



MAPPING THE IMPACTS OF EMERGING TECHNOLOGIES ON MORALITY

A COMBINATORY APPROACH OF MEDIATION ANALYSIS
AND TECHNOMORAL CHANGE

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Summary

Morality operates on three levels. On the macro-level we have abstract principles and concepts that were proven to be robust throughout the years. On the meso-level we find the moral regimes, where these abstract values are more specified and even translated to regulations and rules. On the micro-level we have specific situations, where individual decisions are taking place, shaped according to the circumstances.

In this thesis I develop the Moral Impact Mapping Approach: a framework that helps to investigate how an emerging technology could impact our morality, moral concepts and values in the future. Working with the notion that morality is not fixed but technology and morality co-evolves, I integrated mediation theory and the technomoral scenario approach to complement each other in order to account for anticipating the impacts of emerging technologies on morality on the micro- meso- and macro-level. To demonstrate my approach, I applied it to human germline gene editing in the context of human reproduction.

Introduction

Technologies. We use them to set an alarm in the morning, to go on a holiday on the other side of the world, to prepare food, to tell us medical diagnosis and even to write this thesis. It is also not very likely that we will stop developing new technologies. We see technologies as the solution to our problems, but we also see them as a source of problems. We wear smartwatches to track our health and see whether our body is functioning well, but we are afraid of third parties misusing our data and infringing our privacy when using social media. In any case, technologies play a central role in our lives.

Looking beyond the benefits of new technologies, we are becoming more and more aware of the possible threats they might bring. As a result, various initiatives started to promote the idea to do research and innovation in a responsible way, to prevent undesirable consequences of technologies (Grunwald, 2018). The only issue is that we cannot be certain about the future and because of the complexity of our world, it is often not easy to foresee what is going to come. In 1980, David Collingridge articulated the control dilemma, stressing the tension between control and uncertainty. Because we cannot predict all the impacts of technologies, we cannot step in in time and make changes to the technology early, when change is still relatively easy. Once the consequences are known the technology is already deeply embedded in society and therefore changing the technology becomes difficult (Collingridge, 1980). Trying to deal with governing technologies in the right way, Technology Assessment practices even became institutionalized. By systematically assessing the impacts of technologies they aim at helping policy makers to come up with well-informed decisions, mitigate dangers and negative consequences of technologies.

As the main question in these practices is what we should do, they are operating on an intrinsically ethical consideration. Despite this underlying notion, these traditional TA practices were not necessarily considering moral questions explicitly, or they were just taking our current morality for granted (Swierstra et al., 2009). Recently, in philosophy of technology, works on morality and technology have shown that technologies can not only create morally problematic situations, but they can also influence morality as such. Interpretation of values can be subject to change (Kudina and Verbeek, 2019), or even new values can emerge overtime (Wildt et al., 2021) due to technologies. In this sense, when we are trying to figure out how to ethically guide the development of technologies, our very own ethics might be subject to change with the introduction of new technologies. This is important, because the way our ethics is defined will ultimately shape the outcomes of ethical evaluations. We are thus faced with a new question: how do we anticipate the impact of emerging technologies on morality itself?

I am not the first one asking this question. Marianne Boenink, Tsjalling Swierstra and Dirk Stemerding developed the Technomoral Scenario approach where they build scenarios to see how a technology might bring about moral change in society. Building on historical analysis and the NEST-ethics approach, they are generating potential ethical controversies around a technology in question. By evaluating the outcomes of the controversies, they are showing how moral change may come about in the future.

Operating on the theory of technological mediation, Olya Kudina and Peter-Paul Verbeek carried out a Threshold Technology Analysis (TTA) with the same leading question. They argue for a “modest and empirically informed form of anticipation” (Kudina and Verbeek, 2019). By looking at how people in online discussions give new meaning to the value of ‘privacy’ while engaging with a prototype of Google Glass, they argue that anticipation should be done when a technology is at the ‘threshold’ of society. At this phase people can already engage with an early version of a technology which can give us insights about the potential impacts on morality. In this sense it is not too speculative, since an already existing version of the technology is being analyzed, but it is still an anticipatory approach because the technology is not widespread yet to know its exact functioning on a wider scale in society.

While both works have the same aim in mind, they approach the phenomenon of technologically induced moral change from different angles. The TMS approach focuses on society wide conceptions, engaging more in how ethics operates in its institutionalized setting and speculates about how moral controversies usually resolve in society and how this affects moral norms and frameworks. In this sense it provides a view from a macro-perspective. On the other hand, the TTA offers us insight into how in the interaction between user and technology, new moral considerations come about. It really zooms in and analyzes the impacts on morality from a micro-perspective.

As Floridi and Strait (2020) highlighted in technology assessment moral change is a difficult phenomenon to analyze. There is a higher chance to successfully anticipate changes on morality on the micro-level because there are less variables at play, while on the macro-level due to the complex nature of moral change, anticipation becomes difficult. On the micro-level, morality is more flexible and easier to adjust to specific situations, often creating some niche. On the macro-level, change is usually extremely slow, more factors are at play and therefore we have less certainty in anticipating it. At the same time, we are more concerned with macro-level changes, as they impact our society as such. Micro-level changes ultimately form the basis of the macro-level, but we don’t know which niche will eventually lead to change on higher levels. (Boenink et al., 2010) This is problematic, because intervening with the technology is easier when change has not yet happened on the macro-level.

In this regard we can articulate yet another dilemma in ethical foresight: anticipating impacts of emerging technologies on the micro-level of morality is easier, but we have little clue about the impacts on the macro-level, even though at this point we could still intervene with the technology. While once we see how the technology impacts morality on the macro-level, changing the technology is difficult as at that point it is more widely used in society.

In this thesis I am aiming at developing an approach for practitioners of technology assessment to overcome the above stated dilemma and anticipate the impact on morality of emerging technologies in a comprehensive way, accounting both for the micro- and macro-level changes. To analyze the moral impact of new technologies in a systematic manner, I will work with mediation theory to account for the micro-level and take specific steps from the technomoral scenario approach to account for the meso- and macro-level.

Therefore, the leading question of this thesis is the following:

How can we best integrate mediation theory and the technomoral scenario approach to anticipate the impacts of emerging technologies on all levels of morality?

In order to answer this question, I have divided my thesis into four chapters. In the first chapter, I will engage with the field of Ethical Foresight Analysis. I will touch upon some methods in technology assessment and evaluate them by focusing on how they perceive ethics in their methodology. I will argue that two methods, namely the Technomoral Scenario approach and the Threshold Technology Analysis stand out in the field because they operate on the idea that morality and technology co-evolve. However, I will also show that because of their theoretical considerations, they approach this phenomenon from different perspectives which make them focused on different levels of morality. In Chapter 2 I am going to engage with the theoretical background of mediation theory and introduce a methodology for a mediation analysis. I will also highlight the shortcomings of the method. In Chapter 3 I will deep dive in the literature of technomoral change and explain the three-step framework of the TMS approach. Making an evaluation of the method, I will elaborate on what elements should be also part of the framework I am building in this thesis. Finally, in Chapter 4 I will walk the reader through the steps of, what I will call, the Moral Impact Mapping Approach and demonstrate it through analyzing an emerging technology, human germline gene editing. I chose this technology, because it is developing at a fast pace, and it is expected to have a big impact on deeply held norms and values in the future (Hopster, 2021). Furthermore, even though the literature on human germline gene editing seems endless, the impacts on how it might change our morality and moral concepts has not yet been researched.

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Chapter 1

1. Introduction

This first chapter aims at creating the ground for the approach presented in this thesis. I will start by introducing the field of Ethical Foresight Analysis (EFA) and articulate the difficulty we are facing when analyzing moral change. I will do so in three steps. First, I will explain the Collingridge dilemma, which has been in the center of the debate for the past decades regarding the guidance and control of technology development. Second, I will explain this dynamic structure of morality and how change usually occurs within this structure. Third, I will briefly introduce some key approaches and methods that were developed to overcome this dilemma and evaluate them with a focus on how they conceptualize ethics as such in their assessment. I will argue that the Threshold Technology Analysis (TTA) and the Technomoral Scenario approach (TMS) stand out among the methods because they do not perceive ethics as static, but rather as something more dynamic and prone to change. Finally, following from the evaluation of the already existing approaches I will show that we are facing yet another dilemma in the field of EFA.

2. The control dilemma

David Collingridge's famous control dilemma articulates the reason why technological developments are difficult to control or change to prevent their undesirable social effects (Collingridge, 1980). On the one hand the issue is that we cannot predict all societal consequences of a technology. Because of unknown factors and uncertainties of the future, it is not really possible to foresee all negative consequences of a new technology, even though at an early stage of development it would be easier to change the technology in order to prevent them. On the other hand, when the technology is already embedded in society, we can see its effects. However, as it is then already intertwined with the social structure and practices, changing its use or functioning for the better is difficult, time consuming and expensive. In other words, when change is still a possibility, we cannot foresee what would need to be done, while once a problem arises and we have ideas about what could be of help, intervention becomes problematic. Being intertwined with a whole economic and social fabric, the technology becomes much more complex and therefore difficult to change (Collingridge, 1980). This poses a big challenge for responsible innovation and leaves us with the question of how we can still make policies or design decisions that can, still in time, prevent undesirable consequences.

In response to this dilemma different approaches and methods have been developed. Although the dilemma poses a seemingly unresolvable difficulty, many authors claim that we are not left without any mean to mitigate the concerns. Various scholars attempted to anticipate the impacts of emerging technologies, some of them specifically focusing on the ethical consequences. After Floridi and Strait (2020), I will call the field Ethical Foresight Analysis, which covers, among others, the multitude of approaches trying to overcome the dilemma and engage in anticipatory practices to foresee the ethical impacts of emerging technologies. The methods that fall under this category have a longer history that stretches back to even before the control dilemma has been articulated by Collingridge¹. Providing a full overview is, however, way out of the scope of this thesis. In what comes next, I will specifically focus on some general methods through which the more recent approaches emerged which specifically address ethical consequences. Even though these methods share the same goal, they approach the problem from different angles, highlighting different problems and therefore resulting in different methodological steps and theoretical considerations. During their evaluation I will pay special attention to how they perceive ethics and morality. In order to do so I will first explain the difference between ethics and morality and how I approach the structure of morality and the dynamics of moral change in this thesis.

3. The structure of morality

By morality I am referring to the norms, values and value frameworks that guide people's actions and decisions in general (Boenink et al., 2010). They are often just implicit beliefs that a community or a group of people are operating on because they believe in them serving the idea of a good life. Ethics, in contrast, is the systematic study of morality. When someone engages in reflection on morality, they are doing ethics. This is of course what professional ethicists do, but also everyday people, if they are engaging in discussions around a morally problematic situation.

