Poel, I. van de, & Royackers Lambèr M. M. (2011). *Ethics, technology and engineering: an introduction*. West Sussex, UK: Wiley-Blackwell.
- Rana, P., & Fan, W. (2018, December 28). Chinese gene-editing experiment loses track of patients, alarming technology's inventors. *The Wall Street Journal*.
- Rana, P., Marcus, A. D., & Fan, W. (2018, January 21). China, unhampered by rules, races ahead in gene-editing trials. *The Wall Street Journal*.
- Rufo, F., & Ficorilli, A. (2019). From Asilomar to Genome Editing: Research Ethics and Models of Decision. *NanoEthics*, *13*(3), 223–232. doi: 10.1007/s11569-019-00356-1