

# CRISPR ETHICS: A SURVEY OF THE ISSUES

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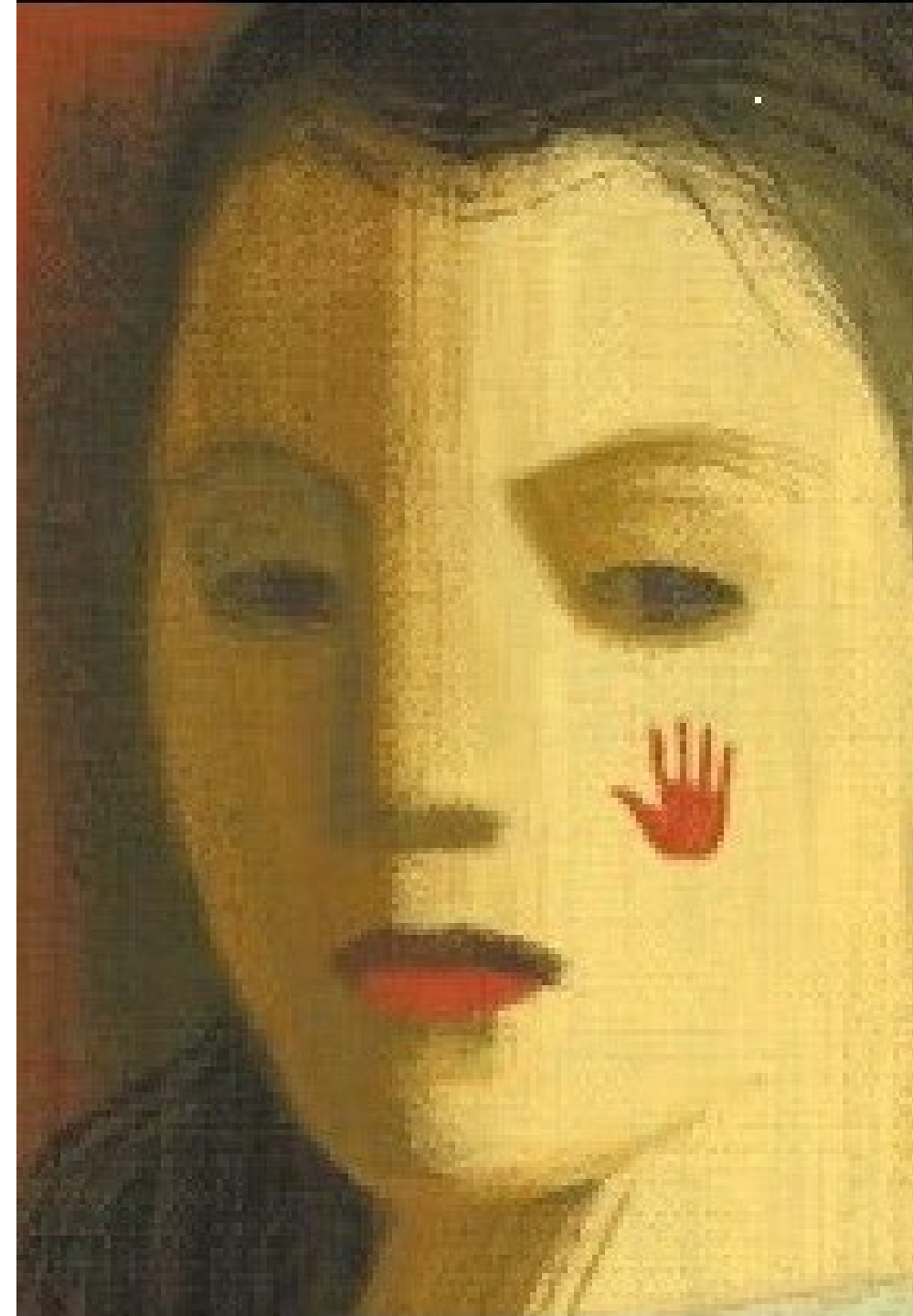
# INTRODUCTION