Following Boenink et al. (2010) I will differentiate between micro-, meso- and macro-level of morality. On the macro-level we can situate the abstract moral principles that are already in place for a very long time and have been proven to be stable in different contexts and situations. On the meso-level I am referring to moral regimes where certain moral considerations have formulated different institutionalized practices. Morality in this level has the form of certain regulatory procedures and rules that guide people. On this level, the abstract concepts from the macro-level are translated into more concrete guidelines and requirements. On the micro-level we are talking about specific situations, where moral considerations are more concrete and are applied to certain specific actions and decisions. This micro-level, in my thesis, covers

¹ For the full list of methods please see Floridi and Strait (2020)

the individual experiences and decisions that are bound to the meso-level institutionalized rules, but still shaped according to the specific circumstances and individual judgment.

On all three levels moral change can take place, but the pace of change largely differs (Boenink et al., 2010). On the macro-level change can occur, but it is usually a gradual process and takes a lot of time. There are plenty of variables and different factors in play that interact with each other and slowly evolve into certain directions. Long-existent, universal values like beneficence, non-maleficence and autonomy belong to this category.

On the meso-level change can be more frequent than on the macro-level, but it also has more stability than morality on the micro-level. On the meso-level the macro-level values are taking a more concrete formulation in some form of rule or regulation. For example, the value privacy takes shape in the form of the GDPR and related informed consent requirements. The understanding of certain abstract concepts is usually being negotiated on this level (Swierstra et al., 2009).

On the micro-level morality is the most flexible. In specific situations and circumstances morality is very often discussed and the resulting actions are usually negotiated to fit the given situation. Here we can think of the process of how a doctor explains the consequences of undergoing a certain surgery. They might do a detailed description if the surgery is not urgent, but they also might just rush through the conditions in case quick action is needed. What is ethically right depends on individual judgment and contextual circumstances. These instances can generate moral ‘niches’, that might result in changes on the meso-, and eventually on the macro-level of morality. It doesn’t mean that moral change can only happen starting off from the micro-level, but because of the flexibility on this level, change is easier to occur here than on other levels. In this thesis the focus will be on this kind of moral change and how it evolves on the meso- and macro-levels.

4. Ethical Foresight Analysis

Ethical Foresight Analysis covers the myriad of methods trying to anticipate ethical impacts of technologies (Floridi and Strait, 2020). In this section I will briefly introduce some of these methods and evaluate them. I will start with Technology Assessment and some of its versions, after which I will move onto the methodologies that specifically address how ethics should be perceived within the field.

4.1. Technology Assessment

Technology Assessment (TA) covers a range of foresight methodologies that investigates emerging technologies and their development possibilities, while taking into account the societal problems and

concerns that can arise around a certain technology in society. The aim of classical TA initiatives was to facilitate a discussion between experts of technologies and decision makers (Grunwald, 2009). By mapping the challenges and consequences of a technology with the help of experts, decision makers are more equipped with the right knowledge to mitigate these identified concerns and act accordingly.

TA methods rely on different methodological tools to carry out the assessment. Throughout the years TA processes have been applied in various different ways and there is no clear consensus on concrete methodological steps how a TA process should be done. Practitioners often use modelling, expert interviews, discourse analysis, scenario building, trend extrapolation among others (Grunwald 2009). For ethical analysis methods that rely on concrete variables were never really suitable due to the complexity and variability of ethical considerations (Floridi and Strait, 2020). Ethics in this sense, always remained qualitative research. However, some attempts to make ethics qualitative also appear. Just recently, for example, de Wildt and colleagues developed a quantitative approach to investigate long-term value change by tracing when the value sustainability appeared in the literature (de Wildt et al., 2021).

4.1.1. Participatory TA

Due to some influential criticism on the fact that TA methods were rather top-down and that there is a need to broaden the basis for decision making, new versions of TAs emerged (van Eijndhoven, 1997). Participatory TA was especially focusing on involving non-experts in the problem-solving processes. It was the task of this new initiative to put the process of evaluation to a new level, namely, to include different social groups like citizens, non-experts or the public in general and consider their perspectives on the concerning technology (Grunwald 2009).

Such TAs have made the step to consider the opinions of people outside of politics and science. In this way not only decision makers evaluate the impacts of technologies, but the people affected by the technologies in question could also contest their arguments and make their voices heard. As a result, policy makers were gaining a broader understanding of the needs and interests of different stakeholders. In this way the decision making is more democratic, since it reflects the views, desires and preferences of a variety of participants. Moreover, conflicts arising from the use of the technology can also be prevented this way, even before the technology becomes widely used.

4.1.2. Constructive TA

Constructive TA (CTA) was developed in the Netherlands and was specifically operating on the question of how we can overcome the Collingridge dilemma. Because TA faces difficulties in intervening with

technologies once they are already widely used, the authors of CTA argued that the assessment process should be an accompanying activity of technology development (Rip et al, 1997).

CTA operates on the so-called Social Construction of Technology. It means that technology development is perceived as a result of different societal forces of meaning giving and negotiation. The main idea behind the method is therefore, to involve multiple stakeholders already at the start of technology development and form a learning society that experiments with the new technology (Grunwald, 2009). Through involving different actors in guiding the development of new technologies, they refrain from creating objective knowledge about technological impacts, and focus on facilitating a democratic way of building ethical considerations into emerging technologies (Floridi and Strait, 2020).

Evaluation

Technology Assessment is hard to detach from ethics. The common notions of TA practices are implicitly normative, operating on the question “how should we handle and deal with technologies?”. Judging technologies and deciding which one is preferable over the other and how they should be implemented is not really possible without engaging in debates. In these discussions references to values and norms are very common (Skorupinski and Ott, 2002). However, the scope of these debates and arguments were limited for a long time. Initially, TA methods focused more on assessing technologies based on their hard impacts (Swierstra, 2015). These include impacts on health and safety that are quantifiable and can be directly associated with harm (Swierstra, 2013). Later on it has been brought to light that technological progress and the introduction of new artifacts and procedures generate more impacts than we initially thought. Technologies also generate less tangible soft impacts. They modify our relations, aspirations, cultural habits, social trends and traditions, ethical norms and concepts (Grunwald, 2009; Swierstra, 2013).

CTA and pTA did a good job in expanding the evaluation of technologies to a broader group of people, which ultimately brings new perspectives and creates a more democratic form of guiding technology development. However, in these assessments, even though they operate on an intrinsically ethical question, moral considerations remain rather implicit. The soft impacts do not get sufficient attention and therefore the assessments remain limited.

4.2. ethical Technology Assessment (eTA)

One of the most influential critiques on TA methodologies was given by Palm and Hansson (2006), who argued for an additional ethical dimension in the analysis that takes into account the moral implications and potential negative ethical consequences of emerging technologies. Even though the traditional way of doing

TA, such as weighing risks and benefits, do have ethical implications, the authors emphasized that an explicit attention to ethics and values is needed throughout the development of a technology. Their main point is that there is a need for a continuous dialogue between the technology developers and other relevant stakeholders. In this way not just the technological, but the moral development receives attention as well. They suggested that technologies, already at an early stage of development, can be shaped according to societal values. In order to facilitate the ground for discussion, Palm and Hansson provided a list of nine ethical concerns². This list could be used as a checklist for technology developers, to evaluate if their product is infringing with these values in some way or not.

Evaluation

Being the first approach specifically targeting the negative ethical impacts of emerging technologies, the methodology faces some crucial limitations. First, the list provided by the authors is rather abstract and vague, leaving a lot of open questions and too much room for interpretation regarding the values (Brey, 2012). This in turn leaves us with little guidance in how to judge a successful assessment. Second, the list of ethical concerns is not exhaustive, and it also lacks a comprehensive methodology in how to evaluate the concerning technology based on the listed values.

Giving a list of potential ethical concerns and suggesting that technologies should be shaped according to societal values indicates that values are some kind of fixed entities, and it is only the technology and its certain features that can be subject to change and should be aligned with the values that were identified to be important. eTA in this sense is failing to acknowledge the dynamic nature of ethics and morality (Boenink et al., 2010). It is feared, fairly so, that if we want to use the ethical TA method, we will be faced with ‘moral presentism’ (Boenink et al., 2010). As Boenink and colleagues argued, if we neglect the co-evolution of morality and technology, our assessment and considerations will not go beyond the existing norms and values. We should try to avoid this moral presentism and rather enhance our abilities to reflect on our current morals. We can analyze why they arose in the first place and whether they are still relevant or appropriate in new contexts and circumstances.

4.3. Technomoral scenarios and soft impacts

Building onto the critique that values are not universal and static, a new anticipatory method has been worked out in the Netherlands a decade ago. Taking a well-known tool from foresight studies Marianne Boenink, Tsjalling Swierstra and Dirk Stermerding (2010) use scenario building to enhance technomoral imagination

² See Palm and Hansson 2006 for the whole list

and anticipate potential ethical controversies regarding emerging technologies. By anticipating how morality, technology and their interaction could evolve it offers reflection on our current moral norms. In order to reduce the speculative nature of anticipation and scenario development, they ground their method in historical analysis. They investigate previous ethical controversies and ethical debates, and by using NEST-ethics (New and Emerging Science and Technology ethics) they construct what ethical considerations would appear with the technology in question. Once they investigate what an ethical deliberation would look like, they evaluate which values and arguments could weigh more in the debates. Eventually they judge how ethical controversies would resolve, and what kind of new technomoral scene could arise as a result. Their approach focuses on a distant-future and long-term development of values and norms, and they try to carefully explore the future grounding it in historical analysis. By offering insight into what the future would look like, morally speaking, the approach tries to enhance moral imagination and broaden the debate around the soft impacts of emerging technologies.

Evaluation

The TMS approach is innovative in the sense that it was the first approach working along the lines of technologically induced value dynamism. By not taking ethics and values as something static, it allows us to go on an exploratory adventure regarding our own moral considerations, rather than making us follow a certain set of rules or checklist about what we should consider valuable and what not. Also, it addresses moral impacts of emerging technologies explicitly, engaging in the interpretation of values and norms, and how this takes shape in a form of societal behavior towards technologies.

