FACULTY OF PSYCHOLOGY AND EDUCATIONAL SCIENCES

The Moral Foundations of Attitudes Towards Genetic Manipulation in Humans

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Abstract

The recent evolutions in biotechnology are very promising and the first designer babies are a fact. But how does the general population stand against gene editing in humans? In this paper, we want to investigate how the attitudes toward genetic editing in humans are linked to different moral values. To study this, we conducted a survey that contained an adaption of the Moral Foundations Questionnaire, a selection of the Moral Foundations Vignettes, an adapted Attitudes Toward Genetic Editing questionnaire, five scenarios involving the genetic editing of a medical disease, and five scenarios involving the enhancement of a trait or characteristic, and two trolley-type moral dilemmas. We found that mainly the moral foundations Care and Sanctity and choosing the utilitarian option in moral dilemmas were linked with attitudes toward gene editing in humans. These relationships were explained by the benefit to the person or society. Additionally, we found that people are more supportive of gene editing in humans when it has a medical purpose than when it has an enhancing purpose. However, we found that the impact of diseases or enhancements on someone's life did not affect the attitudes toward genetic manipulation in humans. These findings show that morality can be linked to attitudes toward gene editing in humans. Further research is needed to get more insight into this relationship.

Keywords: Moral Foundations Theory, attitudes toward gene editing in humans, medical versus enhancement

Samenvatting

De recente ontwikkelingen in de biotechnologie zijn veelbelovend en de eerste designer baby's zijn een feit. Maar hoe staat de algemene bevolking tegenover genetische manipulatie bij mensen? In dit artikel willen we onderzoeken hoe de houding tegenover genetische manipulatie bij mensen samenhangt met verschillende morele waarden. Om dit te onderzoeken, hebben wij een enquête gehouden met een aanpassing van de 'Moral Foundations Questionnaire', een selectie van de 'Moral Foundations Vignettes', een aangepaste versie van de 'Attitudes Toward Gene Editing' vragenlijst, vijf scenario's over genetische manipulatie van een medische ziekte en vijf scenario's over de verbetering van een eigenschap of kenmerk, en twee morele 'trolley-style' dilemma's. Wij vonden dat vooral de morele funderingen 'Care' en 'Sanctity' en het kiezen van de utilitaristische optie in morele dilemma's samenhingen met houdingen ten opzichte van genetische manipulatie bij mensen. Deze verbanden werden verklaard door het voordeel voor de persoon of de samenleving. Bovendien vonden wij dat mensen meer voorstander zijn van genetische aanpassingen bij mensen wanneer het een medisch doel heeft dan wanneer het een verrijkend doel heeft. Wij vonden echter dat de impact van de ziekten of verrijkingen op iemands leven geen effect had op de houding tegenover genetische manipulatie bij mensen. Deze bevindingen tonen aan dat er een verband bestaat tussen moraliteit en de houding tegenover genetische aanpassingen in mensen. Verder onderzoek is nodig om meer inzicht in dit verband te krijgen.

Kernwoorden: Moral Foundations Theory, attitudes tegenover genetische manipulatie in mensen, medisch versus verrijking

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This thesis marks the end of my studies in Theoretical and Experimental Psychology. A course that I enjoyed following. This is the end of one chapter, but the beginning of a new one. I am ready for what will come.

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The Moral Foundations of Attitudes Towards Genetic Manipulation in Humans

In 2018, He Jiankui, a Chinese scientist, created the first genetically edited babies (Regalado, 2019). For such 'designer babies', certain characteristics are selected and introduced into the genetic makeup of the embryo through gene editing techniques (Handyside, 2018). In the field of biotechnology, these techniques are developing fast, and people are both fascinated and concerned about these evolutions. The biotechnology evolutions are very promising, and this can, and some say it will be the future, but is the general population ready for it? And what about the moral issues that go along with it? This paper aims to examine how attitudes toward genetic editing are linked to different moral values. First, we will discuss what exactly genetic editing in humans entails and how recent technical evolutions make it an acute moral issue. Then we will discuss the Moral Foundations Theory and the moral concerns of deontology and utilitarianism, which will serve as a framework for examining how moral values in individuals determine their attitudes toward genetic editing. In doing so, we will also make a distinction between medical diseases and enhancements.

The Evolution of Gene Editing

Before getting deeper into the jungle of gene editing, we need to clarify some important concepts. Firstly, according to the National Institutes of Health (NIH), a genome is 'an organism's complete set of DNA, including all the genes, that makes up the genome. Each genome contains all of the information needed to build and maintain that organism' (Goldman & Landweber, 2016). In other words, a genome contains genes that can give instructions to the cell on what proteins it should make (Elston et al., 2012; Gerstein et al., 2007). By modifying these genes, it is possible to create various outcomes in the organism.

A way to modify these genes is through the use of gene editing techniques, which can make precise and targeted double-stranded breaks in DNA to enable the insertion, deletion, or replacement of DNA with great accuracy. These technologies can produce a specific and targeted alteration in DNA sequences by breaking the double strand at a particular location within the sequence.

The initial concepts of gene editing were first mentioned around the 1960s, and early 70s (Mandip & Steer, 2019). In 1994 a meganuclease was used as the first programmable nuclease to edit human cells. Approximately 10 years later, in 2003, the zinc finger nuclease (ZFN) was first used (Rocha et al., 2020). ZFNs consist of a combination of zinc fingers and a DNA cleavage domain derived from a bacterial protein (Carroll, 2017). In 2011, the transcription activator-like effector nucleases (TALEN) were used for the first time (Rocha et al., 2020). TALENs, similar to ZFNs, utilize the DNA cleavage domain from a bacterial protein, but instead of zinc fingers,

they incorporate DNA recognition modules derived from transcription factors produced by plant pathogenic bacteria (Carroll, 2017). In 2013, the clustered regularly interspaced short palindromic repeats (CRISPR) technology was introduced, which is currently the most popular gene editing technique among scientists (Rocha et al., 2020). CRISPR offers increased efficiency, specificity, ease of use, accessibility for researchers, and relatively affordable price (Howard et al., 2018).

Possible goals of gene editing can be the replacement of missing gene(s), overexpression of a normal gene, interference with gene expression, disruption of an offending gene, or repair of a mutated gene (Mandip & Steer, 2019). Moreover, gene editing finds application in various fields, including those related to humans and non-humans. The medical domain is an example of the former, whereas agriculture and food production are instances of the latter, as Rocha and colleagues (2020) note.

Gene Editing in Non-Humans

The global population is on the rise, which in turn increases the demand for food (Ahmar et al., 2020). However, climate change poses a threat to the environment and can negatively impact crops, making them more susceptible to diseases, high temperatures, and poor water supply (Kim et al., 2021). Climate change can also pose a danger to the environment in the future. It can affect agriculture, biodiversity, human society, and almost all aspects of our world (Karavolias et al., 2021). As a result, researchers are focusing on improving crop yield and stability, and nutritional value (Kim et al., 2021).

Gene editing techniques offer a potential solution for increasing food production and improving crops. The aforementioned tools (ZFN, TALEN, CRISPR) are suitable for conducting plant and animal research and can be utilized to help organisms adapt to their environment (Ahmar et al., 2020; Karavolias et al., 2021). Gene editing has already been successfully applied to a wide range of agricultural organisms (Friedrichs et al., 2019). Some examples of these applications are trying to improve crop yield, quality, and nutrition, facilitate the production of rice in northern regions, speed up breeding, upgrade climate-resilient crops, and enhance plant disease resistance and tolerance against drought, salinity, and flooding (Ahmar et al., 2020; Karavolias et al., 2021).

Additionally, it can also be applied to animals to improve thermotolerance in cattle, manage diseases, enhance livestock productivity and quality, enhance animal fertility, and enhance animal welfare (Jiang & Shen, 2019; Karavolias et al., 2021). For example, modifying a single gene can result in more muscle mass in cows, sheep, pigs, and other food animals

(Carroll, 2017). Moreover, a study by Taylor and colleagues (2022) demonstrated that germline gene editing can alter social behavior in Syrian hamsters.

Gene Editing in Humans

Gene editing is not limited to non-humans only, it can also be applied to humans. The human genome consists of 22 pairs of autosomal chromosomes and one pair of sex chromosomes. These chromosomes are composed of genes and one gene contains around 2000 to 200,000 base pairs (Mandip & Steer, 2019). In humans, gene editing can be performed on somatic cells (these are body cells that stay within the person), where the change is limited to the modified cells, or on germ cells (cells responsible for reproduction), which can result in significant changes in organism's phenotype (Greely, 2019; Sparrow, 2019).

There are also other significant challenges that occur when editing genes in humans. A major one is the delivery of these gene tools. Important factors that can make this more difficult are the physical barriers such as the cell membrane and the nuclear membranes. The modified genes can also be degraded by proteases or nucleases of the host. Additionally, if the modified genes are altered in the body itself then we also have to take the immune system into account (Mandip & Steer, 2019). Moreover, it is also hard to achieve therapeutic levels and there is a chance of off-target mutations (Rocha et al., 2020).

Despite the challenges, some researchers have been successful in editing genes in humans. In 2017, scientists were able to remove a mutated DNA sequence responsible for cardiomyopathy, a disease that can result in heart failure, using CRISPR-CAS9 technology. However, this was a clinical experiment and the embryo was not implanted (Ma et al., 2017). A recent example, that made a lot of commotion, is the experiment conducted by Dr. He Jiankui. In his experiment, he recruited a couple where the father was HIV-positive and the mother was not. The experiment aimed to modify a specific gene to ensure that the future babies were HIV-resistant. By doing this He created the first genetically edited babies using the CRISPR technique (Alonso & Savulescu, 2021; Greely, 2019).

Ethical Considerations and Challenges

Considerations of Experts

These experiments raise many moral, ethical, and regulatory challenges that several experts try to address. These moral, ethical, and regulatory challenges constitute a roadblock to the adoption of gene editing of human cells. There is currently no consensus among scientists regarding the use of gene editing in stem cells. The reason is that there is still a chance of off-target mutations which can lead to genomic instability and disturb the functioning of normal genes (Zhang et al., 2015). It is even possible that when the germline is edited, undesired

outcomes will be passed on to the offspring (Lange & Kappel, 2022; Ormond et al., 2017). Moreover, even when the manipulation of the gene has been successful there is still a chance that it will be accompanied by undesirable outcomes. An example is the genetic elimination of sickle cell anemia. In genetically modifying to eliminate this disease, it has been discovered that it is associated with an increased risk of contracting malaria (Bosley et al., 2015). Therefore, some scientists advocate for a ban, while others support regulation and cautious use of the technology only when it is mature (Rocha et al., 2020).

The Attitudes Toward Gene Editing of the Lay Public

These moral, ethical, and regulatory questions concern not only experts but also the lay public. The potential for genetic interventions to exacerbate existing social inequalities is a concerning issue. In scenarios where only the wealthy can afford genetic enhancements (or treatments), the advantages of environmental factors that already benefit privileged children would be compounded. This could result in a society where social mobility is increasingly limited, and children born to poor parents may find it impossible to compete with the "super-children" of the rich (Bostrom, 2003). As a result, the gap between the poor and the rich will be more visible. However, the CRISPR technique is a relatively inexpensive technique to edit genes. Therefore, more people will be able to afford it which means that it is more important to strictly regulate the use of CRISPR (Boonin, 2018).

Furthermore, there is a concerning issue regarding informed consent. Individuals may not fully understand the implications and risks of genetic editing. Moreover, if parents choose to alter the genes of their future offspring, those infants cannot provide informed consent and will be forced to live with the consequences of their parent's decisions (Cahn, 2021). Additionally, there exists a risk of potential abuse of genetic editing for unethical purposes. This could include creating a "super soldier" or developing a genetically modified workforce. This could lead to the dehumanization of individuals, treating them as mere tools or resources for specific purposes (Asmi, 2017).

The attitudes toward gene editing are also influenced by demographic factors. Individuals who are younger, male, less religious, have higher self-reported knowledge, and trust scientists more tend to be the most supportive of genetic engineering. Knowledge and education are also major predictors of attitudes toward genetic adaptation, although there are mixed results in the literature (see Delhove et al., 2020 and McCaughey et al., 2016).

Furthermore, according to the study of Gaskell and colleagues (2017), and the study of Delhove and colleagues (2020), people tend to view genetic edits more positively when applied in a medical context, particularly in cases when the benefits outweigh the risks. Contrarily, the

majority of people do not favor using genetic engineering to improve certain character traits, or using it for not health-related purposes (McCaughey et al., 2016). They may see this as "playing God," or "going against nature" (Delhove et al., 2020).

Medical versus 'Enhancement'

As mentioned above, the lay public is more accepting when gene editing is used for medical purposes than for enhancing purposes. A possible reason can be that gene editing for enhancement is more common in non-humans, whereas gene editing for treatment may be more beneficial for humans. Indeed, gene editing techniques can be used to treat genetic diseases in humans, which is also called genetic therapy. Moreover, it can also be used to produce cell and animal models to understand such diseases better and develop new genetic therapies and medications (Liang et al., 2017). Various animal models such as zebrafish, mice, rats, pigs, and monkeys have been utilized to study human diseases, including cancer mechanisms (Liang et al., 2017).

Additionally, the therapeutic potential of CRISPR technology has been demonstrated, with applications for repairing genetic deficiencies, treating immune rejection, viral infections, and cancer. CRISPR has already been employed to rectify genetic mutation in somatic cells in diseases such as cataracts, muscle dystrophy, and hearing loss in mouse zygotes (Liang et al., 2017). Examples of human diseases that are also treated with the use of the CRISPR technique are cystic fibrosis, viral infections, and cancer immunotherapy (Mandip & Steer, 2019).

Moreover, studies about gene editing have also shown promising results in treating human genetic conditions like cystic fibrosis, sickle cell anemia, Duchenne muscular dystrophy, and Down syndrome, as well as in identifying and treating deadly diseases such as cancer and AIDS (Khalil, 2020). There are already active HIV clinical trials, and the TALEN technique has been used to modify donor immune cells from a healthy person to an infant to treat leukemia. Moreover, a Chinese group managed to inject a person with CRISPR-Cas9 technique-modified cells to treat aggressive lung cancer (Howard et al., 2018). The examples mentioned above are examples of somatic gene editing. However, there are also examples of gene editing in the germline where some researchers edited the genes of embryos. In April 2015, the group led by Dr. Junjiu Hang claimed to have used gene editing successfully on human embryos (Howard et al., 2018).