FRAMING THE QUESTIONS

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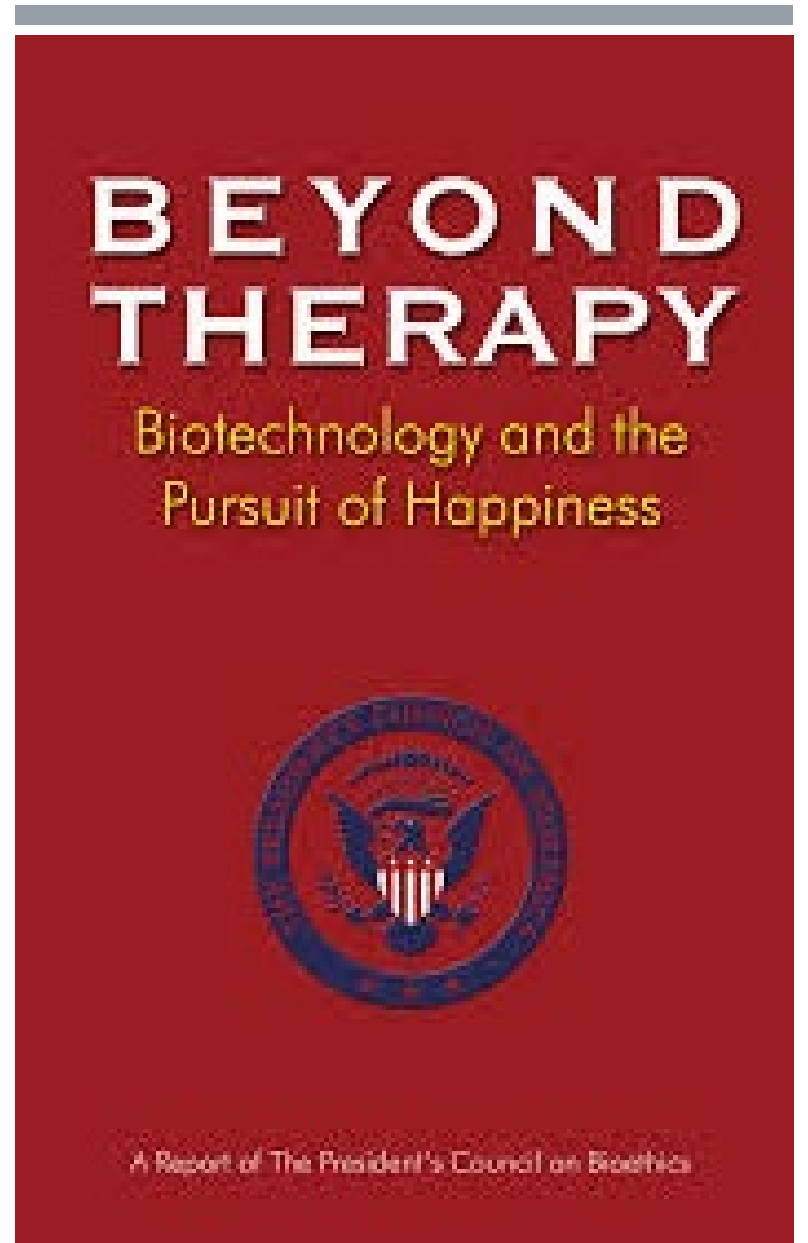
## INTRODUCTION: BACKGROUND

- Leon Kass on Nathaniel Hawthorne's "The Birthmark": the story deals "with certain important driving forces behind the growth and appreciation of modern biology and medicine, our human aspiration to eliminate defects and to pursue some kind of perfection. Goals to which science and technology more and more have been put into service. But it also invites us to think about the human meaning of a birth-mark, being marked at birth. Therefore, it enables us to start talking about bioethics by locating our current concerns in relation to certain enduring matters and questions."