Furthermore, the TMS approach explores the moral impacts of technologies in a rather unconventional way. Let me elaborate on why. We cannot forget that morality and our moral routines and norms are often tacitly embedded in our ways of behavior, actions and practices (Kiran et al., 2015). We do not usually consider certain acts as options because we have a tacitly accepted moral framework. We do not deliberately have to refrain ourselves from breaking someone's car if we are angry or stealing some food if we forgot our purse at home. Even the idea of taking these actions does not come to our mind, because of the deep and sometimes unquestioned embeddedness of morally acceptable behaviors. These norms tacitly constrain us in our everyday lives. When these routines are in some way disrupted or disturbed, we place our focus on them and this is exactly when deliberations and discussions hit their heads up. This often happens when new technologies bring about substantial change in our everyday lives or when a technological hazard occurs. In these cases what we initially thought as self-evident gets questioned. As Swierstra and Rip highlighted: *Emerging technologies, and the accompanying promises and concerns, can rob moral routines of*

their self-evident invisibility and turn them into topics for discussion, deliberation, modification, reassertion' (Swierstra and Rip 2007, 6). This is exactly what the TMS does very well in an anticipatory way. Through developing scenarios about the future, the TMS approach creates the ground to question tacitly embedded values, even though we are not actually facing the situation ourselves yet in the present. We are only imaging it by the pictured future scenarios. Nevertheless, it brings some potential future situations closer to us, enhances our moral considerations and thus contributes to broadening our ideas about the moral impacts of emerging technologies.

As it analyzes the technology on a society level, it investigates moral change on the meso- and macro-level. However, meso- and macro-level changes often happen through successful niches on the micro-level. Therefore, an analysis of the impacts on morality needs to include a close investigation of the micro-level. In the TMS literature by micro-level they refer to local decision-making (Boenink et al., p. 13, 2010). In this thesis I consider the individual situations, without any institutionalized practices to form the micro-level. Of course, these micro-level situations are influenced by the structures and rules of the higher levels, but they are easily shaped by individual judgments and circumstances. In this sense, the micro-level is not really in the focus of the analysis in building technomoral scenarios. Because of this the method is lacking some grounding. The way the scenarios are built are somewhat speculative when it comes to analyzing the meso- and macro-level. In my thesis I set to goal to show how starting from the micro-level we can anticipate moral change that can impact the meso- and macro-level eventually.

4.4. Threshold Technology Analysis

Another attempt, which builds upon the idea of morality and technology mutually influencing each other, is what I will call the Threshold Technology Analysis (TTA). In a paper by Olya Kudina and Peter-Paul Verbeek the technological mediation theory provided the conceptual framework to analyze how the concept of privacy is starting to be reinterpreted upon the introduction of a new technology, namely Google Glass (Kudina and Verbeek, 2019).

As the authors explain, considering the notion of value change we can no longer be certain that the ethical framework we use in the here and now is going to stay the same once a new technology enters our society. Of course, if we would still consider the value of privacy as the right to be left alone (Warren and Brandeis, 1890), as it was conceptualized earlier, then we would not have worked out the General Data Protection Regulation with the aim of protecting people's privacy in the digital sphere. The value of privacy has gotten a new meaning with the development of digital technologies and data mining practices.

This change in conceptions, however, creates another dilemma in the field of EFA. The ethical version of the Collingridge dilemma, as Kudina and Verbeek states: *"when we develop technologies on the basis*

of specific value frameworks, we do not know their social implications yet, but once we know these implications, the technologies might have already changed the value frameworks to evaluate these implications” (Kudina and Verbeek 2019, 293). In other words, when we are using an ethical toolset to evaluate a technology, we don’t know the societal impacts yet. On the other hand, once we know the impacts, the toolset has probably also already changed by which we wanted to evaluate.

As a way out of the dilemma, they argue that we need to investigate technologies at the threshold of society (Kudina and Verbeek, 2019). By threshold they are referring to a point when a prototype or a first version of a technology is already available and users can have the chance to explore it and maybe they even start to integrate it into their lives, but the technology is not widely used yet. Their main claim is that the analysis in this way happens just in time. The technology is mature enough to see how it is appropriated, but since it is not embedded yet in society, there is still the possibility to intervene in its development and make changes for the better. In their methodology, they carry out a qualitative discourse analysis on people’s deliberations about the technology. They argue that by analyzing how users start to reinterpret certain values we get an insight into value dynamism and how technologies might influence concepts important in ethical evaluation.

Evaluation

Just as the TMS method, the TTA specifically addresses how technologies impact morality, more specifically moral values. However, the method of analysis is quite different. Using mediation theory as a framework, the method zooms in on the specific interactions between humans and technology. The subject of research is a certain artifact and the user in concrete situations. This results in having an insight into everyday people’s concrete considerations regarding values in a specific use-cases. In this sense, the micro-level of morality is in the focus.

The case study by Kudina and Verbeek does well in providing an insight into the process of value dynamism itself. They show how a digital technology makes people reconsider what they mean by privacy. While appropriating the new artifact, people are starting to challenge the concept of privacy by relating it to specific contexts and use-case scenarios. Through this empirical research it becomes clear that there is in fact an interaction between a value that has been around for a long time, and a new technology. It sheds light how easily people reconceptualize a meaning of a value. This is the flexibility of morality on the micro-level, that I explained earlier. New meanings and interpretations can quickly come about if the situational context changes.

However insightful this case study is, it also faces some limitations. First, mediation theory as a conceptual tool is claimed to be the basis of the analysis, but there are no clear methodological steps that would make it a usable tool for practitioners of anticipatory ethics. If the aim is to provide a framework to assess the moral impact of technologies, then we must aim at being clearer in how one can carry out such an analysis. In this sense the power of mediation theory remains highly unexploited. Remaining rather vague in the conceptual framework, the systematic exploration of the mediating effects of the technology stays limited. This study by Kudina and Verbeek is rather the evidence that technologies mediate values and conceptualization of values. But in order to equip TA practitioners with an assessment method, we need to articulate a more in-depth methodology. Mediation theory remains to be used as a conceptual lens rather than a method. Of course, it can be that this analysis was only aiming at analyzing value dynamism as a real-life phenomenon and not to explore the moral impacts from a distance through a methodological framework. In the second chapter I will investigate mediation theory in more detail and show that we can develop clear methodological steps through which one can explore the mediating effects in a process of systematic thinking.

The second limitation of the analysis comes actually from its strength. Because it is so focused on the micro-level of morality, it fails to account for the macro-level. Mediation theory has already been criticized for neglecting the interaction between technology, bigger societal factors and contextual influences (Kaplan, 2009). Therefore, also the analysis of the bigger picture of morality is problematic with this framework. Just because users of a technology re-interpret the word privacy in different ways, we do not see how it would operate on the macro-level. While the authors point speculatively at possible societal changes, the method lacks the conceptual tools to address the meso- and macro-level impacts.

5. Yet another dilemma in anticipatory ethics

Based on the above evaluations I think it is clear that it is easier to anticipate changes on the micro-level of morality. Trying to zoom out and foresee the changes on the macro-level is difficult and more speculative, because of the myriad of uncertain factors of the future. The analysis by Verbeek and Kudina supports this. While they could explore how the concept of privacy is mediated due to the interaction with Google Glass, it is hard to tell which conception will be dominant in the long-run and how it will change the moral structure on the macro-level.

In this way we are facing yet another dilemma. While we have at least some reliabilities anticipating micro-level moral changes brought about by technologies, the analysis becomes difficult when we would like to scale it up to the macro-level. When we explore these micro-level changes, intervening in the technology, to its design or related regulatory policies would still be reasonably easy. The problem is that we are not aware

of the macro-level impacts, and therefore we know little about how we should change the technology in order to prevent undesirable outcomes. While once the technology is embedded in society and potentially the macro-level changes become visible, changing the technology, the way it is used, and its regulations becomes more difficult and costly.

Especially because of the structure of morality, the TMS approach and the theoretical framework of the TTA can complement each other and overcome the above state dilemma. In the coming chapters I will make an attempt to integrate their theoretical considerations and methodological steps in a way that practitioners of technology assessment can utilize to map the impact of emerging technologies on all levels of morality.

6. Conclusion

In this chapter I introduced the control dilemma and the field of Ethical Foresight Analysis covering some methods that have been developed to overcome the dilemma. First, I sketched the traditional TA methods, which together with findings from philosophy of technology led to the development of new recent approaches specifically addressing the impacts of technologies on morality. I introduced and evaluated the eTA, the technomoral scenario method and the threshold technology analysis. I argued that only the latter two are taking morality as a more flexible ingredient of technology assessment. Furthermore, I showed that they analyze morality in different ways, TMS focusing more on the macro-level, while the TTA on the micro-level. I also criticized TTA for providing little guidance in the methodology and that it does not equip TA practitioners sufficiently to analyze the moral impacts of technology from a distance. Finally, based on my analysis I concluded that we are facing another dilemma in anticipatory ethics: micro-level moral impacts are easier to anticipate, but we do not know how these will influence the macro-level. Preventing certain niche changes is still easier by early intervention, but since we have little idea about the macro-level we don't know how to intervene. Once the slower macro-level changes become visible, it becomes more difficult to change the technology.

In the next chapters, I will engage more deeply with the literature on mediation theory and technomoral change and will develop a new, integrated approach which can help us mitigate the problem articulated in this dilemma.

Chapter 2

1. Introduction

In the previous chapter I briefly introduced how mediation theory has been applied as a conceptual framework to investigate value dynamism induced by an emerging technology. I also criticized it for being theoretically underdeveloped and that the potential of mediation theory in anticipation of the impact of emerging technologies on morality remains highly unexploited. In this chapter, first I will engage more deeply with the theoretical background and main concepts of mediation theory and explain its relevance for the moral domain. Second, I will argue that because of the way technologies mediate morality through the interaction that comes about between technology and humans, the theory can be systematically applied in the form of a 5-step method to explore the impacts of technologies on morality on the micro-level. Third, I will explain the methodological steps of a mediation analysis based on the presented theoretical considerations. Finally, I will argue that this method has a potential for being a forward-looking approach but lacks some steps in the methodology to use it for anticipatory purposes.

2. Theoretical background

2.1. Postphenomenology

Technological Mediation Theory (TMT) developed by philosopher Peter-Paul Verbeek comes from the field of postphenomenology. The main notion of the theory, as the name incorporates it, stems from the idea that if we want to explore how humans exist and behave in relation to the world, we need to understand the mediating character of technologies. This is because our world is full of technologies and therefore the relation between humans and the world is rather a human-technology-world relation (Verbeek, 2005).

Conceptualizing technologies as mediators in the human-world relationship, Verbeek escapes the traditional views on technology. On the one hand, we have the instrumentalist view that looks at technologies as only neutral tools that humans use to achieve certain goals. In this sense technologies are mere means for humans to reach something, let it be good or bad. It is only the use of the artifact that can be subject of judgment and not the artifact itself (Verbeek, 2005). On the other hand, we have the substantivist stance that refutes the idea that technology is neutral. According to this view, technology is some kind of independent power that determines society, culture and the life of human beings (Verbeek, 2005). Technological development is conceived as something autonomous, which can be realized by human beings, but they cannot

really control it. In both theories there seems to be a strict separation between humans and technology: either we see humans controlling technology, or we have technology that controls humans. This is, however, not in line with how we experience the technological lifeworld (Verbeek, 2005). Verbeek explains that there is empirical evidence that these two theories do not grasp the core of the relation between technology and humans. This relation is much more nuanced than how the previously mentioned two theories try to approach it. Instead of one domain dominating the other, there is a mediating relationship between the two. The way humans perceive the world and act in it is *mediated* by technology (Verbeek, 2005). Technologies have an active role in shaping the character of human-world relations. Neither do they fully determine our lives, nor are they neutral tools which we are just using to reach our ends.