Genetic therapy aims to achieve normal functioning (Sparrow, 2019). When researchers go beyond this curative purpose, then we speak about enhancement. Various definitions exist for the term "enhancement". We will define it as adjusting a characteristic that is within a normal range in a desired direction. Gene editing makes it possible for parents to choose the

characteristics of their children who are then called ‘designer babies’ (Handyside, 2018). Enhancing desirable traits like life expectancy, intelligence, athletic performance, and appearance is complicated due to the influence of multiple genes and environmental factors. This complexity makes it challenging to achieve, especially with the limited understanding of the connection between genotype and phenotype. Overcoming these challenges is essential before any human gene enhancement can take place (Sparrow, 2019).

The Moral Foundations Theory

In this thesis, we are mainly interested in how moral aspects impact attitudes toward gene editing in humans. To investigate this, we will use two well-known frameworks from moral psychology, namely the Moral Foundations Theory (MFT) and the moral concerns of deontology and utilitarianism. The MFT is a theory focused on morality and is developed by Haidt. The goal of the MFT is trying to explain the variety and universality of moral judgments (Graham et al., 2018). In addition, it tries to describe moral judgments, values, and behaviors taking moral intuition and emotion into account (Simpson, 2017). Therefore, the MFT is a descriptive theory with evolutionary and cultural-psychological elements (Graham et al., 2018; Simpson, 2017).

The MFT makes four claims. The first one is that there is a first draft of the moral mind which implies that the MFT is a nativist theory. This theory assumes that we all are born with a first draft of the mind. This draft arises from evolutionary processes and is later during development edited by experience and culture. It ensures that we learn certain things, and no other things, which can also be the case for moral values (Graham et al., 2018). It also makes it possible for humans to quickly and effectively cope with recurrent adaptive problems, such as morality (Graham et al., 2013).

The second claim implies that the initial draft of the mind undergoes changes throughout development and is shaped by culture, including morality. This can explain why there are so many cultural differences in morality (Graham et al., 2018). In addition, it is important to recognize that the moral foundations are not set in stone and do not represent the ultimate moral principles. However, they do limit the moral orders that can be formed (Graham et al., 2013).

The third claim is that intuitions come first which makes the MFT an intuitionist theory. By this, the theory means that judgments, including moral judgments, are intuitive. They are associative, automatic, relatively effortless, rapid, and rely on heuristic processing. In other words, moral judgments are processed by our System 1 thinking (Graham et al., 2018).

The fourth and last claim is that the MFT is a pluralistic theory. This means that there are multiple, distinct types of morality (Simpson, 2017). The MFT contains five moral foundations: care versus harm, fairness versus cheating, loyalty versus betrayal, authority versus subversion,

and sanctity versus degradation (Graham et al., 2013). Moreover, there also seems to be a sixth moral foundation namely liberty versus oppression (Iyer et al., 2012).

There are several moral questions we can ask ourselves that each lead to a moral foundation. The first question we can ask is 'was someone harmed?' (Simpson, 2017), which leads us to the first moral foundation: care versus harm. This foundation is rooted in the adaptive challenge of caring for young, vulnerable, or injured kin, which is a common trait among mammals (Graham et al., 2013; Suhler & Churchland, 2011). The second question we can ask is 'is it fair?', which leads us to the second moral foundation: fairness versus cheating. The third question we can ask is 'was someone disloyal?', which brings us to the third moral foundation namely loyalty versus betrayal. This implies that we have a desire to remain loyal to the group or community to which we belong (Clifford et al., 2015). The fourth question we can ask is 'are we following those in charge?'. This brings us to the fourth moral foundation: authority versus subversion. This entails that we want to respect our authority and traditions (Clifford et al., 2015). The fifth and last question we can ask is 'do we find this disgusting or impure?', which leads us to the fifth moral foundation namely sanctity versus degradation. This suggests that we are preoccupied with the concepts of purity and contamination (Clifford et al., 2015). The sixth foundation, liberty versus oppression, focuses on the concerns regarding domination and coercion (Haidt, 2012).

The Moral Foundations Questionnaire and Vignettes

The Moral Foundations Questionnaire (MFQ) is a popular tool to measure individuals' endorsement of the five moral foundations. The primary objective of the MFQ is to provide a scale that is theoretically grounded and covers the entire spectrum of human moral concerns. It is a reliable and valid instrument, making it an easy-to-use tool for exploring this expanded moral domain (Graham et al., 2011). The MFQ consists of two sections: the relevance section and the judgment section. The relevance section asks respondents to rate the relevance of 15 considerations to questions of right and wrong, while the judgment section consists of 15 agree or disagree items. A disadvantage of this scale is that it largely relies on respondents' rating of abstract principles, rather than judgment of concrete scenarios (Clifford et al., 2015).

To address this limitation, researchers developed the Moral Foundations Vignettes (MFV) as a complementary tool to the MFQ. The MFV consists of 132 scenarios. Each scenario comprises a brief depiction of a behavior that breaches a specific moral foundation. These vignettes are particularly geared toward evaluating third-party moral violations (Clifford et al., 2015). Another advantage of the MFV compared to the MFQ is that this measurement includes the sixth moral foundation liberty versus oppression.

The Link Between the Moral Foundations Theory and Gene Editing in Humans

We aim to explore the possible relations between the moral foundations of the MFT and gene editing in humans in our study. In this section, we will attempt to establish a connection between each of the five foundations and gene editing in humans. As there is a lack of research on this topic, we cannot rely on existing literature and will need to rely on intuition.

The first moral foundation we will try to link with gene editing is care versus harm. This foundation can be involved in the genetic editing of disease-causing genes. It will eliminate the disease and improve the life quality of this person. The second foundation we can link is fairness versus cheating. As we mentioned above, the genetic editing of specific character traits or for medical diseases can become very expensive causing only rich people will be able to afford this. This will possibly lead to inequity and discrimination. The moral foundation sanctity versus degradation can also be linked. Some individuals and groups are against genetic manipulation because it is against nature, and God. The moral foundations loyalty versus betrayal, authority versus subversion, and liberty versus oppression are harder to link with genetic manipulation in humans.

Deontology and Utilitarianism

Another moral framework is the moral concerns of deontology and utilitarianism. Deontology is seen as a rule-based morality and is closely linked to the philosophy of Immanuel Kant (Gawronski et al., 2017). The rules deontology is based on are the moral rules which are grounded in obligations, duties, and rights (Kasher, 1978). The morality of an action lies within the action itself and it does not depend on the consequences of this action (Bostyn & Roets, 2017; Isenberg, 1964). If the action is in line with the moral rules then this is considered a good action, if the action goes against the moral rules then the action is considered a bad action (Kasher, 1978). Contrarily to deontology, for utilitarianists, the morality of an action lies within the consequences of that action and not necessarily in the action itself. Utilitarianism is primarily associated with the philosophy of John Stuart Mill (Gawronski et al., 2017; Jacobson, 2008). Utilitarianists thrive for the greatest good for the greatest number of people (Bostyn & Roets, 2017; Isenberg, 1964).

Currently, there is limited research on the relationship between support for genetic editing and moral reasoning. However, we assume that deontologists will oppose genetic editing if it contradicts moral principles. In contrast, utilitarianists' stance would depend on the potential benefits. If genetic manipulation leads to improved overall well-being or societal benefits, such as the elimination of genetic diseases or the enhancement of cognitive abilities, then they may view it as acceptable.

The Relevance of Impact

In addition to morality, the impact of a disease or enhancement on someone's life can also affect shaping attitudes toward genetic editing. As has been previously mentioned, people are more acceptant of gene editing when it has medical purposes than when it is used for enhancements. However, favorability is also influenced by the severity of the disease, with application to treat life-threatening diseases being more acceptable than debilitating ones (McCaughey et al., 2016). For instance, when a baby will be born with a life-threatening disease, like Patau syndrome, then people will probably be more acceptant to use gene editing to eliminate this disease. In contrast, if the baby will be born with hay fever, which can be a discomfort but not a real threat to someone's life then people may be less acceptant. Further, when taking enhancements into account, changing someone's personality compared to changing someone's athletic ability will possibly have a greater impact on someone's life.

This Study

The focus of this study is to investigate how the six different moral foundations and the moral concerns of deontology and utilitarianism can be linked to attitudes toward genetic manipulation in humans. Additionally, we are also interested in whether there is a mediating role of the benefit to the person or society in these possible links. Further, we also analyzed whether there was a difference in attitudes between the medical and enhancing purpose of gene editing. In addition, we also examined whether the impact of genetic diseases or enhancements affects the specific attitudes of people. Moreover, we also examined whether interest and knowledge in genetic manipulation also influenced these attitudes. To investigate this, we developed an online survey that consisted of the MFQ, a selection of vignettes of the MFV, two trolley-type moral dilemmas, an adaption of the Attitude Toward Gene Editing questionnaire, five scenarios involving the genetic editing of a medical condition or disease, and five scenarios involving the enhancement of a trait or characteristic.

We hypothesize that mainly the moral foundations Care, Fairness, and Sanctity, and the moral concerns of deontology and utilitarianism can be linked to attitudes toward genetic manipulation in humans and that these links will be mediated by the benefit to the person or the society. Moreover, we hypothesize that participants will be more acceptant of gene editing with a medical purpose compared to an enhancing purpose. We also expect that impact will have an effect when gene editing has a medical purpose, more specifically participants will be more acceptant of gene editing of a disease with a high impact on someone's life compared to one with a low impact. Lastly, we hypothesize that interest in and knowledge about genetic manipulation will lead to more positive attitudes toward gene editing.

Methods

Participants

Using a power analysis, we calculated how many participants we needed to have a power of 90%. For the effect sizes, we could not rely on previous research, so we chose to use a standard medium effect size of 0.30. The calculations were done in R by using the *WebPower* package (Zhang et al., 2018). The estimated sample size was 234 participants. To anticipate some loss of valid data based on the attention check, we slightly oversampled and obtained a sample of 269 Dutch-speaking participants in Belgium through social media. However, nine participants were excluded from the analyses due to failure to correctly complete the attention check. Of the remaining participants, 54 identified as male, 204 as female, one as non-binary, and one chose not to disclose their gender. The mean age was 45 years (*SD* = 15.35).

Questionnaire

We used an online survey in our study that consisted of five parts. The survey was made in Qualtrics (https://www.qualtrics.com) and started with an informed consent which participants had to agree to before they could continue the questionnaire.

Moral Decision-Making

In the first part, we included the Moral Foundations Questionnaire (Graham et al., 2011). This questionnaire consists of 30 statements and two control questions. The participants had to indicate to what extent they agreed with the statements. These items were scored on a scale from zero to five (0 = *not at all relevant*, 5 = *extremely relevant*). Examples of statements: "Whether or not someone suffered emotionally" and "People should be loyal to their family members, even when they have done something wrong." (for all the statements, see Appendix A).

In the second part, we used a series of Moral Foundations Vignettes. In the paper of Clifford and colleagues (2015), they developed and validated a large set of moral foundations vignettes (MFVs). We selected eight vignettes for each foundation. The selection was based on the factor loading and the relevance of the vignettes in Flanders. The latter was important because our survey was conducted in Flanders, and therefore some of the original vignettes that are typical for the US context are less recognizable for our sample. The participants were asked to indicate to what extent they found the vignettes morally wrong. To indicate this a scale from zero to four was used (0 = *not at all wrong*, 4 = *extremely wrong*). An example of a vignette related to care is: "You see a woman commenting out loud about how fat another woman looks in her jeans.", related to fairness: "You see a referee intentionally making bad calls that help his favored team win.", related to loyalty: "You see a man blocking his wife from leaving home or

interacting with others.", related to authority: "You see a girl repeatedly interrupting her teacher as he explains a new concept.", related to sanctity: "You see two first cousins getting married to each other in an elaborate wedding.", related to liberty: "You see a man blocking his wife from leaving home or interacting with others." (for all the vignettes, see Appendix A).

Attitudes Toward Gene Editing

In the third part of the survey, we wanted to investigate the general attitudes of the participants toward gene editing. We used a questionnaire from the Wellcome Consultative Panel on gene therapy. This was a panel study set up by the National Centre for Social Research and the Wellcome Trust and was conducted in Great Britain (Sturgis et al., 2005), to investigate the impact of information on public attitudes toward science, ethics, regulation, and potential applications of gene therapy. There were 15 items. An example of a statement used in this panel and our study is: "People worry too much about the risk of changing human genes." and "Scientists should not look for genetic cures because the world will become too overpopulated." (for all the statements, see Appendix A). The statements were scored on a 7-point Likert scale (1 = *strongly disagree*, 7 = *strongly agree*).

Cure versus Enhancement

In the fourth part of our survey, ten scenarios were shown (the scenarios are included in Appendix B). Five scenarios pertained to gene editing as a cure and the other five as an enhancement. In the scenarios that focus on cure, it is mentioned that a couple is pregnant, but their unborn child has a genetic abnormality. The impact of the abnormality is manipulated. This can be highly impactful on someone's life such as Patau syndrome, where the child would die within the first year, or it can be less impactful such as hay fever. However, the couple gets the option to edit the genes of the child to remove this abnormality. In the scenarios based on enhancements, it is mentioned that a couple is pregnant but this time their unborn child is healthy. However, they get the option to edit some genes of their child to enhance some characteristics.

For the scenarios that pertained to gene editing as a cure, we chose five diseases based on their impact on someone's life. The selected diseases include hay fever, Down syndrome, mucoviscidosis, heart disease, and Patau syndrome. Among these diseases, hay fever has the least impact on someone's life, while Patau syndrome has the highest. For the scenarios that pertained to gene editing as an enhancement, we tried to select enhancements with a relatively equivalent impact as the chosen diseases. The enhancements include athletic ability, appearance, intelligence, personality, and sex. We considered that the Patau syndrome and sex would have a relatively equally high impact on someone's life, while hay fever and someone's athletic ability may have a relatively equally lesser impact on someone's life.

After each scenario, the participants have to answer four questions. These questions were "I support the genetical intervention", "I think the genetic intervention is ethically justified", "The genetic intervention would benefit the person", and "The genetic intervention would benefit the society." Participants had to respond to these questions using a Likert scale that went from one to ten (1 = *not at all*, 10 = *totally*).