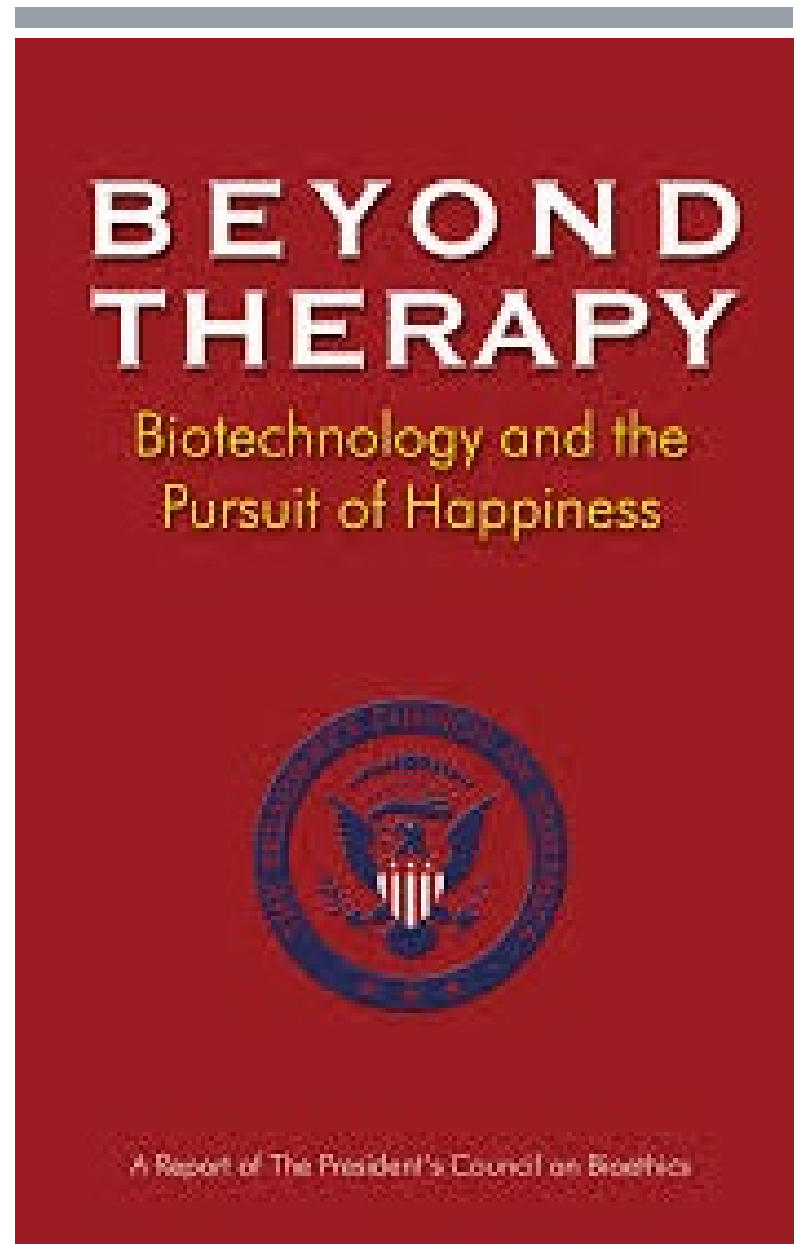
## INTRODUCTION: BACKGROUND

- Focuses on uses of biotechnology that “appeal to free and enterprising people, that would require no coercion, and, most crucially, that would satisfy widespread human desires” (10)
- What is biotechnology for? Do the good ends served by these applications justify their use?
- Is the distinction between therapy (restoring to health) and enhancement (augment or improve upon the norm) adequate to address these uses of biotechnology?