In postphenomenology technology is not analyzed as one big concept defined by a certain set of characteristics, but rather specific technological artifacts are the subject of investigation. If we have a close look at “things”, we can see how they shape and influence the experience of human beings and their existence in the world (Verbeek, 2005).

In his paper “Materializing Morality: Design Ethics and Technological Mediation” Verbeek states that artifacts do mediation in two domains. They can mediate perceptions, and they can mediate actions of human beings (Verbeek, 2006b). In what comes next, I will explain the theory behind these two kinds of meditations, especially because they are key components also of the idea of how morality is constituted by technologies, which I will also explain later.

2.2. Human-technology relations

In order to analyze the mediating character of technologies in a more structured manner, Verbeek turns to Don Ihde’s four types of human-technology-world relations (Verbeek, 2005). First, when a technology and a human being forms a unity which is then directed to the outside world, we are talking about an *embodiment*. Such a relation can mean someone wearing glasses. The glasses and the wearer become one and the world is perceived by the user while being a unit with the glasses.

Second, in a *hermeneutic* relation, the technology is being used in a way that it helps humans understand something about the world. In this case the human directs the attention at the unity of the world and the technology. When we are looking at an ECG, or a thermometer, we are basically “reading” the world through the technology. Without the technology we would not perceive certain conditions about the world as we do it via the technology.

Third, there is the *alterity* relation. This happens when human beings are in direct interaction with technology and the world stays in the background. In this relation the human attention is on the technology itself. Humans are not interacting with the world, rather they are interacting with or doing something to the

technology. In this sense technology becomes a quasi-other, meaning that they have some kind of autonomy, but they are never truly another 'person'. This happens when we are taking out money from an ATM. The machine we are directly interacting with has a certain autonomy in telling us what a right instruction is or what is not, but of course it is not even close to a human being.

The fourth relation is the *background* relation. In this case the technology functions in the background and only facilitates the conditions for the existence of humans in the world. An example of this kind of relation is the heating system or a fridge in an apartment. We are not really interacting with the technology, except for specific moments, but it creates the environment for us where we are doing something else.

Verbeek highlights, however, that with new technologies more of these relations can come about at the same time (Verbeek, 2015). For example, with a Google Glass, there is an embodiment and a hermeneutic relation at the same time, which he calls augmentation relation. While the artifact becomes a unit with the user who is seeing the world through the glasses, it also provides a different representation of the world with the built-in screen. Such hybrid relations are more common with recent technologies.

Using Ihde's concepts of human-technology relations gives the basis for Verbeek to formulate the mediation of perception (Verbeek, 2006).

2.3. Mediation of perception

According to Verbeek, when it comes to technologies mediating our perceptions, we need to specifically consider two of Ihde's human-technology relations, namely the hermeneutic and embodiment relation (Verbeek, 2006). In an embodiment relation we are perceiving the world while being in one unity with technology. The technology therefore is an in-between object, that modifies the perception of the user in a specific way. A microscope enables us to see certain things in the world around us that we would otherwise not be able to see, and thus it shapes our understanding of reality. Looking through a microscope we can see whether a cell is functioning well or not, and a doctor can make a diagnosis thanks to the new information they perceive through the technology. In a hermeneutic relation some part of reality is presented to us in a certain specific way. When we are looking at an EEG signal, we can read the brainwaves of a person produced by their neural activity, but we do not actually see or experience the brainwaves. If it were not for technology, we would not even conceptualize the concept 'brainwave'.

In this sense, according to Ihde, technologies embody certain human *intentions* (Verbeek, 2006b). They are not neutral tools, but they have an active role in shaping the relationship between human beings and the world. As they transform our perception about the world they can amplify or reduce certain parts of reality. These intentions, however, are not set in stone. Whenever a human being interacts with an artifact,

they can establish a new kind of relation and therefore a new intention of the technology can appear. The function of the technology can be re-interpreted in different contexts, in different circumstances and by different users. This means, for example, that a drone with a camera can be used to take amazing pictures from high above, but also to track someone from a distance. This is what Ihde calls multistability (Verbeek, 2005). The intentions of a technology are, therefore, always dependent on some other factors that surround the use of the technology.

2.4. Mediation of action

Building on the work of Bruno Latour, Verbeek articulates how technologies mediate human actions. It is not only the case that technologies are in-between human beings and the world when experiencing and perceiving the world, but they also play a role in how people position themselves in this world. Latour argued that technologies always have a certain 'script' assigned to them, just as actors have a script in a theater play (Latour, 1992, as cited in Verbeek, 2006a). Due to these scripts, artifacts make us do certain specific things. We are throwing away plastic cups in which we get our coffee to go, not because we read the instructions of the cup, but because of the way it is designed. Due to the quality of the plastic, we do not even consider keeping it, but we throw it away right after we finish our drink. Things, in this way, are influencing the actions of human beings. They exert a certain way of behavior on the user interacting with the artifact.

Similarly, as in artifacts mediating perception in a way that they amplify or reduce certain aspects of reality, when artifacts are mediating action, they invite or enable and inhibit or discourage certain actions (Verbeek, 2005; Verbeek, 2006b). As Latour has pointed out, all actors (human and non-human) have programs of actions (Verbeek, 2006b). When entering a relationship, these programs from both actors are translated into a new one. If we consider someone wanting to protect themselves, and this person finds a hammer, when they enter the relationship, the action of protection will be translated into the action of hitting the robber on the head. This process of translation is also context dependent, just as the multistability notion in the mediation of perception (Verbeek, 2006b).

3. Moral mediation of technology

So far, we have seen how Verbeek shed light on what technological artifacts do to us, human beings and how they influence our existence in the world. But how is it connected to our moral decision making and how will it be relevant for analyzing the impacts of emerging technologies on morality?

If technologies are able to change our perception of reality and they are capable of making us do certain actions, then coming from an ethical perspective and asking the questions of how we should act also

gains a different understanding (Verbeek, 2011). If we approach human beings as they exist in relation to different technologies, ethical responsibility is not anymore solely depending on human beings. A moral action is not only the product of human decision making, but it comes about in the cooperation between technology and humans. By technologies mediating what reality is, we make assumptions about what is possible to do and eventually we decide on our actions based on these beliefs. In this sense, we cannot anymore assign moral relevance only to humans. We also have to consider the role of technologies. Even though what usually constitutes a moral agent, such as having consciousness, free will and intentions, cannot be assigned to things, it is also hard to say that they do not have any moral relevance at all and therefore cannot be held accountable (Verbeek, 2011). They are shaping the way human beings exist and behave, and therefore they take up part of the ethical decision-making domain. In this sense, we cannot only refer to people when we are talking about ethical considerations. Since moral actions are the products of human-technology relations, moral agency should be also seen as something that is constituted by the interaction between technologies and humans (Verbeek, 2009).

Verbeek took the example of the ultrasound to show how technologies mediate and partially constitute the moral decisions and actions of human beings (Verbeek, 2008). From a postphenomenological perspective the ultrasound acts as a mediator between the prospective parents and the unborn. Through the technology, people can have a look inside the woman's womb, which then constitutes their reality about the unborn. There is a hermeneutic relationship between the people watching the unborn on the sonogram and the fetus. The machine creates a picture about the unborn through translating the ultrasound waves into a visual representation. Our perception is mediated because of the technology. If we compare it to a situation where there is no ultrasound machine, we realize that in that case we would only see the big belly of the mother and maybe have some ideas about the fetus just because we know how a baby looks when it is born. Because the fetus is visually presented to us inside the woman's womb, we see an individual there. This also leads to conceptualizing something called fetal personhood: seeing the unborn more and more as a person (Verbeek, 2008). Moreover, because the fetus becomes visible, the original connection between the mother and the fetus is disrupted (Verbeek, 2008). While earlier the mother with the fetus was rather perceived as one entity, now due to representing the fetus as an individual a form of isolation takes place between them. The mother also becomes a separate entity, whose function is to form the environment for the baby.

Building on Michel Foucault's work, Verbeek explains how these mediations contribute to constituting the moral subject (Verbeek, 2008). For Foucault, in an ethical system there is a defined code of behavior, but there is also the subject for whom these codes were made and supposed to follow these. If we consider the role of the technology, we can see that the subject (the human) is being constituted through

technological mediations. Moreover, because humans in many cases do not have the choice to decide whether they want the technology to exist or not, they are not fully autonomous in this subject constitution (Verbeek, 2008). Prospective parents have to accept that the ultrasound exists and that they have the option to use it. In this sense they are already in a decision-making situation they did not choose. But they have freedom in shaping this subject constitution. They can still choose to not to decide about the unborn's life regardless of what appears on the screen, or they can choose to be a subject who wants to use the technology and base their decision on the information that is gained through the examination.

4. The strength of mediation theory

Mediation theory investigates technologies in a very mundane way. It does not overgeneralize or analyze technology as a singular entity. In a rather tangible manner, it looks closely at specific objects, their use and appropriation, and explores the dynamics between technology and the user from the closest. It goes beyond classical philosophy of technology where technology is often described as one big entity and takes an empirical turn by zooming in on specific objects and use-cases. By exploring the mediations between humans and technology it focuses on individual lived experiences. Specific artifacts, as well as concrete actors are in the center of the analysis.

As argued by Asle H. Kiran, Nelly Oudshoorn and Peter-Paul Verbeek in their article, mediation theory should be part of the TA process because through a mediation analysis it highlights how technology plays a role in moral subject constitution, which has implications on moral responsibility (Kiran et al., 2015). A mediation analysis enables us to explore how this subject constitution happens through the mediating power of technologies. I agree with their claim specifically because this micro-perspective is usually not in the focus of TA. This is problematic if we consider the structure of morality. It seems that in TA, the focus is always on the impacts on society as such. There is of course theoretically no problem with it, as we want to find out whether the concerning technology as such will shape our society to a desired direction or not. However, in this way we skip a logical step. Because macro-level impacts often develop from micro-level interactions, we have to start with analyzing the micro-level. After all, we should not forget that in many cases the micro-level dynamics are the building blocks of the macro-level impacts.