In a brief correlation calculation, we found that there was a strong correlation between the ratings on "I support the genetical intervention" and the ratings on "I think the genetic intervention is ethically justified" ($r(518) = 0.98$, $p < .001$). Because of the strong correlation between these two ratings, we decided to combine them, by taking the mean, in the variable Approval Ratings. This variable will be used in most of our analyses.

Utilitarianism versus Deontology

In the last part of our survey two moral dilemmas are shown (the dilemmas are included in Appendix C). These dilemmas are known as variations of the Trolley dilemma (Thomson, 1985). In the first dilemma, it is stated that a runaway trolley is coming toward five unsuspected individuals who are working on the track. If the trolley stays on this track, the five individuals will be run over and die. Next to you, there is a handle and you can redirect the trolley to a different track. However, on this track, there is one unsuspected workman who will die if you pull the handle and redirect the trolley to this track. The participants are asked what they will do. Pull the handle by which they save the five individuals, but kill one person, or leave the handle for what it is with the consequence that the five individuals die, but the one person will survive. The second dilemma is the same story, but now you stand on a bridge next to a big person. You can save the five unsuspected workmen on the track by pushing the fat person off the bridge on the track in front of the trolley, but the fat person will die. Again, the participants are asked what they will do. Push the big person from the bridge and save the five individuals, or do nothing, and the five persons will die. For both dilemmas, the participants are also asked to what extent they find it morally acceptable to sacrifice one person to save five others. This is scored on a 7-point Likert scale (1 = *not at all acceptable*, 7 = *totally acceptable*). The dilemmas can be found in Appendix C.

At the end of the survey, we also included demographic questions, such as age and gender. We also included two questions that probed for self-perceived interest and knowledge about gene editing.

Statistical analyses

In our analysis, we used linear regressions to investigate which predictors (Interest, Knowledge, the six moral foundations, and the answer to the switch and footbridge dilemma)

predicted attitudes toward gene editing. Additionally, we used paired *t*-tests to investigate whether (overall) there was a significant difference between the Medical and Enhancement condition for support, ethical justification, benefits person, and benefits society. The Medical condition consisted of the mean ratings of the five genetic diseases (hay fever, Down syndrome, mucoviscidosis, heart disease, Patau syndrome), and the Enhancement condition consisted of the mean ratings of the five enhancements (athletic ability, appearance, intelligence, personality, sex).

Furthermore, we were interested in whether interest, knowledge, and the morality indicators could be linked to the ratings on support and ethical justification, and whether these relationships were mediated by the benefit to the person or society. To test this, we conducted mediation analyses by using the *lavaan* package in RStudio (Rosseel et al., 2017). In the mediation analyses, we used a 5000-sample bootstrap. The independent variables (IV) were: Interest, Knowledge, the six moral foundations, and the answers to the switch or footbridge dilemma. The dependent variable (DV) was: Approval Ratings (mean of the support and ethical justification ratings). The mediators (M1 and M2) were: Benefits Person (BP) and Benefits Society (BS). There was a mediation analysis for each independent variable separately, the two mediators were included in every mediation model.

In the second part of our analysis, we went deeper into each condition (i.e., Medical or Enhancement). In these analyses, we were particularly interested in the effect of 'impact' on the Approval Ratings. To accomplish this, we created a subjective ranking with a gradual increase in impact of the five medical diseases and the five enhancements, rating from least to most impactful. The ranking for medical diseases was based on the life expectancy (e.g., Patau syndrome versus hay fever) and the level of discomfort and quality of life e.g. (mucoviscidosis versus hay fever). From lowest to highest: hay fever, Down syndrome, mucoviscidosis, heart disease, and Patau syndrome. For enhancements, the ranking was based on the assumed potential to alter the course of the target's life and identity (who they are as a person). From lowest to highest: athletic ability, appearance, intelligence, personality, and sex. We conducted linear regression models for each scenario separately, so ten in total. In the models, the DV was the Approval Ratings for that one disease or trait, and the IVs were Benefits Person and Benefits Society.

All the analyses were conducted in RStudio and the level of significance (α) was 0.05.

Results

Cronbach Alphas and Means

Before starting the main analyses, we calculated the Cronbach alphas and means of the questionnaires we used in our survey. The results are presented in Table 1. The MFQ contained 32 items, the MFV 48 items, and the ATGE 15 items. The Cronbach alphas are between the range of .70 and .95, which are acceptable values for internal consistency (Tavakol & Dennick, 2011).

Table 1

The Cronbach Alphas and Means of the Used Scales in our Survey

Questionnaire	Mean (SD)	Cronbach α
MFQ		.87
Care	3.63 (0.72)	
Fairness	3.72 (0.66)	
Loyalty	2.23 (0.79)	
Authority	2.44 (0.82)	
Sanctity	2.51 (0.79)	
MFV		.90
Care	3.30 (0.52)	
Fairness	3.10 (0.55)	
Loyalty	1.98 (0.89)	
Authority	2.58 (0.63)	
Sanctity	2.23 (0.77)	
Liberty	3.68 (0.44)	
ATGE	4.49 (1.01)	.86

The Potential Predictors for Attitudes Toward Gene Editing

First, we focused on whether Interest and Knowledge in genetic manipulation have an impact on the attitudes toward genetic editing scale. We found that higher interest ($\beta = 0.16$, $p < .001$) and knowledge ($\beta = 0.17$, $p < .001$) in genetic manipulation led to higher scores on the ATGE questionnaire.

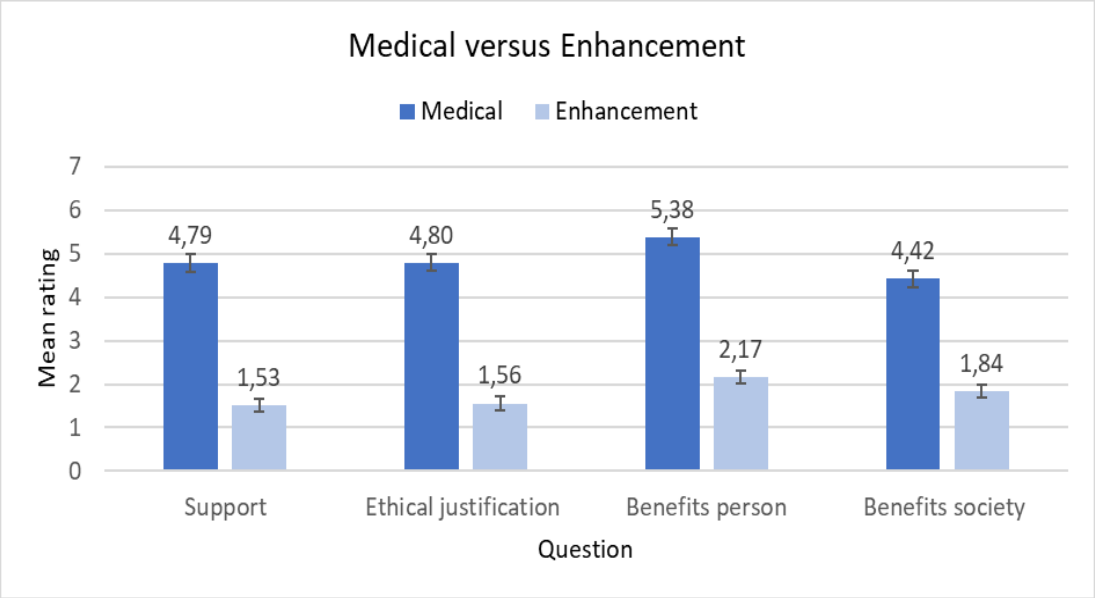
Next, we were interested in how morality impacted the attitudes toward gene editing. We found that higher scores on the moral foundation Care ($\beta = -0.03$, $p = .018$), and Sanctity ($\beta = -0.07$ $p < .001$) of the MFQ, and the moral foundations Care ($\beta = -0.41$, $p < .001$), Authority ($\beta = -0.33$, $p < .001$), and Sanctity ($\beta = -0.29$, $p < .001$) of the MFV significantly led to lower scores on the ATGE questionnaire. For the answers to the switch and footbridge dilemma, we found that choosing the utilitarian option in the switch dilemma led to significantly higher scores on the ATGE questionnaire ($t(258) = -3.00$, $p = .003$).

Differences Between the Medical and Enhancement Condition

Further, we were also interested in whether there was a difference between genetic editing with a medical versus an enhancing purpose in people's support, and ratings of ethical justification, benefit to the person, and benefit to society. The mean ratings are presented in Figure 1 which demonstrates that there is a quite substantial difference between the medical and the enhancement condition for all four variables.

Figure 1

The Mean Ratings for the Four Questions in the Medical versus Enhancement Condition



Note. The error bars represent the Standard Errors (SE).

We found a significant effect of purpose (Medical vs Enhancement) on the rating of support ($t(2598) = 48.39$, $p < .001$) and the rating of ethical justification ($t(2598) = 47.70$, $p < .001$). A paired *t*-test showed that purpose also had a significant effect on the ratings of both benefit to the person ($t(2598) = 45.80$, $p < .001$) and benefit to society ($t(2598) = 36.19$, $p < .001$). The Estimated Marginal Means (EMMS) can be found in Table D1 and the results of the contrast analyses can be found in Table D2 in Appendix D.

In the following analyses, we combined the ratings on support and ethical justification in the variable Approval Ratings (AR). We decided to do this because there is a high correlation between the two ($r(518) = 0.98$, $p < .001$) and Figure 1 also shows that they have a similar pattern. Additionally, we found that the variable Approval Ratings was correlated with the ratings on the benefit to person (BP) and the benefit to society (BS), in both Medical and Enhancement conditions. In the Medical condition, there was a strong correlation between the Approval Ratings and the ratings on the benefit to the person ($r(258) = 0.80$, $p < .001$) and the benefit to society ($r(258) = 0.79$, $p < .001$). In the Enhancement condition, we also found that

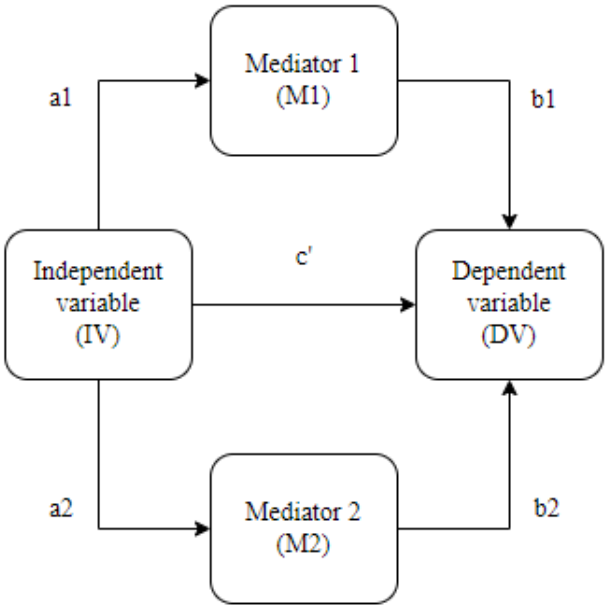
the correlation between the Approval Ratings and the ratings on the benefit to the person ($r(258) = 0.59$, $p < .001$) and the benefit to society ($r(258) = 0.72$, $p < .001$) were relatively high.

Predictors and Mediators for the Approval Ratings in the Specific Cases

Next, we investigate whether Interest, Knowledge, and morality variables predict support (Support) and ethical justification (Ethical) ratings for medical and enhancement gene editing. Additionally, we are interested in whether assessments of benefit to the person and benefit to society played a mediating role in the relationship between the Interest, Knowledge, and morality variables on the one hand, and the Approval Ratings for the medical and enhancement cases on the other hand. Therefore, we conducted mediation analyses testing the overall effects of interest, knowledge, and moral foundations (represented by the total effect values), providing additional estimates of how much of the effect is explained by 'benefit assessment'. The structure of the relationship is shown in Figure 2. The IV in the model could be Interest, Knowledge, or morality indicators. The first mediator is Benefits Person (BP), and the second mediator is Benefits Society (BS). The DV is the Approval Ratings (AR).

Figure 2

Visualization of the Mediation Models



In our results, we will mention the total effects, indirect effects, total indirect effects, and direct effects. The total effect is c' + (a1*b1) + (a2*b2). The first indirect effect is (a1*b1) and the second is (a2*b2) and the total indirect effect is (a1*b1) + (a2*b2). Lastly, the direct effect is c'.

The Effect of Interest and Knowledge on the Approval Ratings

First, we tested the Medical condition. We found that higher scores on interest and knowledge led to significantly higher scores on the Approval Ratings, which were both mediated by the benefit to the person (BP). For Interest, it was also significantly mediated by the benefit to society (BS). In addition, both also had a significant total indirect effect. We did not find significant results in the Enhancement condition. The results can be found in Table 2. The path coefficients are presented in Table D3 in Appendix D and the separate mediation results for Support and Ethical can be found in Table D4 for the Medical condition and Table D5 for the Enhancement condition in Appendix D.

Table 2

Total, Total Indirect, Indirect, and Direct effects of Interest and Knowledge via BP and BS on Approval Ratings

	Total effect	Total indirect effect	Indirect effect via BP	Indirect effect via BS	Direct effect
Medical					
Interest	**0.089** (0.031) [0.029; 0.150]	**0.088** (0.027) [0.035; 0.141]	**0.055** (0.018) [0.022; 0.091]	**0.034** (0.015) [0.006; 0.065]	0.000 (0.015) [-0.029; 0.030]
Knowledge	**0.078** (0.036) [0.006; 0.147]	**0.064** (0.030) [0.002; 0.122]	**0.040** (0.019) [0.004; 0.078]	0.024 (0.016) [-0.008; 0.056]	0.014 (0.019) [-0.024; 0.052]
Enhancement					
Interest	0.022 (0.023) [-0.021; 0.069]	0.022 (0.018) [-0.011; 0.060]	0.003 (0.004) [-0.002; 0.012]	0.019 (0.016) [-0.011; 0.054]	0.000 (0.014) [-0.026; 0.028]
Knowledge	0.019 (0.025) [-0.027; 0.071]	0.019 (0.020) [-0.016; 0.064]	0.002 (0.004) [-0.003; 0.012]	0.017 (0.018) [-0.014; 0.058]	0.000 (0.017) [-0.034; 0.034]

Note. We used a 5000-sample bootstrap. Values in bold are significant ($p < .05$). Values between parentheses denote Standard Errors, values between brackets denote Confidence Intervals (95%).