## INTRODUCTION: BACKGROUND

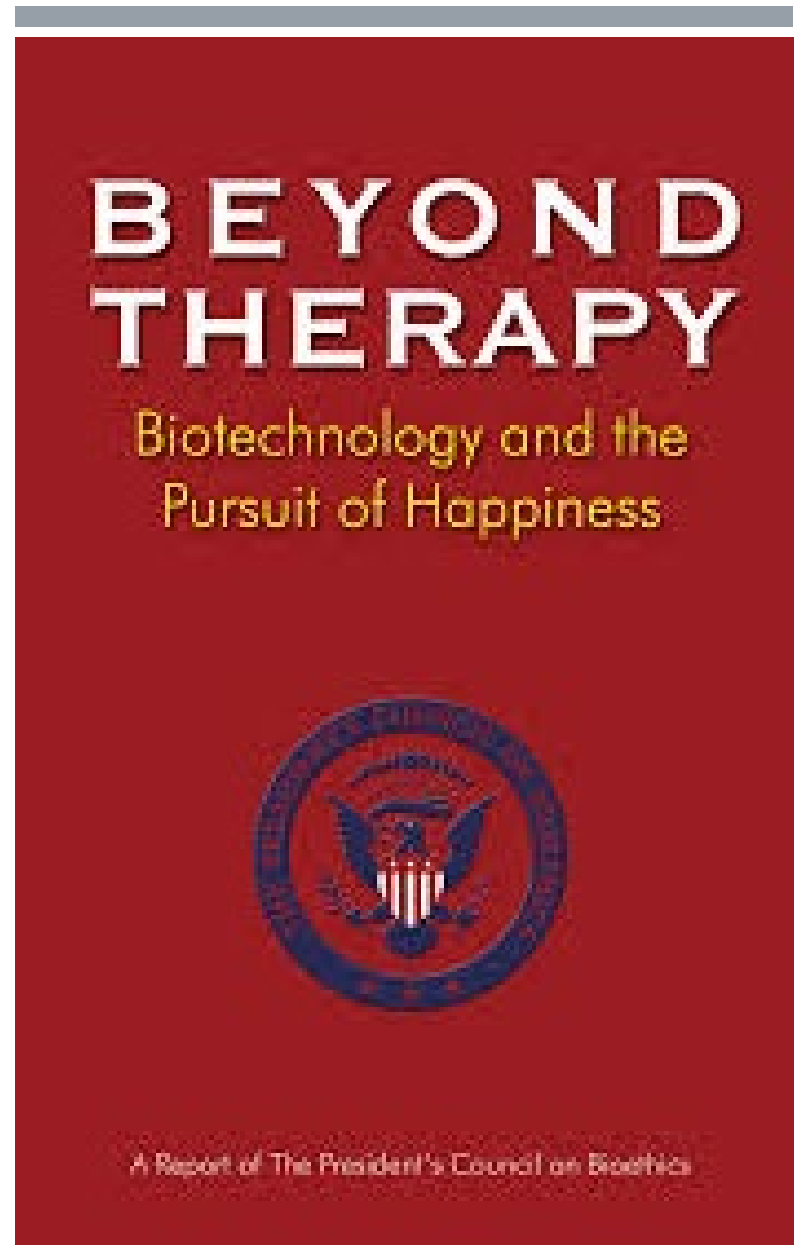
- *Screening Out*: routine pre-natal tests + abortion for fetal anomaly;  
Preimplantation Genetic Diagnosis
- *Selecting In*: Preimplantation Genetic Diagnosis.
- *Fixing Up*: Genetic Engineering



## INTRODUCTION: BACKGROUND

“Fixing Up” or “Genetic engineering of desired traits” (37) – the report displays skepticism about this use:

- Polygenic basis for many “desirable traits” (e.g., appearance, intelligence, memory)
- Environmental contributions to the development of “desirable traits”
- Difficulties of engineering, especially safety concerns (e.g., off-target mutations, effects on future generations).