Based on these considerations, mediation analysis can serve the purpose of investigating the micro-level of morality. Analyzing the human-technology relations, and the mediations of the technology will ultimately help us to see how the moral subject and moral considerations are being shaped by the technology.

5. The methodology

As I have explained above, technologies mediate our perceptions and our actions. I also showed how these mediations affect morality as well. But this is not yet concrete enough to apply it in a systematic manner to explore how technology has an impact on morality. Therefore, in what comes next, I will define the steps through which we can carry out a mediation analysis. The aim of the analysis is to arrive on the moral relevance of mediations, which will account for exploring the micro-level impacts of technologies on morality. To reach this goal I defined five separate steps, which will guide us in a systematic manner to investigate the mediations coming up between humans and technology.

1. Introduce the ‘technology’ of the human-technology-world relation

First, we need to introduce the technology in question. We can elaborate on its technical details and characteristics, explain its use and functions. We can explain how it has been developed and for what aim. The main goal of this step is to get an idea about the technology in question. It is key to have a strong understanding of the technology because it defines also the relation that humans will have to it.

2. Introduce the ‘human’ in the human-technology-world relation

Next to the technology, we have to understand who is affected by the technology. As we know the context of the technology, we have to identify what user base the technology will have or who are going to interact with the technology. Here we have to think about people directly using the technology, but we also have to consider people indirectly affected by the technology. Going even further, we have to think about who might be affected in the future. In order to analyze the specific human-technology relations and the moral implications of this relation, we have to have a list of who can be the ‘human’.

3. Identification of human-technology relations

Using Ihde’s four types of human-technology relations, we can identify what kind of relation comes about with each stakeholder in interaction with the technology. The four types are embodiment, alterity, hermeneutic and background relation. As already said, new technologies can belong to more categories at the same time creating new kinds of hybrid relations. Nevertheless, they can be analyzed through these four lenses.

4. Identifying points of mediations

At this step we have to think about the two domains of mediation. We have the domain of perception/experience and the domain of action/behavior. The question we can ask ourselves is: how does the new technology alter the perception of the individual in the human-technology relation and how does it affect their action taking?

5. Reflection on moral implications and identifying affected values

Based on the previous step we can identify in which ways the different mediations have an implication on moral considerations. What actions are influenced by the concerning technology and therefore what kind of moral choices are affected? How does it change our experience and perception that has an effect on our moral beliefs? What new moral questions does it make us ask? Based on this analysis, we can also identify and name the specific values that are affected, altered or reconceptualized by the mediations.

6. What mediation theory does not account for

There are two main shortcomings in a mediation analysis. First, since it closely analyzes the interactions between user and technology, it only accounts for investigating the micro-level of morality. While we have little clue about the meso- and macro-level. The strength of this theory is therefore also its weakness. Even though we can extrapolate from the micro-level interactions to the bigger societal consequences, this is not in the focus of the analysis and therefore remains unclear how we could account for it. The concept of mediation misses out on societal interactions and handles human-technology-world relationships as purely individual affairs (Kaplan, 2009).

Second, mediation theory can be best applied in hindsight, when we have all kinds of empirical data available about the use of the technology, the specific interactions and use-cases. In its current form, the methodology lacks the steps to use it in an anticipatory way. If we don't know how the technology is being used, how can we investigate its mediating effects? There were already some attempts to use it for anticipation. In what comes next I will elaborate on them.

7. Attempts to use mediation analysis for anticipation

Concerned with the design of artifacts, Verbeek (2011) argues for mediation analysis to be used in an anticipatory manner. He emphasizes the roles of the designer in the process and leaves the analysis to their imagination. His approach is highly focused on the design choices of specific technological artifacts. He

claims that based on the designers' intentions and with the artifact in mind, they can systematically analyze how certain values can be designed into the technology by materializing it into the artifact. My target group in this thesis is, however, not designers but TA practitioners. Also, the methodology developed in this thesis aims at providing a framework for analyzing somewhat more abstract technologies or technological procedures and not specific artifacts or objects. Therefore, the mediation analysis has to be approached from a different angle than Verbeek (2011) did.

Another more recent methodology, the guidance ethics approach also works on the idea of technological mediation (Verbeek and Tjink, 2020). In collaboration with the ECP | Platform for the Information Society Verbeek developed a three-step framework to provide a tool for analyzing and hopefully mitigating the concerns about the ethical impacts of digital technologies in the Netherlands. Considering the fact that technology and society mutually influence each other the main idea of this approach is to *guide* technology development by ethical analysis and avoid doing a generic assessment with predefined principles or theories with an outcome that either approves or disapproves the technology as such. Refraining from discussing a technology in the broad sense, like robotics or blockchain, the approach targets more context specific applications, like feeding robots for the disabled. Moreover, the analysis goes beyond asking the question whether we should use or ban the technology and provide a yes or no answer. Instead, it aims at providing guidance to the question: how the technology could, in a specific environment in a specific setting, be valuable for society. Verbeek argues for using a deliberative method. This means that various stakeholders should be involved in the form of a dialog to discuss how we can develop a certain technology that is, after all, beneficial for our society.

In the guidance ethics approach, the problem is similar to the TTA. Even though mediation theory is the conceptual lens and theoretical background for the approach, it is not explained how one can do a systematic analysis of technological mediations. Also, because of this it does not necessarily highlight how a new technology impacts morality itself. Nevertheless, it does have some conceptual foundations that are needed to do anticipatory work. It emphasizes analyzing the context of the technology and to identify key values affected. Some of these considerations will be incorporated in the method I am developing in this thesis as well.

8. Conclusion

In this chapter I dived into the theoretical background of technological mediation developed by Peter-Paul Verbeek. I have explained how this postphenomenological theory investigates our technological lifeworld by zooming in on the interaction between the user and the technology. There are two domains in which

technologies mediate between humans and the world. They mediate perceptions and they mediate actions. Because of these mediations our moral beliefs and choices are also being shaped by technologies. Based on these considerations, I developed a method for analyzing how technology mediates morality. I argued that this method enables us to investigate the micro-level of morality. However, I explained that it has to be augmented with the right steps to be able to use it in an anticipatory manner.

Chapter 3

1. Introduction

In the previous chapter I investigated the postphenomenological approach, mediation theory and proposed a methodology which can be used to identify the mediating effects of technologies and draw the moral relevance of these mediations. I highlighted that the method lacks the anticipatory power as it analyzes technologies best in hindsight. Moreover, it only looks at the micro-level of interactions therefore it is suitable for analyzing the micro-level of moral impacts but has difficulties when it comes to the macro-level.

To account for the shortcomings of the approach in this chapter I will engage more deeply with the technomoral scenario method and the underlying theory. I will argue that it can complement the meditation analysis and provide the right methodological steps to develop a framework for anticipation of moral impacts in a more extensive way, accounting for exploring the potential moral impacts on all levels of morality. To this end, I will start this chapter with explaining the main theoretical foundations of technomoral change after which I will introduce the methodology that was developed for building future technomoral scenarios. After this, I am going to evaluate the methodology in more detail based on which I will consider what I will incorporate for my own methodology that will be described in Chapter 4.

2. Theoretical background

The technomoral scenario approach was developed by Tsjalling Swierstra, Marianne Boenink and Dirk Stermerding to help policy makers in the process of assessing technologies and their societal impacts (Stermerding et al., 2010; Swierstra et al., 2009; Boenink et al., 2010). The approach has three main characteristics. First, it focuses on the soft impacts of technologies. Second, it follows the idea that ethics and technology co-evolve and that they are mutually shaping each other. Third, because they acknowledge this co-shaping of technology and morality, they try to provide an ethical reflection that steps out of our current moral paradigm and moves beyond an ethical checklist approach. To achieve their goals, they use a common strategy from the field of future studies, namely, scenario building.

2.1. Soft and hard impacts

As mentioned earlier the authors of this approach differentiate between hard and soft impacts. Hard impacts are effects of technologies that are more objective, rational and factual, while soft impacts are more tangible, subjective, even emotional or value laden (Swierstra and Te Molder, 2012). Hard impacts are usually

associated with risk and it is often the case that we can quantify them. Imagine, for example, if a nuclear bomb kills a hundred people. It is quite clear cut to quantify the harm of the bomb. On the other hand soft impacts are less tangible and therefore are difficult to grasp with numbers. They affect our practices and values, the way we interact and behave. In common language they are often referred to as societal and ethical impacts.

In the West we live in societies with a dominant liberal ideology. This liberalism operates on the idea of freedom of choice. If the state wants to intervene in these societies in any way, they have to sufficiently justify it. Such justification is mainly associated with the prevention of harm, based on Mill's no-harm principle (Stuart Mill 1859 as in Swierstra and Te Molder, 2012). That is why the risk assessment of technologies were mostly focusing on the value of health and safety. They are the most clear-cut values associated with harm doing. Everything else that falls out of these categories, liberals are not interested in and it is up to the individual to decide whether it is good or bad for them. The main idea was that everyone is free in their choices, up until the point where someone can get hurt. Other values such as privacy, sustainability, profit and employment made their ways into technology assessment, once they were associated with harm (Swierstra and Te Molder, 2012).

Unfortunately, with soft impacts the case is not so simple. If there is no clear link to threatening someone's safety and health, then the investigation is off the table. After all, if social media alienates us from reality, how can that be judged as ultimately bad. Some will say it is nice to escape reality, while others will find this idea amazing.

It might not be fully clear cut what soft impacts entail and whether they are good or bad, but it does not mean we should not investigate them. Technologies shift user practices, value frameworks and responsibilities. Only if we think about how the internet and the use of chat applications shifted expectations about people's availability. Before these technologies, emails were only accessible from computers and answering a message could take days. Today, because there is the possibility, we expect people to be available immediately, anytime and anywhere. There is an obvious shift in normative expectations, which fundamentally shapes our social interactions. Whether someone thinks it is right or wrong could differ, but if these impacts are a cause for concern for a significant number of people, then according to our democratic values, they should be subject to deliberations and taken into account in decision-making processes (Swierstra and Te Molder, 2012).

2.2. The challenge in the co-evolution of ethics and technology

As already mentioned, the technomoral scenario approach places the co-evolution of morality, our society and technology in focus. Working along this idea is not easy, though. The co-evolution of ethics and technology implies that we are basically unable to judge emerging technology by our current ethical

frameworks. The guiding lines along which we would evaluate a future technology in the present is inappropriate since these might change once the technology is introduced (Boenink et al, 2010; Kudina and Verbeek, 2019). At the same time, we cannot use the frameworks from the future for assessment, simply because we don't know what they will be like. By developing technomoral scenarios we end up in a paradoxical situation. We imagine a world with different morals than ours, but at the same time we are still immersed in our current moral world with a normative opinion.