The Effect of Morality on the Approval Ratings

Medical. First, we analyzed the relationships between the moral foundations and the Approval Ratings and whether it is mediated by the benefit to the person (BP) and the benefit to society (BS). The results are presented in Table 3. We found significant effects for the moral foundations Care, Loyalty, and Sanctity of the MFQ, and the moral foundations Care and Sanctity of the MFV.

The analyses showed that there was a negative significant total effect of the moral foundations Care (MFQ & MFV), and Sanctity (MFQ) which means that higher scores on these moral foundations led to lower ratings on the Approval Ratings. The relation between the moral foundation Care (MFQ) and Approval Ratings is mediated by the benefit of the person and the benefit to society. The total indirect effect was also significant and negative. For the moral foundation Sanctity (MFQ), it was only mediated by the benefit to the person. In this relation,

the total indirect effect was significant and negative. Further, we discovered a negative, significant, indirect effect via the benefit to the person for the relation between the moral foundation Loyalty (MFQ) and the Approval Ratings, and also between the moral foundation Sanctity (MFV) and the Approval Ratings. The latter also contained a negative significant total indirect effect. The mediation effect in all relationships was the following: higher scores on the moral foundations led to lower ratings on the benefit to the person or the benefit to society, which in turn led to lower ratings on the Approval Ratings. The path coefficients can be found in Table D6 in Appendix D6.

Next, we analyzed the relationships between the answers on the moral dilemmas and the Approval Ratings for which the results can be found in Table 3. We found that choosing the utilitarian option in the switch dilemma led to higher ratings on the Approval Ratings. This relationship is mediated through the benefit to the person. The total indirect effect was also significant. Further, we found a significant, positive direct effect for the relationship between choosing the utilitarian option in the footbridge dilemma and the Approval Ratings.

The results of the separate mediation analyses for Support and Ethical can be found in Table D7 in Appendix D.

Table 3

Total, Total Indirect, Indirect, and Direct effects of Morality via BP and BS on Approval Ratings in the Medical Condition

	Total effect	**Total indirect effect**	**Indirect effect via BP**	**Indirect effect via BS**	**Direct effect**
Care	**-0.029** (0.014)	**-0.030** (0.012)	**-0.018** (0.007)	**-0.013** (0.006)	0.001 (0.006)
	[-0.054; -0.001]	[-0.052; -0.007]	[-0.031; -0.005]	[-0.026; 0.000]	[-0.011; 0.014]
Care	**-0.220** (0.106)	-0.129 (0.090)	-0.084 (0.052)	-0.045 (0.048)	-0.091 (0.049)
	[-0.417; -0.001]	[-0.297; 0.060]	[-0.187; 0.019]	[-0.138; 0.052]	[-0.185; 0.005]
Fairness	-0.010 (0.015)	-0.010 (0.013)	-0.008 (0.007)	-0.002 (0.007)	-0.001 (0.007)
	[-0.038; 0.019]	[-0.034; 0.015]	[-0.022; 0.007]	[-0.015; 0.011]	[-0.015; 0.013]
Fairness	0.014 (0.105)	0.020 (0.089)	-0.013 (0.051)	0.033 (0.046)	-0.007 (0.054)
	[-0.196; 0.217]	[-0.153; 0.196]	[-0.110; 0.085]	[-0.059; 0.125]	[-0.108; 0.100]
Loyalty	-0.018 (0.012)	-0.019 (0.011)	**-0.012** (0.006)	-0.007 (0.006)	0.001 (0.006)
	[-0.041; 0.005]	[-0.041; 0.002]	[-0.025; -0.001]	[-0.019; 0.004]	[-0.010; 0.012]
Loyalty	0.031 (0.065)	-0.007 (0.055)	-0.016 (0.030)	0.009 (0.029)	0.038 (0.029)
	[-0.099; 0.161]	[-0.114; 0.102]	[-0.077; 0.041]	[-0.048; 0.068]	[-0.018; 0.096]
Authority	-0.004 (0.013)	-0.004 (0.011)	-0.002 (0.006)	-0.002 (0.006)	0.000 (0.006)
	[-0.030; 0.021]	[-0.025; 0.018]	[-0.015; 0.010]	[-0.015; 0.010]	[-0.012; 0.011]
Authority	-0.176 (0.093)	-0.121 (0.081)	-0.086 (0.048)	-0.034 (0.042)	-0.055 (0.044)
	[-0.358; 0.008]	[-0.275; 0.039]	[-0.184; 0.003]	[-0.118; 0.047]	[-0.141; 0.031]

	Total effect	Total indirect effect	Indirect effect via BP	Indirect effect via BS	Direct effect
Sanctity	**-0.026** (0.012)	**-0.020** (0.010)	**-0.014** (0.006)	-0.006 (0.006)	-0.007 (0.006)
	[-0.049; -0.004]	[-0.039; 0.000]	[-0.026; -0.003]	[-0.018; 0.004]	[-0.019; 0.005]
Sanctity	-0.143 (0.077)	**-0.129** (0.064)	**-0.088** (0.038)	-0.041 (0.036)	-0.014 (0.040)
	[-0.289; 0.011]	[-0.252; 0.003]	[-0.165; -0.018]	[-0.113; 0.030]	[-0.094; 0.066]
Liberty	0.034 (0.177)	-0.027 (0.132)	-0.036 (0.068)	0.009 (0.074)	0.061 (0.082)
	[-0.221; 0.458]	[-0.225; 0.281]	[-0.144; 0.125]	[-0.103; 0.183]	[-0.068; 0.259]
Switch	**0.331** (0.142)	**0.286** (0.124)	**0.161** (0.080)	0.125 (0.066)	0.045 (0.084)
	[0.052; 0.607]	[0.044; 0.540]	[0.016; 0.332]	[0.004; 0.261]	[-0.122; 0.207]
Footbridge	0.171 (0.128)	-0.053 (0.108)	-0.033 (0.064)	-0.021 (0.055)	**0.224** (0.062)
	[-0.074; 0.422]	[-0.074; 0.422]	[-0.158; 0.095]	[-0.129; 0.088]	[0.103; 0.345]

Note. We used a 5000-sample bootstrap. Values in bold are significant ($p < .05$). Values between parentheses denote Standard Errors, values between brackets denote Confidence Intervals (95%). The italic moral foundations are from the MFQ, and the other moral foundations are from the MFV.

Enhancement. We analyzed the relationships between the moral foundations and the Approval Ratings for which the results can be found in Table 4. The analyses showed significant effects for the moral foundations Care and Fairness of the MFQ, and the moral foundations Care, Authority, and Sanctity of the MFV.

We discovered negative significant total effects for the moral foundations Care (MFV), Fairness (MFQ), Authority (MFV), and Sanctity (MFV) which means that higher scores on these moral foundations led to lower ratings on the Approval Ratings. The relation between the moral foundation Care (MFV) and the Approval Ratings is mediated by the benefit to society and the total indirect effect was significant and negative. The relationship also contained a negative significant direct effect. The relationship between the moral foundation Authority (MFV) and Approval Ratings also contained a negative significant direct effect. Further, the relationship between the moral foundation Care (MFQ) and the Approval Ratings contained a negative significant indirect effect via the benefit to society and the total indirect effect was also significant and negative. The mediation effect in the relationships was the same as in the Medical condition, namely, higher scores on the moral foundations led to lower ratings on the benefit to society, which in turn led to lower ratings on the Approval Ratings. The path coefficients can be found in Table D8 in Appendix D. The analyses for the moral dilemmas showed no significant results. The results of the separate mediation analyses for Support and Ethical can be found in Table D9 in Appendix D.

Table 4

Total, Total Indirect, Indirect, and Direct effects of Morality via BP and BS on Approval Ratings in the Enhancement Condition

	Total effect	**Total indirect effect**	**Indirect effect via BP**	**Indirect effect via BS**	**Direct effect**
Care	-0.024 (0.015)	**-0.024** (0.011)	-0.004 (0.003)	**-0.020** (0.010)	0.000 (0.008)
	[-0.053; 0.006]	[-0.046; -0.004]	[-0.010; 0.002]	[-0.042; -0.003]	[-0.015; 0.018]
Care	**-0.386** (0.100)	**-0.192** (0.083)	-0.017 (0.030)	**-0.175** (0.081)	**-0.194** (0.054)
	[-0.576; -0.187]	[-0.364; -0.041]	[-0.080; 0.038]	[-0.345; -0.030]	[-0.295; -0.085]
Fairness	**-0.028** (0.013)	-0.016 (0.009)	-0.002 (0.002)	-0.013 (0.009)	-0.012 (0.009)
	[-0.054; -0.002]	[-0.036; 0.001]	[-0.008; 0.002]	[-0.033; 0.002]	[-0.030; 0.005]
Fairness	-0.103 (0.080)	-0.070 (0.056)	-0.015 (0.015)	-0.055 (0.051)	-0.032 (0.047)
	[-0.269; 0.046]	[-0.190; 0.028]	[-0.051; 0.008]	[-0.166; 0.031]	[-0.126; 0.057]
Loyalty	-0.007 (0.008)	-0.004 (0.006)	-0.001 (0.001)	-0.003 (0.006)	-0.003 (0.005)
	[-0.023; 0.009]	[-0.017; 0.008]	[-0.004; 0.001]	[-0.015; 0.008]	[-0.013; 0.007]
Loyalty	-0.039 (0.053)	-0.007 (0.037)	-0.002 (0.006)	-0.005 (0.033)	-0.032 (0.033)
	[-0.150; 0.058]	[-0.086; 0.060]	[-0.017; 0.009]	[-0.077; 0.055]	[-0.097; 0.033]
Authority	0.005 (0.009)	0.004 (0.006)	0.000 (0.001)	0.003 (0.006)	0.001 (0.006)
	[-0.012; 0.023]	[-0.008; 0.017]	[-0.002; 0.002]	[-0.006; 0.016]	[-0.010; 0.012]
Authority	**-0.203** (0.082)	-0.096 (0.062)	-0.013 (0.015)	-0.083 (0.058)	**-0.107** (0.047)
	[-0.370; -0.048]	[-0.226; 0.019]	[-0.047; 0.013]	[-0.207; 0.022]	[-0.200; -0.016]
Sanctity	-0.013 (0.009)	-0.012 (0.007)	-0.002 (0.002)	-0.009 (0.006)	-0.002 (0.006)
	[-0.033; 0.004]	[-0.027; 0.001]	[-0.008; 0.001]	[-0.023; 0.002]	[-0.013; 0.009]
Sanctity	**-0.128** (0.053)	-0.064 (0.044)	-0.012 (0.015)	-0.052 (0.039)	-0.064 (0.037)
	[-0.236; -0.032]	[-0.160; 0.013]	[-0.046; 0.014]	[-0.139; 0.016]	[-0.135; 0.007]
Liberty	-0.165 (0.120)	-0.085 (0.075)	-0.014 (0.019)	-0.071 (0.066)	-0.080 (0.080)
	[-0.436; 0.026]	[-0.260; 0.029]	[-0.064; 0.012]	[-0.222; 0.030]	[-0.256; 0.066]
Switch	-0.133 (0.129)	-0.153 (0.095)	-0.015 (0.018)	-0.138 (0.089)	0.020 (0.076)
	[-0.411; 0.100]	[-0.376; 0.007]	[-0.060; 0.011]	[-0.346; 0.003]	[-0.125; 0.167]
Footbridge	0.128 (0.091)	0.013 (0.060)	0.002 (0.011)	0.011 (0.053)	0.115 (0.068)
	[-0.042; 0.318]	[-0.105; 0.136]	[-0.017; 0.031]	[-0.097; 0.114]	[-0.010; 0.253]

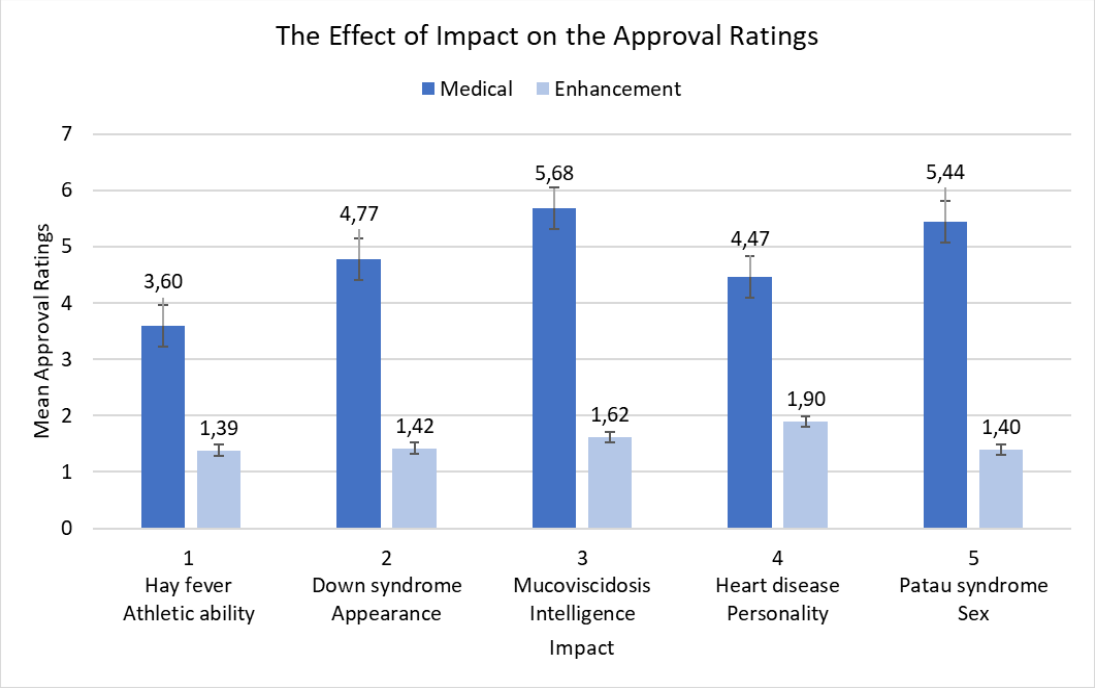
Note. We used a 5000-sample bootstrap. Values in bold are significant ($p < .05$). Values between parentheses denote Standard Errors, values between brackets denote Confidence Intervals (95%). The italic moral foundations are from the MFQ, and the other moral foundations are from the MFV.