INTRODUCTION:  
DOUDNA &  
CHARPENTIER

“A Programmable  
Dual-RNA–Guided  
DNA

Endonuclease in  
Adaptive Bacterial  
Immunity” (2012)





## INTRODUCTION: HE JIANKUI

### ***Chinese Scientist Claims to Use Crispr to Make First Genetically Edited Babies***

The researcher, He Jiankui, offered no evidence or data to back up his assertions. If true, some fear the feat could open the door to “designer babies.”

### **Genome-edited baby claim provokes international outcry**

The startling announcement by a Chinese scientist represents a controversial leap in the use of genome editing.





## INTRODUCTION: GOALS

- Describe CRISPR/Cas9 gene editing techniques and their potential therapeutic uses.
- Analyze the primary moral arguments in support of the use of CRISPR/Cas9 techniques.
- Analyze the primary moral arguments against the use of CRISPR/Cas9 techniques



## INTRODUCTION: FORECASTING

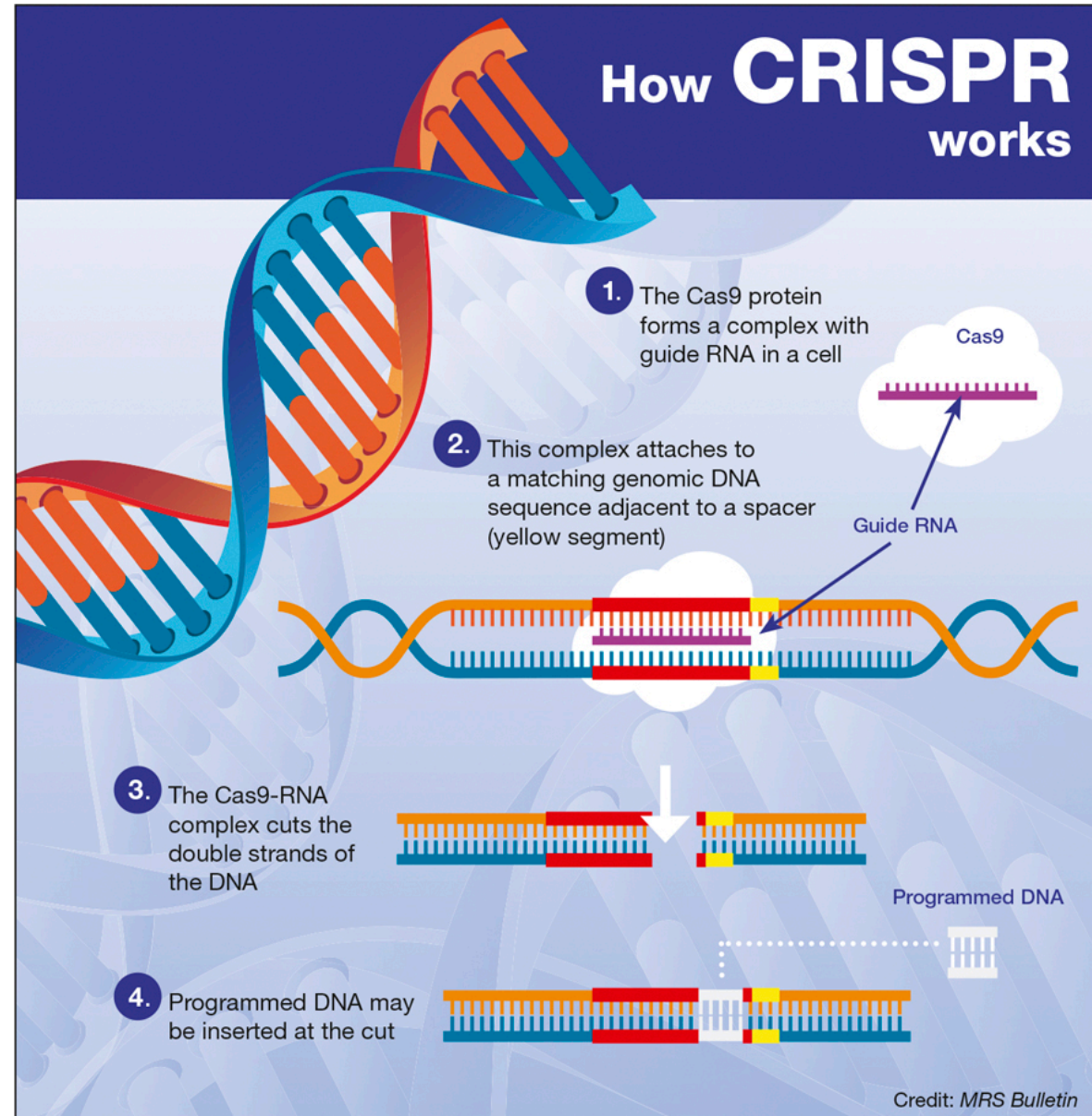
- Proponents: concerns of compassion & justice justify the use of the technology.
- Opponents: concerns of justify raise significant questions about the specific applications of this technology.
- Any assessment of the moral value of CRISPR/Cas9 needs to consider these questions about justice with moral seriousness.