Swierstra and colleagues argue that we have to try to avoid both moral futurism and moral presentism (Swierstra et al., 2009). We fall into moral futurism if we ultimately favor the morals of the future over the current one. This could lead us to not think of our current moral values and value frameworks as important or worthy of consideration with the idea that right now we possess no valuable insight on what is right or wrong. On the other hand, if we think that our current norms are better than what might come in the future, we fall into the trap of moral presentism. It would imply that we discard the possibility from our future selves and future generations to learn more and improve morally. So, what can we do?

We should not blindly reject, nor blindly accept change in morality. It may seem that we have almost no good choice. We are as we are, immersed in our own moral beliefs, values and practices. Our moral shadow is always there with us. We cannot escape it. Are we trying the impossible then? Maybe. What Swierstra and colleagues argue for, is to at least try to open up our minds. Despite being immersed in our current moral paradigm, we can and should enhance our moral imagination. This is what the TMS method offers. Building technomoral scenarios enables us to travel to different moral paradigms and through them we embrace our willingness to learn (Swierstra et al., 2009).

As already mentioned in Chapter 1, moral routines are often tacitly embedded in our way of being. If we let new ideas in and ask ourselves the question why we do what we do in a certain way or why we believe in something to be right or wrong, we can end up either reflecting or understanding our views and maybe even changing them eventually. But nevertheless, through explicitly considering them, we allow ourselves to potentially learn something new. This is when morality becomes ethics (Swierstra, 2009). The explicit reflection and reassessment of moral routines is specifically what an ethical evaluation entail. This is what an ethical assessment needs to include.

3. The methodology

The approach consists of three main steps. First, we have to sketch the moral landscape. Second, with the use of NEST-ethics we can construct possible controversies that could arise due to the technology. Third, judging the plausibility of different resolutions we construct closure. These steps can be repeated to anticipate further

in the future. In general, this approach encourages us to think in long-term time periods, as usually moral change does not happen overnight. The methodology will be explained based on Boenink et al. (2010) and Swierstra et al. (2009).

3.1. Sketching the moral landscape

Since we don't know what will happen in the future, we have to use our imagination to speculate about it and make well-informed guesses. However, we can work with information already available to us. To give some solid grounding for the scenarios and avoid far-fetched philosophizing about the future, the first step in the analysis is to map the past and the present (Boenink et al., 2010). With sketching the moral landscape we can provide an overview about the current morals, practices and regulations in the expected context of the new technology. We can look into the past to see how the relevant moral practices and regimes evolved up until today. Since the technology in question might not be available yet, it can be helpful to look at a similar technology and investigate the ethical issues and controversies that have appeared around that. Alternatively, we can explore the practice that the technology aims to change and investigate how this evolved in the past, what was questioned and contested already around it previously.

Regardless of the subject of study, this step should delineate the subject itself and provide an overview of the past and present controversies and how they were dealt with (Boenink et al., 2010). Once we have an idea of the moral landscape, we can put our imagination to work and speculate about the future.

Before continuing with the explanation of the method, I will first introduce NEST-ethics, which forms the basis of the next methodological step.

3.2. NEST-ethics

In order to construct possible ethical debates around the NEST in question, the authors use the so-called NEST-ethics. Developed by Swierstra and Rip (2007), NEST-ethics is an inventory of ethical arguments and patterns that are usually prevalent in ethical debates about NEST. Their main claim is that many of the ethical arguments around NEST are not new, but they follow a certain pattern. Content wise the arguments are different, but they can be categorized by their type, such as being consequentialist (1), they can emphasize rights and principles (2), they can focus on justice (3), or they argue based on the idea of what a good life is (4).

The logic behind these argumentation patterns is the following. The first arguments around a NEST usually emphasize the positive consequences of what developers, creators and designers want to achieve with it. This could include the promises and hopes about how the new technology will increase well-being or our control

of the world. They focus on this envisioned betterment that the technology would bring and argue based on these benefits why we should develop them. Usually, these expectations are then being attacked by people who are more skeptical about the NEST in question. Swierstra and colleagues identify 4 axes along which the arguments appear. Skeptics question whether the promises are plausible, or they are more hyped expectations. Also, it is usually contested if the technology in general will bring more benefits than harm or whether the side-effects are expected and calculated at all. Skeptics even bring up possible alternative solutions and ask whether there could be a better way to go for the envisioned benefits. Finally, the benefits themselves are contested, whether they truly bring something good to our society.

The second group of argumentation type is concerned with rights and duties of individuals or certain groups of people. Arguments will be made in line with the idea that people have the right to utilize the technology, or at least that they can do it as long as they do not harm others. However, a more prevalent type of argumentation goes the other way around and questions if people should have the right to the technology. The skeptical arguments here can also be categorized into 4 subtypes. First, very rarely people question if the principle holds in general. Second, people don't deny the principle itself, but they argue that it is not applicable to the technology in question. Third, the principle is acknowledged, but it is argued that the right and duty of someone is to not to use the technology. Finally, the principle itself is not attacked but is argued to be less important than other arguments.

The third category of argumentation patterns are surrounding the issues of justice. The question is usually how the benefits of the technology should be distributed. Of course, this already implies that the technology is accepted. Concerns that come up are usually questioning how will the NEST benefit all or those in need, instead of just a certain group of lucky people. Some usually argue that after a while the new technology will reach everyone, or those who are in need, while others think that this can only happen with political help, especially if we want to help the relative position of the people who will be able to access the technology only at a later stage.

The fourth category includes the arguments about the good life. Due to the complexity of the concept of good life and the various different ideas around it, the categorization here becomes difficult. Despite the variety of arguments, one particular idea is contested from the aspect of the good like. This is the general promise that technologies should enable us to have more control over our lives. It would seem self-evident at first sight that this is what we are aiming for, however, scholars often question whether it is always the right thing to desire. Ideas such as claiming that we want to play god, or that we transgress our natural limits and we dehumanize ourselves are quite common.

There are also other more general patterns of arguments surrounding NEST and moral development, which Swierstra and Rip call meta-ethical patterns. These views are overarching whole discussions about NEST, and they can result in the above-mentioned types of arguments.

We can distinguish between techno-optimists and techno-pessimists, where the former sees technology as the solution to problems, while the latter believes that they are the source of problems. Another debate is between determinists and voluntarists. Determinists believe that NEST will anyhow change our societal system regardless of what people discuss or decide. They are basically claiming that we have no control over what is going to happen, since technological development is predetermined by its internal logic. Even if we decide not to act, due to international competition, the technology will be developed anyway. Voluntarists on the other hand argue that since technologies are formed by social structures and forces, it is indeed possible to steer it into desirable directions and this is what we should try to do. Finally, we can also differentiate between arguments around moral change. Here one group would argue that a new technology is not too different from a previous one, and even if it changes morality society will accommodate to it. The other group would claim that moral change is in itself a problem, and that a new technology is therefore immoral or that if we accept it, we will be in moral decay. This latter one is also often referred to as the slippery slope argument.

3.3. Generating potential moral controversies with NEST-ethics

The second step is generating controversies (Boenink et al. 2010). In order to construct possible moral controversies, we need to follow three steps. First, we have to list the different expectations and promises that surround the new technology. We can ask the question: what the technology enables us to do or what problem does it offer to solve.

Second, taking the previously constructed list of expectations we can use the argumentation categories of NEST-ethics to attack these promises. The ethical reflection thus includes the considerations of consequences, the impacts on rights and duties, on distributive justice and on the idea of the good life. In this way the expectations and goals that the technology offers are criticized through the four categories.

The third step is to construct chains of arguments. We have to imagine how reactions would follow counter reactions. For example, the promising benefit of the technology is usually followed by arguments that focus on the negative impacts. It is questioned if the benefits outweigh the costs and risks, or if the particular technology under discussion is the best way to realize the benefit, or even if the claimed benefits are benefits at all. At this point it is usually concluded that more research is needed to figure out these issues. Once the previously listed problems are somewhat resolved or at least discussed, then deontological and good life considerations enter the debate. These try to investigate if the envisioned idea of the good life is indeed the one that we should strive for and whether the technology will only enable that specific good life for a few or

for all. These again are then countered in various ways with specific arguments that bring up specific principles or important rights.

3.4. Generating closure

After identifying the possible arguments and counterarguments that arise around the NEST in question, the third step is to decide which resolution might be plausible (Boenink et al., 2010, Swierstra et al., 2009). How would the controversy be resolved or temporarily come to a closure? The leading question in this step is of course, how we weigh the arguments at hand. First and foremost, we look at how similar issues were solved in the past. Besides this we have to pay attention to the current trends in morality. What new ideas, values and practices are uprooting in our present and what values are rather stable. Based on these insights, we can imagine what direction the debate would go and thus anticipate which decisions could be made. When we come to a plausible idea about the outcome of the decision-making, the controversy comes to a temporary or partial closure.

By having sketched different scenarios of the future, the scenario building is finished. The approach results in showing how an emerging technology might lead to moral controversy. It paints a picture of the interaction between society and technology in the future. It highlights that our moral landscape might be really different in, for example, 20 years (Boenink et al., 2010). The main goal of the scenarios is to enhance moral imagination and contribute to a wider and richer discussion in technology assessment (Boenink et al., 2010). The scenarios can be helpful in involving the public in these discussions. Another key characteristic of the approach is that it encourages to do ethics as a self-reflective process (Boenink et al., 2010). Let me elaborate on its importance.

4. Perceiving ethical technology assessment as self-reflection

Before I explain what we should take away from the method, let me reflect on the theoretical considerations of technomoral change and highlight one especially important idea regarding how we should perceive doing ethics in technology assessment.

We can see based on the above analysis that the TMS approach is explicitly focusing on developing an anticipatory approach for policy makers with clear methodological steps. Their considerations address key challenges regarding doing ethical evaluation with the notion in mind that values and morality are not fixed. What practitioners of ethical TA should definitely take away from their writings is the idea that doing ethical assessment is itself a reflective process and should be a reflective process on our own current moral world, norms and values that we often take for granted. The discussions around the desirability of a technology

should always include a reflection on ourselves as well. Even though we like to apply checklists, because they are ‘easy’, we should not be satisfied with that, and we should rather acknowledge the fact that in these assessment processes we are learning about ourselves and exploring our morality in the first place. If we take this seriously, the assessment can become much more fruitful and constructive. We stay aware of not only the technological impacts, but also of what and why we value in the first place and how we define our own ethics based on this. We can understand ourselves more by questioning what at first sight might seem self-evident.

5. What should we take away with us from the TMS approach?

Now that I have explained the theoretical background and the methodology of the TMS approach, I will elaborate on how I will incorporate parts of it and customize it for my own method. In my considerations I will focus on conceptual tools that are needed for doing anticipatory work while taking into account the structure and characteristic of technomoral change. I will refer to the developing method as the Moral Impact Mapping Approach (MIMA).