The Effect of Impact on the Approval Ratings

In the next part of our analysis, we focused more on the impact of the different diseases or enhancements on the Approval Ratings. Figure 3 demonstrates the Estimated Marginal Means (EMMS) for the Approval Ratings for each disease or enhancement.

Figure 3

The EMMS for the Approval Ratings for each Disease or Enhancement



Note. The numbers on the x-axis represent the subjective impact rating. Under the number are the corresponding disease and enhancement respectively. The error bars represent the Standard Errors.

We found for the Medical condition that mucoviscidosis had the highest rating on the Approval Ratings. Then the Patau syndrome, followed by Down syndrome, heart disease, and hay fever respectively. For the Enhancement condition, we found that personality had the highest rating on the Approval Ratings then intelligence, appearance, sex, and athletic respectively. The results of the contrast analyses can be found in Table D10 in Appendix D. To further investigate the effect of impact, we tested the effect of the benefit to the person (BP) and the benefit to society (BS) on the Approval Ratings (AR) for each scenario. The results can be found in Table 5.

Table 5

The Effects of BS and BP on the Different Diseases and Enhancements

Condition	Scenario	Impact	Estimates		Adjusted R^2	p-value
			BP	BS		
Medical	Patau syndrome	5	**0.62**	**0.23**	0.60	< .001
	Heart disease	4	**0.54**	**0.38**	0.67	< .001
	Mucoviscidosis	3	**0.66**	**0.33**	0.70	< .001
	Down syndrome	2	**0.56**	**0.36**	0.70	< .001
	Hay fever	1	**0.44**	**0.48**	0.66	< .001
Enhancement	Sex	5	**0.47**	0.16	0.31	< .001
	Personality	4	**0.45**	0.10	0.46	< .001
	Intelligence	3	**0.11**	**0.34**	0.35	< .001
	Appearance	2	**0.15**	**0.50**	0.41	< .001
	Athletic	1	**0.09**	**0.49**	0.44	< .001

Note. Estimates in bold are significant within the model.

We found that the benefit to the person (BP) and the benefit to society (BS) explained more unique variance for the medical diseases than for the enhancements. In addition, the estimates of the benefit to the person and the benefit to society were all significant, except the benefit to society in the scenarios of Sex and Personality. It is also noticeable that there is no linear relationship between the amount of variance that is explained and the level of impact in both conditions.

Discussion

In this study, we were mainly interested in how the six moral foundations and the moral concerns of deontology and utilitarianism can be linked to attitudes toward genetic manipulation in humans. Additionally, we investigated whether these relationships were mediated by the benefit to the person or society. Further, we were also interested in whether there was a difference in attitudes between gene editing with a medical or an enhancing purpose. Moreover, we also examined whether there was an effect of the impact of the diseases and enhancements on the attitudes. Lastly, we were interested in whether interest in and knowledge about genetic manipulation influenced the attitudes toward gene editing in humans. To test these questions, we used the MFQ and a selection of vignettes of the MFV, an adaptation of the ATGE questionnaire, five scenarios about gene editing of medical diseases, and five about gene editing of enhancements. We also added two trolley-style moral dilemmas.

Our results showed that mainly the moral foundations Care and Sanctity and choosing the utilitarian option were linked to attitudes toward genetic manipulation. These findings are in line with our hypothesis, however, we also expected an effect of the moral foundation Fairness and the moral concern of deontology. We found that, for medical purposes, higher scores on the moral foundations Care and Sanctity led to lower scores on the ratings of benefit to the person

or society, which in turn led to lower ratings on support and ethical justification. Contrary, choosing the utilitarian option in the switch dilemma led to higher ratings on the benefit to the person, which in turn led to higher ratings for support and ethical justification. We also found that choosing the utilitarian option in the footbridge dilemma led to higher ratings on support and ethical justification. For enhancing purposes, we discovered that higher scores on the moral foundation Care led to lower ratings on the benefit to society, which in turn led to lower ratings on support and ethical justification. We also found that higher scores on the moral foundation Fairness, Authority, and Sanctity led to lower ratings on support and ethical justification. Moreover, we found that people are more supportive of gene editing in humans when it has a medical purpose than when it has an enhancing purpose as we expected. Interestingly, the impact of the disease or enhancement on someone's life did not have an effect which was not expected. Lastly, we found that higher (self-reported) interest and knowledge in gene manipulation led to higher scores on the ATGE questionnaire which is in line with our hypothesis.

Morality and Approval of Gene Editing in Humans

It is interesting to discover that especially the moral foundations Care and Sanctity had a link with attitudes toward genetic manipulation in humans. Individuals who score high on the moral foundation Care are concerned about the well-being of others and especially those who are injured and vulnerable (Graham et al., 2013; Suhler & Churchland, 2011). As a result, we would expect that individuals who score high on this moral foundation would have more positive attitudes toward gene editing because it has the potential to eliminate a genetic disease that has an impact on someone's life. However, we found the opposite. A possible explanation can be that these individuals are more concerned about the risks of these relatively new technologies. It is possible that for these individuals, the risks of these editing techniques outweigh the benefit, namely eliminating the genetic disease. The results for the moral foundation Sanctity seem more intuitive. Individuals who score high on this moral foundation are mainly individuals who hold purity in high regard (Clifford et al., 2015). Indeed, in the paper of Delhove and colleagues (2020), they found that the main ethical worry about genetic manipulation was that it may disrupt nature.

For the enhancing purpose of gene editing, we found a relationship between the moral foundations Fairness and Authority and the ratings of support and ethical justification. These relationships were not mediated by the benefit to the person or the society and were also not found for gene editing with a medical purpose. Individuals who score higher on the moral foundation Fairness may be more concerned with the inequalities that can go along with gene editing. A possible explanation for why we observed this effect for the enhancing purpose and

not the medical purpose can be that if gene editing of characteristics is possible, there are more opportunities to edit a characteristic than a disease. Everyone has a characteristic they can edit, however, not everyone has a genetic disease. Wealthy people who can afford these genetic enhancements, could edit every characteristic they have and thus transform themselves into a "super-human" making the gap between rich and poor more visible (Boonin, 2018; Bostrom, 2003). Individuals who score high on the moral foundation Authority find it important to respect the authorities (Clifford et al., 2015). This might be more prominent for enhancing purposes because in general people are more acceptant of gene editing when eliminating a disease rather than enhancing a characteristic or trait (Delhove et al., 2020; Gaskell et al., 2017; McCaughey et al., 2016). Moreover, Rossant (2018) mentions in his paper that the National Academy of Sciences, which is an authority, banned human gene editing that did go beyond treatment such as enhancement.

Another finding that is noteworthy to mention is that the mediating role of the benefit to the person was only found in the relationships between the moral foundations and the ratings on support and ethical justification when gene editing had a medical purpose and not when it had an enhancing purpose. A possible explanation can be that enhancing is seen as adjusting a characteristic that is within a normal range in a desired direction. Contrarily, genetic diseases can have a major impact on someone's life. Therefore, gene editing can be more beneficial for a person who has a genetic disease compared to a person who wants to edit an already normal characteristic.

We also found that individuals who chose the utilitarian option in the switch and footbridge dilemma had higher ratings on support and ethical justification. According to the paper of Smith (2020), human germline genetic modification can increase utility on two levels, namely on the individual level and on the level of the population. On the individual level, it can avoid the suffering of individuals. On the population level, there would be a world with fewer diseases and debilities which means higher overall utility. Both would lead to a greater good for a greater number of people which is one of the motives of utilitarians (Isenberg, 1964).

Remarkably we did not find significant results for individuals who chose the deontological option in the moral dilemmas. Deontology is based on moral rules (Gawronski et al., 2017). It is possible that the moral rules about the relatively new gene editing technique are not clear. For instance, the CRISPR technique can eliminate genetic diseases, however, it also includes some risks such as off-target mutations. As a deontologist, you do not want to hurt people, but whether you edit the genes or not, the person might get hurt.

Another remarkable discovery is that we did not find the same results for the moral foundations of the MFQ and those of the MFV. In our study, we decided to use both. This decision was made because each has its advantages and disadvantages and because both are intended to measure the same moral foundations (except for the moral foundation Liberty which is only measured by the MFV), we expected that the results would also be similar. However, it is noticeable that we found different results for the moral foundations of the MFQ and the MFV. A possible explanation can be due to the way the MFQ and the MFV measure the moral foundations. The former uses abstract statements and the latter imaginable scenarios (Clifford et al., 2015; Graham et al., 2011). These differences in measurement can lead to the engagement of different cognitive processes which can lead to different results.

Approval of Gene Editing with Medical Purposes Compared with Enhancing Purposes

Although some people are skeptical about gene editing in humans, there is a higher acceptance of gene editing for medical diseases than for enhancements (Delhove et al., 2020, 2020; Gaskell et al., 2017; McCaughey et al., 2016). A possible explanation might be that gene therapy may be more accepted because it has primarily moral goals. Genetic enhancement, contrarily, has more goals that are morally questionable (Resnik, 2000). Another explanation for why people are in general more acceptant of gene editing for medical purposes is that the benefits may outweigh the risks.

For the medical diseases, we expected that Patau syndrome would have the highest rating on support because this syndrome has a high impact on someone's life expectancy. However, the results showed that the highest rating on support was for mucoviscidosis. A possible explanation can be that mucoviscidosis is more known in the general population and people may have a better idea about it compared to the Patau syndrome. We also found that the rating on support for heart disease was also lower than expected. This might be because there was an alternative to eliminate the disease, namely an operation. Indeed, the presence of an alternative with the same benefit but with lower risks may also cause people to be less positive toward genetic editing (Lange & Kappel, 2022).

Predictors of Attitudes Toward Gene Editing

First, it is interesting to see that (self-reported) interest in and knowledge about gene editing can have a positive effect on the attitudes of people toward gene editing. This may explain why individuals do not accept gene editing because of a lack of understanding of the technology as mentioned in the study of Delhove and colleagues (2020). This study found that people with a higher (self-reported) knowledge of gene editing had a higher acceptance of the techniques, which demonstrates that educating individuals on gene editing is likely to positively shift

people's attitudes toward genetic manipulation. To create better regulations around genetic manipulation, it is important to maintain an ongoing dialogue between patients, the public, scientists, clinicians, and policymakers (Delhove et al., 2020; McCaughey et al., 2016, 2019).

Moreover, we found that the moral foundations Sanctity, Care, and Authority also influenced the attitudes toward gene editing. However, this was a negative effect, which means that higher scores on these moral foundations led to lower scores on the ATGE questionnaire. The same explanation regarding these moral foundations' effects on the ratings of support and ethical justification can be applied. Individuals who score high on the moral foundation Care may be more concerned about the risks associated with gene editing techniques rather than the potential benefits it has. Individuals who score high on the moral foundation Sanctity may prioritize notions of purity and view gene editing as a violation of nature (Clifford et al., 2015). Additionally, individuals who score high on the moral foundation Authority may be resistant to accepting gene editing because gene editing in humans is not widely accepted by authorities (Baylis et al., 2020).

Limitations and Future Directions

Our study has some limitations. One of them is the subjective ranking used for investigating the impact of the different diseases and enhancements. This subjective ranking was not based on the literature. We also found that most of our sample consisted of women, which may affect our results. For instance, previous research found that women were less interested and less acceptant of gene editing compared to men (Hampel et al., 2000; Hendriks et al., 2018). Another limitation we want to address is that someone's opinion may depend on who they rate in a given situation. In the scenarios we used, the participants had to rate questions about a couple they did not know. It is possible that if they had to rate questions in which they found themselves in the situation, their rates would be different. Indeed, a study by Hendriks and colleagues (2018) found that the majority of the participants were willing to edit genes in themselves to prevent the transmission of neuromuscular disease to their offspring.

In this study, we used a survey to investigate how the moral foundations and moral concerns of deontology and utilitarianism can be linked to the attitudes toward genetic manipulation in humans. It may also be interesting to test this with experimental designs to further investigate how the mechanisms behind these moral foundations and concerns can influence attitudes. Moreover, to set up good regulations around genetic manipulation in humans, it is important to not only listen to the experts but also to the public and that is what we tried to do in this study. Gene editing in humans is a topic that concerns people all over the world. Our study was done in Belgium and was limited to Flemish participants, therefore, it can be

interesting for future research to include people with diverse backgrounds and different countries.

Conclusion

To conclude, we found that especially the moral foundations Care and Sanctity, and the moral concern of utilitarianism can be linked with attitudes toward genetic manipulation in humans. Moreover, we found that high interest in and knowledge about gene manipulation led to higher acceptance of gene editing. It may be important for policymakers to keep the moral values of the public in mind if they design a policy for gene editing in humans. It is also important to help the public understand how this technique works and what the benefits and risks are. Further research is needed to gather more information about what the public thinks about gene editing in humans and what their concerns are.

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Appendix A

The Moral Foundations Questionnaire

Moral Foundations Questionnaire by Graham et al. (2011), measured on a scale from zero to five (0 = *not at all relevant*, 5 = *extremely relevant*).

“Of iemand emotioneel heeft geleden”

“Of sommige mensen anders behandeld werden dan anderen”

“Of iemands daden liefde toonden voor zijn of haar land”

“Of iemand een gebrek aan respect voor autoriteit heeft getoond”

“Of iemand standaarden van puurheid en fatsoenlijkheid geschonden heeft”

“Of iemand goed was in wiskunde”

“Of iemand zorgde voor een zwak of kwetsbaar iemand”

“Of iemand oneerlijk heeft gehandeld”

“Of iemand zijn of haar groep verraden heeft”

“Of iemand de tradities van de maatschappij volgde”

“Of iemand iets walgelijks heeft gedaan”

“Of iemand wreed was”

“Of iemands rechten werden ontzegd”

“Of iemand een gebrek aan loyaliteit heeft getoond”

“Of iemands actie chaos of wanorde veroorzaakte”

“Of iemand zich gedroeg op een wijze die God zou goedkeuren”

“Medeleven met degenen die lijden, is de allerbelangrijkste deugd”

“Wanneer de overheid wetten maakt, dan moet de garantie dat iedereen eerlijk behandeld wordt het allerbelangrijkste principe zijn”

“Ik ben trots op de geschiedenis van mijn land”

“Respect voor autoriteit is iets dat alle kinderen moeten leren”

“Mensen behoren geen walgelijke dingen te doen, zelfs wanneer er niemand schade berokkend wordt”

“Het is beter iets goeds te doen dan iets slechts”

“Een van de ergste dingen die een mens kan doen is een weerloos dier pijn doen”

“Rechtvaardigheid is de belangrijkste vereiste voor een maatschappij”

“Mensen behoren loyaal te zijn aan hun familieleden, zelfs wanneer zij iets slechts hebben gedaan”

“Mannen en vrouwen hebben elk verschillende rollen in de maatschappij”

“Ik vind sommige daden slecht, omdat zij onnatuurlijk zijn”

"Het kan nooit goed zijn om een mens te doden"
"Ik vind dat het moreel onjuist is dat rijke kinderen een heleboel geld erven, terwijl arme kinderen niets erven"
"Het is belangrijker om een teamspeler te zijn dan om jezelf te uiten"
"Als ik een soldaat was en ik was het oneens met de orders van mijn leidinggevende, dan zou ik toch gehoorzamen omdat dit mijn plicht is"
"Kuisheid is een belangrijke en waardevolle deugd"

The Moral Foundation Vignettes

The Moral Foundations Vignettes were selected from the paper of Clifford et al. (2015), and measured on a scale from zero to four (0 = *not at all wrong*, 4 = *extremely wrong*).