# WHAT IS CRISPR/Cas9?

UNDERSTANDING THE TECHNOLOGY

# WHAT IS CRISPR/CAS9?

- **Clustered Regularly Interspaced Short Palindromic Repeats / Crispr Associated Protein 9.**
  - Naturally occurring mechanism bacteria employs as a defense against viruses.
- As a tool: target DNA; guide RNA + Cas9; cut; repair.





## WHAT IS CRISPR/CAS9?

“[the repair mechanism] is useful because ... if you can create a break at a place of interest, then you can change that gene. You fool the cell. Give it a separate piece of DNA that you have made. A piece of DNA which is identical to the chromosome that you’re cutting, Except for the change that you wish to make. And Mother Nature will not know she’s being fooled. She will repair the break using this piece of DNA you provided as a template. And so whatever change you’ve brought in will then go into the chromosome” (Fyodor Uranov, *Human Nature*).



## WHAT IS CRISPR/CAS9?

“You can think of it like a cursor in Microsoft Word. In Word, if you have a document, where you edit first, you have to place the cursor there. In DNA, wherever you make a cut is the equivalent of a cursor in this word processor of the genome. That’s where you can type in a new word” (Feng Zhang, *Human Nature*).



## WHAT IS CRISPR/CAS9?

“If you imagine an organism’s genome as a multivolume encyclopedia, then CRISPR would allow anyone with the right technical skills to edit a single letter on page 124 of volume 8 of the genome, replacing the ‘d’ with an ‘r’” (Austriaco).



## WHAT ARE ITS POTENTIAL USES?

### Some Applications

- Advancing Scientific Understanding





# WHAT ARE ITS POTENTIAL USES?

## Some Applications

- Advancing Scientific Understanding
- Use in Non-Human Populations
  - Improvements in crops and livestock
  - Inactivation of viruses
  - Gene drive and disease vectors



# WHAT ARE ITS POTENTIAL USES?

## Some Applications

- Advancing Scientific Understanding
- Use in Non-Human Populations
- Use in Human Populations
  - Somatic Cell Gene Therapies
  - Stem and Progenitor Cell Therapies
  - Germline Genomic Therapies
  - Germline Enhancements?

# ARGUMENTS FOR & AGAINST CRISPR/Cas9

POINT / COUNTERPOINT



## THE CASE FOR & AGAINST CRISPR/Cas9

The good of advancing scientific understanding morally justifies the experimentation essential to achieve this goal.



## THE CASE FOR & AGAINST CRISPR/Cas9

The good of addressing environmental causes of sickness and disease (e.g., by enhancing food supplies, eliminating disease vectors) morally justifies the use of CRISPR/Cas9 in editing non-human populations.