As I mentioned in the previous chapter, some conceptual elements that enable us to do anticipatory work were missing from the mediation analysis. In the TMS approach we can find these. To start with, the TMS’ first step, sketching the moral landscape is important. However, I suggest dividing this step into two separate parts. First, I suggest not only mapping the moral landscape but also the technological landscape. This means that I will delineate the technology, specify the technical details, and explain what the technology aims to replace, help or do. At this point it is also useful to list expectations and promises of the technology and thus introduce the expected use-contexts more specifically. This step is also needed for the mediation analysis because in this way I explore the ‘technology’ in the human-technology-world relationship.

Second, I will also need to analyze the moral context in which the technology is planned to be utilized. Since the circumstances influence how technologies will be appropriated and used, I need to have a clear view on the current stance of morality. Specifically, because I want to carry out a mediation analysis, I need substantial knowledge about the current perceptions, routines and practices. In this way I have the basis for comparison to see what the technology will make people perceive and do differently once it is in use. Therefore, the first step of the TMS approach should be the second step of MIMA. To have a structured overview of the landscape, I suggest using the three-level differentiation. First, I will start by analyzing the macro-level, more abstract values connected to the (development of the) technology, then I move onto the meso-level where we identify the institutionalized practices that have been established with the current technologies (that the new technology might want to replace or improve) in use. Finally, I arrive at the micro-

level where I can explain in what way people are currently doing their practices where the technology is expected to be introduced focusing on their moral considerations behind these practices.

Third, I will incorporate NEST-ethics, but slightly differently than in the original TMS approach. I will go beyond just analyzing the technology as one entity and generate the arguments around the whole. Based on the findings in the mediation analysis, I will construct the arguments with NEST-ethics around certain specific points of mediations. Nickel et al. (2022) recently investigated the structure of moral change. They argued that moral change starts with moral uncertainty, followed by moral inquiry which eventually can result in moral change. As the authors argue, moral uncertainty arises from an individual phenomenon, when someone faces a situation in which the current norms and value frameworks do not work, and confusion arises regarding the right action. Trying to mitigate this problematic situation, moral inquiry starts by looking for new concepts, values or new interpretations of them. This investigation is collective in nature, because the aim is to establish a new consensus in a community on how one should act in the new situation. Building onto these considerations, in my methodology I will try to construct such deliberation about the technology that follows from morally new or uncertain situations. By investigating how the new technology in question mediates perceptions and behavior and how this then leads to moral implications, a mediation analysis can enable me to anticipate morally uncertain situations. Where mediation appears, a new moral situation can appear, where current values and norms might not be sufficient in their current form. After having these new moral situations identified, I can anticipate how a moral inquiry would go by constructing the arguments with NEST-ethics. At this point I am making a shift from analyzing the micro-level to analyzing the meso-level of morality.

Finally, I will also incorporate the last step of TMS as the last step of my own method. By analyzing the previously sketched arguments I will generate possible closures. At this step I will make reflections on how and whether the macro-level of morality is impacted by the changes on the micro- and meso-level.

6. Conclusion

In this chapter I explored the theoretical foundations of the TMS approach and explained its methodological steps. The three main foundations of the approach are that it focuses on the soft impacts of technologies, it deals with the notion that technology and morality co-evolves and that by acknowledging this, the ethical analysis becomes a self-reflection process, where the ethics in a technology assessment is also an exploration of our own current morality.

The TMS method has three steps: 1) Sketching the moral landscape, 2) Generating moral controversies with NEST-ethics and 3) Generating closure by judging the plausibility of the debates. By

considering what would allow the mediation analysis to be used in an anticipatory way and also to have the right tools to account for anticipating the moral impacts on the meso- and macro-level I elaborated on what steps and conceptual tools should I take with me to incorporate it to the method I am developing in this thesis.

With these findings in mind, in the next chapter I am going to introduce, explain and apply a new method, the Moral Impact Mapping Approach that will account for anticipating the impact of emerging technologies on all levels of morality.

Chapter 4

1. Introduction

In this chapter I will present the Moral Impact Mapping Approach while applying it to an emerging technology. I am going to investigate the CRISPR-Cas9 gene editing method and its application for editing the germline of human embryos. I chose human germline gene editing (HGGE) because of its rapid development while also being one of the disruptive technologies, meaning that it is expected to have a substantial impact on deeply held norms, beliefs and values (Hopster, 2021). Despite the great amount of literature on gene editing, to my knowledge the impact on morality itself has not yet been investigated. In the myriad of ethical discussions and ethical committee reports about HGGE, ethical arguments usually seem to refer to some standard ethical concepts or values to which we have to hold ourselves to (Schleidgen et al., 2020). The assessments often seem to be based on some implicitly or explicitly predefined values and norms to which we have to compare and contrast the technology and its impacts. The arguments usually operate with various categorical differentiation, like the distinction between natural and unnatural (Odzuck, 2018), enhancement and therapy (Lanphier et al., 2015) trying to draw lines in-between these categories. I want to refrain from dealing with the technology on a more generic level, talking about gene editing in humans as such. The moral impacts are in the nuances, and this is how we should approach technologies when it comes to their assessment.

2. The 5-step approach

In this section I will explain the steps of the Moral Impact Mapping Approach. This description will be a brief one, but in the analysis section I will elaborate on them more deeply when I am applying it to human germline gene editing. In this section I will sketch the different steps and articulate what choices I made in constructing them. I will explain what I have taken from the TMS approach and what I left out and why.

I. Introduction of the technology and the technical details in context

The first step of the approach is to introduce the technology. This was also a necessary step in exploring the mediations of the technology. Here we should think of a brief but clear description of a technology that incorporates the articulation of the artifact/technology, how it will be used and what is the process of how the technology is utilized. The main goal of this step is to get a clear idea about the technology. We should avoid using very detailed description with all the scientific details and using difficult jargon.

II. Sketching the moral landscape

The second step is to sketch the moral landscape. I integrated this step from the TMS approach. It is a key element if we want to explore how morality would evolve in the future because first, we need to have an idea about morality in the here and now to start our speculation from what we know now. Furthermore, as the TMS approach argues, moral landscapes can be country specific, with different histories. Therefore, it is necessary to look at morality with respect to a specific location (continent, country, etc.) where the technology is expected to be used. Morality can operate differently in different countries and cultures.

In order to have a more structured picture of the landscape, we can differentiate between micro-, meso- and macro-level and describe how morality operates currently on all three.

III. Mediation analysis

At this step we perform the mediation analysis described on page 27. Since the technology has already been described in step one, this analysis can start with exploring the 'human' in the human-technology-world relation and then proceed with the remaining steps.

IV. Generating ethical discussion with NEST-ethics

Once we explored the mediations, we can generate the arguments that could arise around the NEST in question. This step is also part of the TMS approach, but in a slightly different way. The arguments I am generating are even more content specific. The discussion that arises around the technology works with some mediated concept and values. Because we explored the mediations earlier, it gives us an even more accurate picture of the content of the arguments that may come up in the debate. At this point we are moving on analyzing the meso-level of morality. The micro-level interactions between technology and humans result in some morally uncertain or new situations, as I explained earlier. This is then followed by a moral investigation, where new arguments might arise, trying to find the right concepts and conceptualizations to resolve these new moral situations. This is what we try to anticipate at this step of the approach

V. Evaluating arguments and constructing plausible closures

The final step is to evaluate the arguments and construct closures. At this point we need to think of different external factors that can influence the development of the technology and give weight to some of the arguments generated earlier. The aim is not to engage in a normative discussion and weigh the arguments in terms of what is right or wrong. Rather, by imagining different scenarios in how the technology could evolve,

we try to see which argument might become more dominant than the other. We can come back to analyzing morality on all three levels and see how the technology might affect the previously sketched landscape of morality in the future. Comparing to the moral landscape in the here and now we can contrast the new moral futures and engage in a more in-depth discussion about the technology in question.

3. The analysis

3.1. Explaining the technology and the technical details in context

In the first step I introduce the concerning technology and specify the technical details to get a clear view on what the technology is expected or planned to be used for. The idea here is to grasp the main characteristics of the technology to get a clear understanding on what the subject of research is. Without getting lost in the technical details, we should aim for providing a coherent overview focusing on the main functions and aims of the technology. Furthermore, we have to clarify the specific context in which the technology is expected to be used. This is important, because as said earlier, technologies usually operate in different ways depending on the environment and the use intentions, therefore their impacts are also dependent on the use context. To narrow down the analysis I will analyze the technology in the UK³.

Genome editing technologies make it possible to modify the genes of a living organism. Today it is possible to correct, insert or delete almost any DNA section in different types of cells (Rodríguez-Rodríguez et al., 2019). These targeted modifications are aiming at correcting defects or unwanted alterations in the genetic make-up. Genes for humans are like the code for a computer program. The genes code certain functions and characteristics of a person. If we modify the code, the corresponding functions are changing as well. The process that gene editing techniques try to mimic is naturally present in the human body. If a DNA breaks in a certain gene, the cell's DNA repair mechanism is triggered, which tries to 'heal' the broken part by building back the original gene. The only difference is that with targeted gene editing scientists decide about the DNA part that will be built back by the repair mechanism.

When we are talking about gene editing the germline, we are referring to hereditary genetic modification. In contrast, in somatic gene editing, the only affected person is the individual who undergoes the treatment. There are three ways how the germline can be targeted (Ranisch, 2020). First, the genetic

³ I chose the UK to be able to understand legislative documents and government recommendations. This was a strategic choice only to be able to demonstrate the approach in this thesis.

modification can take place in the human zygote, which develops into a genetically modified embryo. Second, the germ cells or their progenitors can be targeted. This means that either the sperm cells or the eggs are modified. The third option is to modify stem cells which eventually grow into germ cells that can be used for reproduction.

CRISPR-Cas9 (clustered regularly interspaced short palindromic repeats and CRISPR-associated protein 9) is one of the most well-known techniques because it is easier to use and less expensive than the other methods (Carroll, 2017). The process goes as follows: scientists engineer the so-called guide RNA (gRNA) molecule according to the DNA sequence that they wish to modify (Doudna and Charpentier, 2014). The programmed RNA will bind to its analogous part of the target DNA. This eventually will guide the Cas9 enzyme to cut at the desired location within the genome of the organism. There are repair mechanisms in cells to rebuild the broken DNA with the help of nucleases. However, if scientists inject a sample gene, in the form of an RNA during the cutting mechanism, then the insertion of a new gene takes place at the broken site of the genome. The two-component system of gRNA and Cas9 protein allows for an efficient, targeted and precise cutting of the DNA strands. It is also called the biological version of cut and replace.