Care Foundation

"Je ziet een vrouw hardop commentaar geven over hoe dik een andere vrouw er uitziet in haar jeans."
"Je ziet een jongen die zijn broer uitlacht omdat hij gedumpt is door zijn vriendin."
"Je ziet een man tegen een vrouw zeggen dat haar schilderij eruitziet alsof het door kinderen is gemaakt."
"Je ziet een meisje lachen als ze beseft dat de vader van haar vriendin de conciërge is."
"Je ziet een meisje lachen met een andere leerling die haar tekst vergeet tijdens een schooltoneelstuk."
"Je ziet een jongen stenen gooien op grazende koeien in de wei."
"Je ziet iemand zijn hond in de regen achterlaten nadat die in het vuilnis speelde."
"Je ziet een trainer in de zoo een dolfijn prikken om het publiek te entertainen."

Fairness Foundation

"Je ziet een scheidsrechter opzettelijk foute beslissingen nemen om zijn favoriete team te laten winnen."
"Je ziet een student het antwoord van een klasgenoot kopiëren op een examen."
"Je ziet iemand vals spelen in een kaartspel met een groep onbekenden."
"Je ziet een loper tijdens de marathon een kortere weg nemen op het parcours om te winnen."
"Je ziet een meisje zakgeld vragen, ook al deed haar broer de klusjes die zij moest doen."
"Je ziet een politicus die federaal belastinggeld gebruikt om een uitbouw aan zijn huis te bouwen."
"Je ziet een voetballer die doet alsof een tegenstander een serieuze overtreding tegen hem heeft begaan."

“Je ziet een manager de helft van de donuts uit een doos nemen, en weinig over laten voor anderen.”

Liberty Foundation

“Je ziet dat een vader zijn zoon verplicht om hetzelfde beroep als hij te kiezen.”

“Je ziet een vader die van zijn zoon eist dat hij het familierestaurant overneemt.”

“Je ziet een moeder die haar dochter dwingt zich in te schrijven als geneeskunde student op de universiteit.”

“Je hoort dat een moeder tegen haar zoon zegt dat zij zal beslissen wie zijn vrienden zijn.”

“Je ziet een man tegen zijn vriendin zeggen dat ze zich moet bekeren tot zijn geloof.”

“Je ziet een man die zijn vrouw verbiedt kleding te dragen die hij niet eerst heeft goedgekeurd.”

“Je ziet een vrouw tegen haar verloofde zeggen dat hij naar haar politieke partij moet overstappen.”

“Je ziet een man die zijn vrouw belet het huis te verlaten of met anderen om te gaan.”

Authority Foundation

“Je ziet een stagiair die een bevel negeert om zich professioneel te kleden en zijn haar te kammen.”

“Je ziet een meisje haar leraar herhaaldelijk onderbreken terwijl hij een nieuw concept uitlegt.”

“Je ziet een tienermeisje dat laat thuiskomt en de duidelijke avondklok van haar ouders negeert.”

“Je hoort een studente zeggen dat haar prof een idioot is tijdens een les.”

“Je ziet een man zijn rug toekeren en weglopen terwijl zijn baas zijn werk in twijfel trekt.”

“Je ziet een sterspeelster die het bevel van haar coach negeert om naar de bank te komen tijdens een wedstrijd.”

“Je ziet een vrouw graffiti spuiten op de trappen van het gerechtsgebouw.”

“Je ziet hoe een werknemer alle ideeën van haar baas probeert te ondermijnen in het bijzijn van anderen.”

Loyalty Foundation

“Je ziet een coach feestvieren met de spelers van de tegenpartij die net de wedstrijd gewonnen hebben.”

“Je ziet dat de vrouw van de coach een verkoop sponsort voor het rivaliserende team.”

“Je ziet een burgemeester zeggen dat de naburige stad een veel betere stad is.”

“Je ziet een lerares publiekelijk zeggen dat ze hoopt dat een andere school de wiskundewedstrijd wint.”

"Je ziet een Belgische zwemmer juichen als een Chinese tegenstander zijn teamgenoot verslaat en het goud wint."
"Je ziet een Belg tegen buitenlanders zeggen dat België helemaal niets voorstelt in de wereld."
"Je ziet een man zijn familiebedrijf verlaten om voor hun grootste concurrent te gaan werken."
"Je ziet de ambassadeur van België in Nederland grapjes maken over de domheid van de Belgen."

Sanctity Foundation

"Je ziet een neef en nicht met elkaar trouwen in een uitgebreide bruiloft."
"Je ziet een man in het afval zoeken naar afgedankt ondergoed van vrouwen."
"Je ziet een verhaal over een afgelegen stam die het vlees eet van hun overleden leden."
"Je ziet een werknemer in een mortuarium zijn peperoni pizza eten van een lijk."
"Je ziet een homoseksuele man in een homobar die seks aanbiedt aan iedereen die hem een drankje aanbiedt."
"Je ziet een alleenstaande man een opblaasbare sekspop bestellen die op zijn secretaresse lijkt."
"Je ziet een dronken oudere man die orale seks aanbiedt aan iedereen in de bar."
"Je ziet een zeer dronken vrouw zoenen met meerdere vreemden in de stadsbus."

The attitudes toward gene editing statements

The statements were selected from the questionnaire of the Wellcome Consultative Panel on gene therapy (Sturgis et al., 2005). The items were measured using a 6-point Likert scale.
"Over het algemeen doet de moderne wetenschap meer kwaad dan goed."
"Wetenschap en technologie maken ons leven gezonder, gemakkelijker en comfortabeler."
"Wetenschap doet onze manier van leven te snel veranderen."
"Genetische behandelingen van ziekten zullen veel doen om het menselijk lijden te verminderen."
"Iemands genen veranderen is te riskant, wat de voordelen ook mogen zijn."
"Het is beter om te proberen ziektes te genezen zonder de genen van mensen te veranderen."
Uiteindelijk zal onderzoek naar menselijke genen ons meer helpen dan schaden.
"Het zou beter zijn als we helemaal niet wisten hoe we de genen van mensen kunnen veranderen."
"Mensen maken zich te veel zorgen over het risico van het veranderen van menselijke genen."
"We moeten nooit tussenkomen in de genen van mensen."
"Wetenschappers moeten niet zoeken naar genetische behandelingen omdat de wereld dan te overbevolkt wordt."

“Het veranderen van genen zou verboden moeten worden omdat het knoeien is met de natuur.”
“In plaats van de genen te veranderen van mensen met een beperking, moeten we voorzieningen bieden om het leven voor hen gemakkelijker te maken.”
“Het zou moeten worden toegestaan om nieuwe genetische behandelingen te testen op kinderen.”

Appendix B

Medical versus enhancement scenarios

Een echtpaar is gewenst zwanger, maar krijgt te horen dat hun ongeboren kind een **genetische afwijking** heeft, namelijk het Patau syndroom. Er bestaat geen behandeling voor deze afwijking na de geboorte en de meeste baby's sterven binnen het jaar. Het echtpaar krijgt echter de optie om de genen van hun ongeboren kind aan te passen (CRISPR), zodanig dat de afwijking niet meer aanwezig is in het kind.

Een echtpaar is gewenst zwanger, maar krijgt te horen dat hun kind een **genetische afwijking** heeft, namelijk een hartafwijking die voor het eerste levensjaar waarschijnlijk dodelijk zou zijn. Chirurgen kunnen de afwijking na de geboorte operatief herstellen en dit zorgt ervoor dat het kind een normaal leven zal hebben. Het echtpaar krijgt echter ook de optie om de genen van hun ongeboren kind aan te passen (CRISPR), zodanig dat de afwijking niet meer aanwezig is in het kind.

Een echtpaar is gewenst zwanger, maar krijgt te horen dat hun kind een **genetische afwijking** heeft, namelijk ernstige hooikoorts. Dit zal geen effect hebben op de levensverwachting van het kind, maar mogelijks wel op de levenskwaliteit. Het echtpaar krijgt de optie om de genen van hun ongeboren kind aan te passen (CRISPR), zodanig dat de afwijking niet meer aanwezig is in het kind.

Een echtpaar is gewenst zwanger, maar krijgt te horen dat hun kind een **genetische afwijking** heeft, namelijk mucoviscidose (taaislijmziekte). Er bestaat geen operatieve behandeling om de afwijking ongedaan te maken. De levensverwachting van het kind is beperkt tot 40-45 jaar en het kind zal een lagere levenskwaliteit hebben door de vele symptomen van de aandoening (bv. veel hoesten en ijzertekort in het bloed). Het echtpaar krijgt echter ook de optie om de genen van hun ongeboren kind aan te passen (CRISPR), zodanig dat de afwijking niet meer aanwezig is in het kind.

Een echtpaar is gewenst zwanger, maar krijgt te horen dat hun kind een **genetische afwijking** heeft, namelijk Downsyndroom. Er bestaat geen operatieve behandeling om deze afwijking ongedaan te maken. Het kind zal verschillende mentale en fysieke beperkingen hebben, maar zal hier zelf minder van merken door het beperkte ziektebesef, waardoor de levenskwaliteit nog relatief hoog kan zijn. Het kind heeft een levensverwachting van ongeveer 60 jaar hebben. Het echtpaar krijgt echter ook de optie om de genen van hun ongeboren kind aan te passen (CRISPR), zodanig dat de afwijking niet meer aanwezig is in het kind.

Een echtpaar is gewenst zwanger, en krijgt te horen dat hun nog ongeboren kind **gezond** is. Ze krijgen echter de optie om de genen van hun ongeboren kind aan te passen, zodanig dat het kind een verhoogde intelligentie kan hebben.

Een echtpaar is gewenst zwanger, en krijgt te horen dat hun nog ongeboren kind **gezond** is. Ze krijgen echter de optie om de genen van hun ongeboren kind aan te passen, zodanig dat het kind een aantal gewenste uiterlijke kenmerken kan hebben zoals lichaamslengte, oogkleur, haarkleur...

Een echtpaar is gewenst zwanger, en krijgt te horen dat hun nog ongeboren kind **gezond** is. Ze krijgen echter de optie om de genen van hun ongeboren kind aan te passen, zodanig dat het kind het geslacht kan hebben dat de ouders liever wensen.

Een echtpaar is gewenst zwanger, en krijgt te horen dat hun nog ongeboren kind **gezond** is. Ze krijgen echter de optie om de genen van hun ongeboren kind aan te passen om zo bepaalde persoonlijkheidstrekken te veranderen (bv. agressie verminderen, extraversie verhogen, …)

Een echtpaar is gewenst zwanger, en krijgt te horen dat hun nog ongeboren kind **gezond** is. Ze krijgen echter de optie om de genen van hun ongeboren kind aan te passen, zodanig dat het kind een betere atletische aanleg kan hebben.

Appendix C

Moral dilemmas
Switch dilemma:

Een op hol geslagen tram rijdt langs de sporen richting 5 werkmannen die allemaal gedood zullen worden als de tram blijft doorrijden. Op het andere spoor ligt 1 werkman. Jij staat wat verder van het treinspoor, naast een hendel. De enige manier om de levens van de 5 werkmannen te redden is door aan de hendel te trekken om de tram naar het andere spoor te leiden. De ene persoon op dit spoor zal sterven als je dit doet maar de 5 andere werkmannen zullen gered zijn. Trek je aan de hendel, ja of nee?

Footbridge dilemma:

Een op hol geslagen tram rijdt langs de sporen richting 5 werkmannen die allemaal gedood zullen worden als de tram blijft doorrijden. Jij staat op een brug over de sporen, tussen de aankomende tram en de vijf werkmannen. Naast je op de brug staat een dikke persoon die je niet kent. De enige manier om de levens van de 5 werkmannen te redden is door deze onbekende persoon van de brug te duwen op de sporen. Zijn lichaam zal zo de tram tot stilstand brengen. De persoon die je niet kent zal sterven als je dit doet maar de 5 werkmannen zullen gered zijn. Duw je de onbekende persoon van de brug, ja of nee?