## THE CASE FOR & AGAINST CRISPR/Cas9

The goods made possible through somatic cell and (adult) stem cell gene therapies morally justifies their use in adult human patients.

## THE CASE FOR & AGAINST CRISPR/Cas9

POINT	COUNTERPOINT
Advancing scientific understanding	Destruction of human embryos
Addressing environmental causes of disease and sickness through editing plants and non-human animals.	Unintended negative economic, social, and ecological effects
Treating monogenic diseases in adult human populations	Risks to individual patients; justice-based concerns with access to treatments.



## THE CASE FOR & AGAINST CRISPR/Cas9

The goods made possible through germline genomic editing in human populations morally justifies its therapeutic use in cases of monogenic diseases.





## THE CASE FOR CRISPR/Cas9

“The human genome was created by a blind process of mutation and selection occurring over thousands of generations. This process had no foresight for the creatures it would produce. This has resulted in vast natural inequality. The most extreme examples are single gene disorders, where some people become destined to a short life with much pain due to random quirks in their DNA...We ought to use powerful technologies like [heritable genome editing] to correct these inequalities and promote human flourishing. Such actions are moral imperatives” (Gyngell, Bowman-Smart, and Savulescu 2019).

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## THE CASE FOR CRISPR/Cas9 IN HERITABLE GENOME EDITING

“There are circumstances in which genome editing in germline cells or embryos might be the only or most acceptable option for prospective parents who wish to have a genetically related child while minimizing the risk of transmitting a serious disease or disability.”

*Human Genome Editing: Science, Ethics, and Governance*, a report of the National Academies of Sciences, Engineering, and Medicine.

## THE CASE FOR & AGAINST CRISPR/Cas9

POINT	COUNTERPOINT
Alleviating suffering by eradicating heritable causes of disease.	Safety for future generations.
Creating conditions in which potential individuals are better able to flourish.	Respect for potential persons on whom one experiments without consent.
Securing the possibility of creating children who are genetically-related and free of inherited diseases.	Questionable moral status of the desire for genetically-related children who are free of inherited diseases.



## THE CASE FOR & AGAINST CRISPR/Cas9

The goods made possible through germline genomic editing in human populations morally justifies its therapeutic use in cases of causes of significant disabilities.

## THE CASE FOR & AGAINST CRISPR/Cas9

POINT	COUNTERPOINT
Alleviating suffering by eradicating heritable causes of disability.	Questions about the 'seriousness' of specific disabilities as candidates for editing.
Creating conditions in which potential individuals are better able to flourish.	Questions about social injustice and inequalities use of gene editing for disability might raise.

# CONCLUSION

SUMMARY



## CONCLUSION – THE CASE FOR CRISPR/Cas9

- Advancing scientific understanding
- Addressing environmental causes of disease and sickness through editing plants and non-human animals.
- Treating monogenic diseases in adult human populations.
- Alleviating suffering by eradicating heritable causes of disease.
- Securing the possibility of creating children who are genetically-related and free of inherited diseases.
- Alleviating suffering by eradicating heritable causes of disability.
- Creating conditions in which potential individuals are better able to flourish.

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## CONCLUSION – THE CASE AGAINST CRISPR/Cas9

- Destruction of human embryos
- Unintended negative economic, social, and ecological effects
- Justice-based concerns with access to treatments.
- Risks for patients and risks for future generations.
- Respect for potential persons.
- Questionable moral status of the desire for genetically-related children who are free of inherited diseases.
- Questions about the ‘seriousness’ of specific disabilities as candidates for editing.
- Questions about social injustice and inequalities use of gene editing for disability might raise.
- Dispositions and attitudes toward future children





## CONCLUSION: SUMMARIZING

- Proponents: concerns of compassion & justice justify the use of the technology.
- Opponents: concerns of justify raise significant questions about the specific applications of this technology.
- Any assessment of the moral value of CRISPR/Cas9 needs to consider these questions about justice with moral seriousness.

# QUESTIONS?

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