Appendix D

Table D1

The Estimated Marginal Means for the Medical and Enhancement Condition for Support, Ethical Justification, Benefits Person, and Benefits Society

Dependent variable	Condition	emmean	SE	DF	lower.CL	upper.CL
Support	Medical	4.79	0.05	2598	4.69	4.88
	Enhancement	1.53	0.05	2598	1.44	1.62
Ethical	Medical	4.80	0.05	2598	4.70	4.89
	Enhancement	1.56	0.05	2598	1.46	1.65
Benefits Person	Medical	5.38	0.05	2598	5.29	5.48
	Enhancement	2.17	0.05	2598	2.07	2.26
Benefits Society	Medical	4.42	0.05	2598	4.33	4.52
	Enhancement	1.84	0.05	2598	1.74	1.94

Table D2

The Contrasts Between Medical and Enhancement for Support, Ethical Justification, Benefits Person and Benefits Society

Dependent variable	Contrast	Estimate	SE	Df	t.ratio	p-value
Support	Enhancement - Medical	-3.26	0.07	2598	-48.39	< .001
Ethical	Enhancement - Medical	-3.24	0.07	2598	-47.70	< .001
Benefits Person	Enhancement – Medical	-3.22	0.07	2598	-45.81	< .001
Benefits Society	Enhancement – Medical	-2.58	0.07	2598	-36.19	< .001

Table D3

Path Coefficients of Interest and Knowledge via BP and BS on Approval Ratings

	a1	b1	a2	b2
Medical				
Interest	**0.106** (0.030)	**0.515** (0.072)	**0.080** (0.033)	**0.421** (0.063)
	[0.048; 0.163]	[0.373; 0.654]	[0.015; 0.145]	[0.297; 0.546]
Knowledge	**0.077** (0.034)	**0.512** (0.071)	0.057 (0.037)	**0.421** (0.063)
	[0.011; 0.142]	[0.366; 0.643]	[-0.017; 0.128]	[0.303; 0.548]
Enhancement				
Interest	0.036 (0.031)	0.070 (0.056)	0.031 (0.024)	**0.618** (0.092)
	[-0.024; 0.095]	[-0.034; 0.191]	[-0.015; 0.078]	[0.415; 0.780]
Knowledge	0.030 (0.035)	0.070 (0.056)	0.028 (0.027)	**0.618** (0.093)
	[-0.036; 0.100]	[-0.033; 0.187]	[-0.024; 0.082]	[0.423; 0.787]

Note. We used 5.000 bootstrap samples. The standard errors are reported between parentheses. Values in bold are significant ($p < .05$). Values between parentheses denote Standard Errors, values between brackets denote confidence Intervals (95%)

Table D4

Total, Total Indirect, Indirect, and Direct Effects of Interest and Knowledge via BP and BS on Support and Ethical in the Medical Condition

	Total effect	Total indirect effect	Indirect effect via BP	Indirect effect via BS	Direct effect
Support					
Interest	**0.086** (0.033) [.022; .148]	**0.090** (0.028) [.035; .143]	**0.054** (0.017) [.023; .089]	**0.035** (0.016) [.007; .069]	-0.004 (0.016) [-.034; .026]
Knowledge	0.063 (0.039) [-.014; .135]	**0.065** (0.032) [.000; .125]	**0.039** (0.019) [.003; .078]	0.025 (0.017) [-.008; .059]	-0.001 (0.020) [-.041; .038]
Ethical					
Interest	**0.092** (0.032) [.027; .154]	**0.087** (0.027) [.034; .138]	**0.055** (0.018) [.022; .094]	**0.032** (0.014) [.006; .062]	0.005 (0.018) [-.032; .040]
Knowledge	**0.093** (0.035) [.020; .163]	**0.063** (0.030) [.002; .123]	**0.040** (0.019) [.005; .079]	0.023 (0.016) [-.007; .055]	0.030 (0.020) [-.008; .070]

Note. We used 5.000 bootstrap samples. The standard errors are reported between parentheses. Values in bold are significant ($p < .05$). Values between parentheses denote Standard Errors, values between brackets denote confidence Intervals (95%)

Table D5

Total, Total Indirect, Indirect, and Direct Effects of Interest and Knowledge via BP and BS on Support and Ethical in the Enhancement Condition

	Total effect	Total indirect effect	Indirect effect via BP	Indirect effect via BS	Direct effect
Support					
Interest	0.013 (0.023) [-.032; .063]	0.022 (0.018) [-.010; .061]	0.004 (0.004) [-.003; .014]	0.019 (0.015) [-.009; .052]	-0.010 (0.014) [-.036; .019]
Knowledge	0.019 (0.026) [-.030; .071]	0.020 (0.020) [-.016; .063]	0.003 (0.004) [-.004; .014]	0.017 (0.017) [-.013; .054]	-0.001 (0.018) [-.037; .035]
Ethical					
Interest	0.032 (0.024) [-.014; .079]	0.021 (0.017) [-.011; .058]	0.002 (0.003) [-.003; .010]	0.020 (0.016) [-.011; .054]	0.010 (0.016) [-.020; .043]
Knowledge	0.020 (0.025) [-.028; .072]	0.019 (0.019) [-.015; .062]	0.001 (0.003) [-.004; .009]	0.018 (0.018) [-.015; .060]	0.001 (0.018) [-.034; .036]

Note. We used 5.000 bootstrap samples. The standard errors are reported between parentheses. Values in bold are significant ($p < .05$). Values between parentheses denote Standard Errors, values between brackets denote confidence Intervals (95%)

Table D6

Path Coefficients of Morality via BP and BS on Approval Ratings in the Medical Condition

	a1	**b1**	**a2**	**b2**
Care	**-0.034** (0.012)	**0.516** (0.069)	**-0.031** (0.014)	**0.421** (0.062)
	[-0.057; -0.010]	[0.376; 0.651]	[-0.059; -0.002]	[0.299; 0.544]
Care	-0.165 (0.098)	**0.509** (0.069)	-0.106 (0.115)	**0.422** (0.063)
	[-0.353; 0.037]	[0.370; 0.639]	[-0.320; 0.132]	[0.302; 0.547]
Fairness	-0.015 (0.014)	**0.515** (0.067)	-0.005 (0.016)	**0.421** (0.061)
	[-0.040; 0.013]	[0.385; 0.644]	[-0.037; 0.027]	[0.302; 0.542]
Fairness	-0.025 (0.096)	**0.515** (0.070)	0.078 (0.107)	**0.422** (0.063)
	[-0.209; 0.168]	[0.375; 0.650]	[-0.136; 0.283]	[0.300; 0.548]
Loyalty	**-0.024** (0.011)	**0.516** (0.070)	-0.017 (0.013)	**0.421** (0.062)
	[-0.046; -0.002]	[0.377; 0.649]	[-0.042; 0.010]	[0.300; 0.543]
Loyalty	-0.031 (0.058)	**0.519** (0.071)	0.022 (0.069)	**0.418** (0.063)
	[-0.143; 0.083]	[0.375; 0.652]	[-0.112; 0.158]	[0.298; 0.545]
Authority	-0.004 (0.011)	**0.515** (0.070)	-0.004 (0.014)	**0.421** (0.062)
	[-0.027; 0.018]	[0.375; 0.650]	[-0.031; 0.023]	[0.299; 0.542]
Authority	**-0.170** (0.087)	**0.508** (0.069)	-0.081 (0.095)	**0.424** (0.062)
	[-0.339; 0.002]	[0.369; 0.640]	[-0.255; 0.112]	[0.305; 0.548]
Sanctity	**-0.027** (0.010)	**0.508** (0.070)	-0.014 (0.013)	**0.424** (0.062)
	[-0.048; -0.006]	[0.368; 0.641]	[-0.039; 0.010]	[0.304; 0.548]
Sanctity	**-0.171** (0.066)	**0.513** (0.071)	-0.097 (0.082)	**0.422** (0.063)
	[-0.298; -0.041]	[0.371; 0.645]	[-0.256; 0.065]	[0.299; 0.548]
Liberty	-0.069 (0.126)	**0.518** (0.068)	0.022 (0.170)	**0.419** (0.062)
	[-0.270; 0.228]	[0.383; 0.650]	[-0.236; 0.404]	[0.301; 0.541]
Switch	**0.314** (0.145)	**0.513** (0.070)	**0.298** (0.142)	**0.420** (0.060)
	[0.025; 0.594]	[0.380; 0.652]	[0.018; 0.575]	[0.301; 0.535]
Footbridge	-0.063 (0.120)	**0.519** (0.067)	-0.049 (0.125)	**0.421** (0.060)
	[-0.302; 0.177]	[0.385; 0.646]	[-0.292; 0.205]	[0.306; 0.544]

Note. We used 5.000 bootstrap samples. The standard errors are reported between parentheses. Values in bold are significant ($p < .05$). Values between parentheses denote Standard Errors, values between brackets denote confidence Intervals (95%)

Table D7

Total, Total Indirect, Indirect, and Direct effects of Morality via BP and BS on Support and Ethical in the Medical Condition

	Total effect	Total indirect effect	Indirect effect via BP	Indirect effect via BS	Direct effect
Support					
Care	**-0.027** (0.014) [-.054; .001]	**-0.031** (0.012) [-.054; -.007]	**-0.017** (0.007) [-.031; -.005]	**-0.014** (0.007) [-.028; .000]	0.004 (0.007) [-.010; .017]
Care	-0.191 (0.108) [-.388; .033]	-0.131 (0.094) [-.301; .069]	-0.083 (0.052) [-.187; .019]	-0.047 (0.052) [-.144; .058]	-0.060 (0.053) [-.164; .043]
Fairness	-0.007 (0.014) [-.034; .021]	-0.010 (0.013) [-.034; .016]	-0.007 (0.007) [-.021; .006]	-0.002 (0.007) [-.016; .012]	0.003 (0.008) [-.011; .018]
Fairness	0.062 (0.109) [-.145; .275]	0.022 (0.090) [-.148; .199]	-0.013 (0.050) [-.110; .086]	0.035 (0.048) [-.058; .127]	0.040 (0.057) [-.068; .154]
Loyalty	-0.017 (0.012) [-.041; .008]	-0.020 (0.011) [-.042; .003]	**-0.012** (0.006) [-.025; -.001]	-0.007 (0.006) [-.020; .005]	0.003 (0.006) [-.009; .014]
Loyalty	0.061 (0.067) [-.071; .195]	-0.007 (0.056) [-.116; .107]	-0.016 (0.030) [-.074; .044]	0.010 (0.031) [-.050; .072]	**0.068** (0.031) [.009; .129]
Authority	-0.003 (0.013) [-.030; .022]	-0.004 (0.011) [-.027; .018]	-0.002 (0.006) [-.015; .009]	-0.002 (0.006) [-.014; .010]	0.000 (0.006) [-.012; .013]
Authority	-0.161 (0.095) [-.346; .027]	-0.122 (0.081) [-.279; .039]	-0.086 (0.047) [-.182; .003]	-0.036 (0.044) [-.121; .046]	-0.039 (0.044) [-.129; .048]
Sanctity	**-0.021** (0.012) [-.044; .002]	-0.020 (0.010) [-.040; .001]	**-0.014** (0.006) [-.026; -.003]	-0.006 (0.006) [-.018; .005]	-0.001 (0.006) [-.014; .011]
Sanctity	-0.128 (0.080) [-.278; .024]	**-0.130** (0.066) [-.253; -.004]	**-0.087** (0.037) [-.163; -.022]	-0.043 (0.038) [-.118; .027]	0.002 (0.043) [-.083; .085]
Liberty	0.045 (0.180) [-.223; .493]	-0.026 (0.134) [-.228; .288]	-0.035 (0.067) [-.144; .123]	0.010 (0.077) [-.105; .193]	0.071 (0.088) [-.070; .299]
Switch	**0.354** (0.146) [.070; .634]	**0.291** (0.126) [.055; .545]	**0.159** (0.078) [.021; .329]	0.132 (0.069) [.009; .272]	0.063 (0.094) [-.114; .246]
Footbridge	0.147 (0.130) [-.118; .394]	-0.054 (0.109) [-.271; .162]	-0.032 (0.062) [-.157; .089]	-0.022 (0.057) [-.136; .090]	**0.201** (0.066) [.069; .329]
Ethical					
Care	**-0.031** (0.014) [-.056; -.002]	**-0.030** (0.011) [-.051; -.007]	**-0.018** (0.007) [-.031; -.005]	-0.012 (0.006) [-.024; -.001]	-0.001 (0.007) [-.015; .014]
Care	**-0.249** (0.109) [-.449; -.031]	-0.127 (0.089) [-.294; .051]	-0.085 (0.053) [-.187; .013]	-0.043 (0.047) [-.139; .050]	**-0.121** (0.054) [-.228; -.012]
Fairness	-0.014 (0.015) [-.043; .017]	-0.010 (0.012) [-.033; .015]	-0.008 (0.007) [-.022; .006]	-0.002 (0.006) [-.015; .011]	-0.004 (0.008) [-.020; .012]
Fairness	-0.035 (0.109) [-.247; .177]	0.019 (0.088) [-.160; .185]	-0.013 (0.052) [-.117; .088]	0.032 (0.044) [-.058; .117]	-0.054 (0.062) [-.169; .065]

	Total effect	Total indirect effect	Indirect effect via BP	Indirect effect via BS	Direct effect
Loyalty	-0.020 (0.012)	-0.019 (0.011)	**-0.013** (0.006)	-0.007 (0.006)	-0.001 (0.006)
	[-.043; .005]	[-.040; .002]	[-.025; .000]	[-.018; .004]	[-.013; .012]
Loyalty	0.000 (0.067)	-0.008 (0.054)	-0.016 (0.030)	0.009 (0.028)	0.008 (0.034)
	[-.132; .134]	[-.111; .102]	[-.077; .043]	[-.045; .065]	[-.058; .073]
Authority	-0.004 (0.013)	-0.004 (0.011)	-0.002 (0.006)	-0.001 (0.006)	-0.001 (0.006)
	[-.030; .022]	[-.025; .016]	[-.015; .009]	[-.012; .009]	[-.013; .012]
Authority	**-0.191** (0.096)	-0.120 (0.080)	-0.087 (0.049)	-0.033 (0.040)	-0.072 (0.052)
	[-.379; -.002]	[-.271; .034]	[-.188; .002]	[-.115; .042]	[-.171; .024]
Sanctity	**-0.031** (0.012)	**-0.019** (0.010)	**-0.014** (0.006)	-0.006 (0.005)	-0.012 (0.007)
	[-.055; -.007]	[-.039; .000]	[-.026; -.003]	[-.017; .004]	[-.026; .002]
Sanctity	**-0.159** (0.077)	**-0.127** (0.062)	**-0.089** (0.038)	-0.039 (0.033)	-0.031 (0.042)
	[-.303; -.012]	[-.245; -.002]	[-.167; -.018]	[-.107; .026]	[-.116; .049]
Liberty	0.023 (0.172)	-0.028 (0.127)	-0.036 (0.068)	0.009 (0.069)	0.051 (0.083)
	[-.227; .439]	[-.215; .276]	[-.145; .125]	[-.097; .177]	[-.082; .242]
Switch	**0.309** (0.148)	**0.282** (0.123)	**0.164** (0.082)	0.118 (0.063)	0.027 (0.088)
	[.017; .587]	[.043; .516]	[.015; .331]	[.006; .251]	[-.142; .202]
Footbridge	0.195 (0.130)	-0.053 (0.106)	-0.033 (0.065)	-0.020 (0.052)	**0.248** (0.066)
	[-.060; .445]	[-.264; .149]	[-.165; .092]	[-.122; .082]	[.116; .381]

Note. We used 5.000 bootstrap samples. The standard errors are reported between parentheses. Values in bold are significant ($p < .05$). Values between parentheses denote Standard Errors, values between brackets denote confidence Intervals (95%)

Table D8

Path Coefficients of Morality via BP and BS on Approval Ratings in the Enhancement Condition

	a1	b1	a2	b2
Care	**-0.050** (0.014)	0.071 (0.057)	**-0.033** (0.014)	**0.619** (0.092)
	[-0.078; -0.021]	[-0.034; 0.192]	[-0.060; -0.005]	[0.426; 0.787]
Care	**-0.529** (0.116)	0.032 (0.055)	**-0.281** (0.114)	**0.623** (0.088)
	[-0.748; -0.293]	[-0.070; 0.148]	[-0.495; -0.058]	[0.444; 0.792]
Fairness	**-0.041** (0.016)	0.059 (0.057)	-0.021 (0.013)	**0.620** (0.090)
	[-0.071; -0.010]	[-0.046; 0.182]	[-0.050; 0.004]	[0.433; 0.785]
Fairness	**0.229** (0.102)	0.066 (0.054)	-0.089 (0.078)	**0.620** (0.092)
	[-0.429; -0.028]	[-0.035; 0.179]	[-0.248; 0.061]	[0.430; 0.796]
Loyalty	-0.012 (0.011)	0.069 (0.056)	-0.006 (0.009)	**0.619** (0.091)
	[-0.033; 0.012]	[-0.038; 0.183]	[-0.023; 0.013]	[0.430; 0.790]
Loyalty	-0.036 (0.066)	0.068 (0.056)	-0.007 (0.053)	**0.620** (0.093)
	[-0.163; 0.091]	[-0.037; 0.182]	[-0.110; 0.097]	[0.423; 0.793]

	a1	b1	a2	b2
Authority	0.002 (0.012)	0.071 (0.056)	0.006 (0.009)	**0.618** (0.093)
	[-0.021; 0.025]	[-0.032; 0.190]	[-0.011; 0.024]	[0.424; 0.787]
Authority	**-0.225** (0.098)	0.059 (0.056)	-0.134 (0.085)	**0.617** (0.093)
	[-0.414; -0.031]	[-0.046; 0.173]	[-0.303; 0.032]	[0.423; 0.793]
Sanctity	**-0.036** (0.011)	0.068 (0.059)	-0.015 (0.010)	**0.619** (0.092)
	[-0.059; -0.015]	[-0.041; 0.190]	[-0.034; 0.004]	[0.429; 0.790]
Sanctity	**-0.230** (0.070)	0.054 (0.057)	-0.082 (0.058)	**0.628** (0.092)
	[-0.372; -0.095]	[-0.053; 0.171]	[-0.201; 0.029]	[0.440; 0.798]
Liberty	-0.221 (0.171)	0.065 (0.055)	-0.114 (0.107)	**0.619** (0.091)
	[-0.620; 0.036]	[-0.036; 0.180]	[-0.369; 0.051]	[0.432; 0.785]
Switch	-0.220 (0.152)	0.070 (0.056)	-0.223 (0.124)	**0.620** (0.093)
	[-0.524; 0.080]	[-0.036; 0.191]	[-0.478; 0.010]	[0.427; 0.793]
Footbridge	0.035 (0.117)	0.069 (0.055)	0.017 (0.087)	**0.619** (0.093)
	[-0.192; 0.267]	[-0.035; 0.179]	[-0.153; 0.189]	[0.427; 0.788]

Note. We used 5.000 bootstrap samples. The standard errors are reported between parentheses. Values in bold are significant ($p < .05$). Values between parentheses denote Standard Errors, values between brackets denote confidence Intervals (95%)

Table D9

Total, Total Indirect, Indirect, and Direct effects of Morality via BP and BS on Support and Ethical in the Enhancement Condition

	Total effect	Total indirect effect	Indirect effect via BP	Indirect effect via BS	Direct effect
Support					
Care	-0.025 (0.016)	**-0.025** (0.011)	-0.005 (0.003)	-0.020 (0.010)	0.000 (0.009)
	[-.056; .007]	[-.047; -.005]	[-.012; .000]	[-.042; -.002]	[-.016; .018]
Care	**-0.409** (0.099)	**-0.200** (0.082)	-0.030 (0.030)	**-0.170** (0.078)	**-0.210** (0.054)
	[-.605; -.214]	[-.369; -.047]	[-.090; -.024]	[-.335; -.031]	[-.317; -.106]
Fairness	**-0.027** (0.014)	-0.016 (0.010)	-0.004 (0.003)	-0.013 (0.009)	-0.010 (0.009)
	[-.054; -.001]	[-.038; .001]	[-.010; .001]	[-.033; .002]	[-.027; .007]
Fairness	-0.117 (0.080)	-0.074 (0.057)	-0.021 (0.017)	-0.053 (0.050)	-0.043 (0.046)
	[-.281; .030]	[-.196; .026]	[-.061; .003]	[-.160; .034]	[-.137; .044]
Loyalty	-0.003 (0.008)	-0.004 (0.007)	-0.001 (0.001)	-0.003 (0.006)	0.001 (0.005)
	[-.019; .012]	[-.017; .008]	[-.004; .001]	[-.014; .007]	[-.008; .011]
Loyalty	-0.041 (0.054)	-0.008 (0.037)	-0.003 (0.008)	-0.004 (0.032)	-0.034 (0.033)
	[-.150; .053]	[-.085; .064]	[-.021; .011]	[-.071; .055]	[-.098; .030]
Authority	0.007 (0.009)	0.004 (0.006)	0.000 (0.001)	0.003 (0.005)	0.003 (0.006)
	[-.010; .025]	[-.008; .017]	[-.003; .003]	[-.006; .016]	[-.007; .014]
Authority	**-0.191** (0.082)	-0.100 (0.065)	-0.020 (0.016)	-0.080 (0.058)	**-0.092** (0.044)
	[-.351; -.037]	[-.232; .011]	[-.057; .005]	[-.202; .015]	[-.182; -.004]

	Total effect	Total indirect effect	Indirect effect via BP	Indirect effect via BS	Direct effect
Sanctity	-0.014 (0.009) [-.032; .003]	-0.013 (0.007) [-.027; .001]	-0.003 (0.002) [-.009; .000]	-0.009 (0.006) [-.022; .002]	-0.001 (0.006) [-.012; .010]
Sanctity	**-0.129** (0.053) [-.241; -.032]	-0.069 (0.044) [-.170; .009]	-0.019 (0.015) [-.052; .006]	-0.050 (0.037) [-.137; .015]	-0.060 (0.038) [-.133; .013]
Liberty	-0.150 (0.118) [-.431; .033]	-0.089 (0.078) [-.273; .029]	-0.021 (0.022) [-.077; .007]	-0.068 (0.066) [-.224; .028]	-0.061 (0.078) [-.229; .080]
Switch	-0.136 (0.131) [-.418; .100]	-0.155 (0.096) [-.367; .006]	-0.021 (0.021) [-.070; .009]	-0.134 (0.086) [-.333; .003]	0.019 (0.078) [-.134; .175]
Footbridge	0.137 (0.090) [-.038; .324]	0.014 (0.061) [-.111; .134]	0.003 (0.013) [-.021; .037]	0.010 (0.052) [-.099; .111]	0.124 (0.066) [-.005; .261]
Ethical					
Care	-0.022 (0.015) [-.052; .007]	**-0.023** (0.011) [-.046; -.005]	-0.002 (0.003) [-.009; .004]	**-0.021** (0.011) [-.044; -.003]	0.001 (0.008) [-.015; .018]
Care	**-0.363** (0.105) [-.568; -.164]	**-0.185** (0.083) [-.363; -.032]	-0.004 (0.031) [-.067; .058]	**-0.181** (0.084) [-.360; -.032]	**-0.177** (0.058) [-.288; -.063]
Fairness	**-0.029** (0.014) [-.057; -.002]	-0.015 (0.010) [-.036; .002]	-0.001 (0.003) [-.007; .004]	-0.014 (0.010) [-.035; .002]	-0.014 (0.010) [-.034; .006]
Fairness	-0.088 (0.079) [-.250; .059]	-0.066 (0.057) [-.185; .032]	-0.009 (0.015) [-.044; .018]	-0.057 (0.054) [-.172; .034]	-0.022 (0.047) [-.115; .072]
Loyalty	-0.011 (0.008) [-.028; .006]	-0.004 (0.006) [-.017; .008]	-0.000 (0.001) [-.003; .001]	-0.004 (0.006) [-.016; .008]	-0.007 (0.006) [-.019; .005]
Loyalty	-0.036 (0.054) [-.141; .064]	-0.006 (0.036) [-.082; .063]	-0.001 (0.005) [-.014; .009]	-0.005 (0.034) [-.078; .059]	-0.030 (0.035) [-.098; .038]
Authority	0.003 (0.010) [-.017; .022]	0.004 (0.006) [-.008; .017]	0.000 (0.001) [-.002; .002]	0.004 (0.006) [-.007; .016]	-0.001 (0.007) [-.015; .012]
Authority	**-0.214** (0.086) [-.383; -.052]	-0.092 (0.061) [-.220; .017]	-0.007 (0.015) [-.039; .023]	-0.085 (0.059) [-.214; .018]	**-0.122** (0.056) [-.236; -.015]
Sanctity	-0.013 (0.010) [-.241; -.032]	-0.011 (0.007) [-.170; .009]	-0.001 (0.002) [-.052; .006]	-0.010 (0.006) [-.137; .015]	-0.002 (0.007) [-.133; .013]
Sanctity	**-0.127** (0.054) [-.241; -.024]	-0.059 (0.043) [-.155; .017]	-0.006 (0.015) [-.036; .024]	-0.053 (0.041) [-.143; .018]	-0.068 (0.040) [-.148; .008]
Liberty	-0.181 (0.125) [-.482; .012]	-0.081 (0.072) [-.255; .029]	-0.008 (0.019) [-.054; .024]	-0.073 (0.067) [-.236; .029]	-0.100 (0.087) [-.312; .057]
Switch	-0.130 (0.134) [-.408; .102]	-0.152 (0.097) [-.367; .008]	-0.009 (0.018) [-.048; .020]	-0.142 (0.094) [-.356; .007]	0.022 (0.080) [-.135; .179]
Footbridge	0.119 (0.102) [-.072; .324]	0.013 (0.059) [-.104; .129]	0.001 (0.009) [-.016; .024]	0.011 (0.055) [-.100; .116]	0.107 (0.082) [-.045; .277]

Note. We used 5.000 bootstrap samples. The standard errors are reported between parentheses. Values in bold are significant ($p < .05$). Values between parentheses denote Standard Errors, values between brackets denote confidence Intervals (95%)

Table D10

The Results of the Contrast Analyses for the Effect of Impact of the Five Diseases and Five Enhancements on Support and Ethical

	Contrast	Estimate	SE	Df	t.ratio	p-value
Support						
Medical	Hay fever – Down syndrome	-1.16	0.17	1295	-6.77	< .001
	Hay fever – Mucoviscidosis	-2.09	0.17	1295	-12.15	< .001
	Hay fever – Heart disease	-0.82	0.17	1295	-4.78	< .001
	Hay fever – Patau syndrome	-1.91	0.17	1295	-11.14	< .001
	Down syndrome – Mucoviscidosis	-0.92	0.17	1295	-5.38	< .001
	Down syndrome – Heart disease	0.34	0.17	1295	2.00	.269
	Down syndrome – Patau syndrome	-0.75	0.17	1295	-4.37	< .001
	Mucoviscidosis – Heart disease	1.27	0.17	1295	7.38	< .001
	Mucoviscidosis – Patau syndrome	0.17	0.17	1295	1.01	.851
	Heart disease – Patau syndrome	-1.09	0.17	1295	-6.37	< .001
Enhancement	Athletic – Appearance	0.00	0.11	1295	0.00	1.000
	Athletic – Intelligence	-0.23	0.11	1295	-2.13	.208
	Athletic – Personality	-0.50	0.11	1295	-4.69	< .001
	Athletic – Sex	-0.01	0.11	1295	-0.11	1.000
	Appearance – Intelligence	-0.23	0.11	1295	-2.13	.208
	Appearance – Personality	-0.50	0.11	1295	-4.69	< .001
	Appearance – Sex	-0.01	0.11	1295	-0.11	1.000
	Intelligence – Personality	-0.27	0.11	1295	-2.56	.078
	Intelligence – Sex	0.22	0.11	1295	2.02	.256
	Personality – Sex	0.49	0.11	1295	4.59	< .001
Ethical						
Medical	Hay fever – Down syndrome	-1.18	0.17	1295	-6.93	< .001
	Hay fever – Mucoviscidosis	-2.07	0.17	1295	-12.16	< .001
	Hay fever – Heart disease	-0.91	0.17	1295	-5.35	< .001
	Hay fever – Patau syndrome	-1.76	0.17	1295	-10.33	< .001
	Down syndrome – Mucoviscidosis	-0.89	0.17	1295	-5.23	< .001
	Down syndrome – Heart disease	0.27	0.17	1295	1.58	.511
	Down syndrome – Patau syndrome	-0.58	0.17	1295	-3.41	.006
	Mucoviscidosis – Heart disease	1.16	0.17	1295	6.81	< .001
	Mucoviscidosis – Patau syndrome	0.31	0.17	1295	1.83	.358
	Heart disease – Patau syndrome	-0.85	0.17	1295	-4.99	< .001
Enhancement	Athletic – Appearance	-0.07	0.11	1295	-0.64	.968
	Athletic – Intelligence	-0.23	0.11	1295	-2.07	.235
	Athletic – Personality	-0.52	0.11	1295	-4.58	< .001
	Athletic – Sex	-0.02	0.11	1295	-0.20	1.000

	Contrast	Estimate	SE	Df	t.ratio	p-value
	Appearance – Intelligence	-0.16	0.11	1295	-1.42	.612
	Appearance – Personality	-0.45	0.11	1295	-3.93	< .001
	Appearance – Sex	0.05	0.11	1295	0.44	.992
	Intelligence – Personality	-0.28	0.11	1295	-2.51	.089
	Intelligence – Sex	0.21	0.11	1295	1.87	.337
	Personality – Sex	0.50	0.11	1295	4.37	< .001