Gene editing offers the chance to cure genetic diseases. Some diseases are the result of multiple genetic deficits, while others are a result of a single genetic variant. Because of the complexity of our genetics and genetic diseases, the current vision of germline gene editing entails the idea of curing monogenic diseases, such as Cystic fibrosis, Huntington's chorea, Duchenne muscular dystrophy (DMD) and sickle cell anemia (Doudna, 2020). Today if prospective parents are carrying a hereditary disease, they have some options to avoid having a sick child: they can use a gamete donor, use Prenatal Genetic Diagnosis (PGD), embryo selection or they can choose to adopt a child. (Spaander, 2022). HGGE would be an additional option on this list, but currently it is banned to use it for reproductive purposes in the UK (The Human Fertilisation and Embryology Act, 2008).

There are two main technical limitations of gene editing: off-target effects and mosaicism. The former happens when not only the targeted parts of the DNA get modified, while in the latter the modification does not reach all cells in an embryo (Ranisch, 2020). If HGGE would be legal to use for reproductive purposes, then due to these unwanted effects, a genetic diagnosis would be needed to test the results of the modification before the embryo is transferred to the uterus. However, the current genetic tests cannot reliably detect the off-target mutations and mosaicism. (Ranisch, 2020)

3.2. Sketching the moral landscape

In this step the goal is to explain the technology and its moral context. This moral context entails the related practices and the regulations. If the technology is not yet used, we have to look at the current alternatives and how these technologies are considered and used today.

As explained earlier in the previous chapter, at this step it can be useful to analyze the moral landscape on the three levels. First, we can look into the acro-level and explore based on what abstract moral values are the basis of the current regime. Second, we can analyze the meso-level, accounting for the institutionalized practices that are in place for the technology. In case the technology is not yet used in any form, we can investigate the practices around the current technologies that the new one wants to improve, augment, or replace. Finally, we take the micro-level by zooming in on the individual relation to the currently available technology and connected practices.

HGGE for editing the genes of embryos makes it belong to the field of human reproductive technologies. Therefore, in this section I will explore the current technologies that are used in technologically assisted reproductive processes and the current moral considerations and connected practices.

The first in-vitro (IVF) fertilization happened in 1978 and was considered a breakthrough in reproductive technologies as it made it possible for couples to conceive if they were naturally unable to. Even though it was considered a great scientific success, it received some harsh critiques. At that time, the procedure was accused of being unnatural and that we are trying to “play god” (Locke, 2020). Interestingly, this argument is also present in the current HGGE debate. Today, IVF is legal in the UK and is funded by the National Health Service (NHS) for women who are under 43 years and were trying for two years to get pregnant without success (National Health Service, 2022a).⁴

Preimplantation genetic diagnosis (PGD) evolved directly from IVF technology: it is an extra step in IVF and cannot be carried out separately. In the UK PGD is currently under strict regulation and can only be used if couples have a known serious inheritable disease in their families and the risk is high that their child would carry it too (Human Fertilization and Embryology Authority, 2022). In order to prevent this, they test the embryos and select the healthy ones, which they implant back into the womb of the woman.

Prenatal genetic screening (PGS) is a technology used to make genetic tests of the zygote as soon as possible in the pregnancy. The difference between PGD and PGS is that in the latter, the embryo is tested outside of the women’s body and will be only implanted if decided to do so, while with PGS the pregnancy

⁴ Some other, more specific conditions also apply, please see: <https://www.nhs.uk/conditions/ivf/>

is already established. In case the results show a sign of illness of the future child, it can be decided to end the pregnancy by abortion.

HGGE technically would be possible to use, like PGD, as part of the IVF treatments but there is also research on performing gene editing on the embryo within the utero (Peranteau and Flake, 2020). However, currently, in the UK HGEE on embryos is permitted only for research purposes, under strict regulations, and it is illegal to transfer them for establishing pregnancy (The Human Fertilization and Embryology Act, 2008). Interestingly though, in the latest report of the Nuffield Bioethics council they say that editing the DNA of a human embryo is “morally permissible” in case it happens in the best interest of the future child, and it does not worsen the already existing divide in the society (Nuffield Council on Bioethics, 2018). Nevertheless, change in the legal regulations has not been made yet.

In a recent report of the Parliamentary Office of Science and Technology of the UK, they highlight that the technique could be used to edit genes that are causing 10000 monogenic disorders (The Parliamentary Office of Science and Technology, 2020). Their main reason for not permitting its use yet, is the safety concerns that are still not minimized enough.

On the micro-level of morality currently, a couple who wants to have kids usually start trying in a natural way. Women can prepare for the pregnancy by quitting harmful practices, such as smoking or drinking alcohol. IVF and embryo testing can be deliberately chosen by people who know that they have serious inherited diseases in their family and want to avoid passing the diseases onto their children (Human Fertilization and Embryology Authority, 2022b).

On the meso-level there are the institutionalized practices. Today in the UK, a woman who couldn't conceive naturally for the past two year can choose to undergo IVF, where also PGD can be performed. In general, for pregnant women the government offers three tests to perform during the pregnancy (National Health Service, 2022b). The first screening test is for sickle cell and thalassemia before the 10th week of the pregnancy. Also, blood tests are offered for HIV, hepatitis B and syphilis. The second test is offered around 11-14 weeks for Down's syndrome, Edwards' syndrome and Patau's syndrome. Finally, a screening is offered around weeks 18-21 to check the development of the baby.

The prevalent abstract values operating on the macro-level are beneficence (benefiting others), nonmaleficence (avoiding harm), respect for autonomy, and justice (Evans, 2021). These are considered the guiding principles in general in the debates and discussion about HGGE.

3.3. Mediation analysis - mapping the moral impacts on the micro-level

With a new technology, new forms of technological mediations appear, which can affect morality and result in morally new situations. Just as in the guidance ethics approach, the aim is not to apply a previously determined

set of ethical principles and values, but to explore the ethics from “within”. In this way we are not falling into the trap of moral presentism, but also not really allowing us to fall into the trap of moral futurism where we first want to try to find out what moral values will be at stake and work with them. Rather in a more explanatory way I want to see how technology affects the very concepts and definitions of values and norms. We have let ourselves go on a journey regarding our own morality and practices. With this more fluid concept of ethical analysis, we let ourselves learn and explore.

Based on the steps explained in Chapter 2, I will carry out a mediation analysis. The previous steps augment the mediation analysis to use it for anticipatory purposes. Because the technology is not yet used, it is difficult to provide a full overview on the mediations. However, by having explained the technology and sketched the moral landscape, I have enough information to imagine the future use of the technology and its context to explore the majority of mediations.

At this point of the analysis the technology in question has to be imagined in a specific context that it is expected to be used. Based on the current state-of-the art of the technology we have to play with the idea of what if, but this what if must be as realistic as possible. The closer the technology is to enter the market and become available for use, the easier it is to have a realistic and clear idea on how it would actually operate within society.

At the last step of the mediation analysis, I will reflect on the moral implications of the mediations, and also where moral uncertainty can appear with the new technology.

HGGE has been just recently declared to be ethically permissible if it is in the best interest of the child. This means that due to current developments, we can expect the technology to be used for treating serious illnesses that are monogenic in nature. Since HGGE is such an impactful technology, its use would probably be regulated by a committee, who decides whether an embryo can get the treatment or not. Furthermore, HGGE would be performed together with IVF, in order to avoid having a pregnancy where off-target effects or mosaicism happened. The technology realistically would be an additional option, next to other assisted reproductive technologies for people who have known heritable genetic diseases or who want to avoid having a child with a genetic disorder. Taking into account the off-target effects and the issue with mosaicism, the embryo would be tested before and after the treatment and the reproduction would happen through IVF. In this case, if a problem arises there is no need to terminate the pregnancy, only to discard the embryo(s).

In the mediation analysis, step one was to delineate the technology, which in case of MIMT has already happened in step one. Therefore, the mediation analysis starts with exploring who is the ‘human’ in the human-technology-world relationship. By analyzing the specific human-technology relations and the

mediating effects of the technology in this relation, we are exploring the micro-level interactions. This enables us to reflect on the micro-level of morality and moral considerations.

3.3.1. The 'human' in the human-technology-world relationship

The directly affected people are the prospective parents, the medical professional and the future child. The indirectly affected individuals are members of the prospective parents' families and friends, but also other people who one day want to have children. To demonstrate the approach, I will now only map the mediations for the prospective parents.

3.3.2. Identifying human-technology relations

Prospective mom/dad – HGGE – the world:

Between the prospective parents and the technology there is a *hermeneutic* relationship. It is somewhat different from a classical hermeneutic relation because there is no immediate representation of the world that we can read (like in the case of an MRI machine or a thermometer). However, reality is presented to prospective parents in a certain specific way because of the technology. The hermeneutic relation is not only due to HGGE, but also due to the interplay of technologies involved in the process. HGGE makes the prospective mom and dad center their attention on their own genetic make-up and also on their future child's. In order to perform gene editing, one has to know their genome, therefore there has to be a genetic diagnosis made first. The 'world' for the prospective parents, which, in this case, is the future child, is presented as some data in terms of genetic diagnostic results. It has to be interpreted in order to imagine how a child would be in the future with the forecasted characteristics that the data tells the prospective parent.

3.3.3. Identifying points of mediations - Mediation of perception and mediation of action

Mediation of perception/experience:

Reproductive technologies are available today, and prospective parents are free to choose to undergo, for example, different types of PGS to test for genetic disorders. I consider HGGE to be another option on this list. With this in mind, I will investigate how this would mediate the perception and experience of humans.

Perception of reproduction

Reproduction has already become more and more technological because of the development of already available reproductive technologies. Due to some of these technologies, prospective parents are already facing

some decisions when the woman becomes pregnant. As said earlier, in the UK there are currently three screening tests offered by the NHS. These technologies make prospective parents already face certain decisions. They have to choose to perform or not to perform the tests. If they decide to do them, they have to decide what they do with the information they gain.

With HGGE being available the decision-making process for getting a child is getting even more emphasis. The possibility to choose HGGE mediates even the idea of how to start the reproduction process. Prospective parents might want to choose to do a genetic test even before deciding on trying to get a child. If the results show some unwanted genetic condition, they are facing another decision. They can choose (or not to choose) to undergo IVF to have the possibility to perform gene editing if the embryo carries a certain unwanted genetic variant. As we can see, the option of HGGE makes the process of getting a child even more a series of decisions, some of which precedes even the practice of starting a pregnancy in a natural way.

Perception of the future child

An image of the unborn, as an individual with certain genetic conditions already appears when the prospective parents decide to do the genetic test to see their genetic makeup. By having the results ready, they can already imagine their future child with certain conditions. Even though there is not even an embryo yet, they get an idea about their future child by seeing what genetic combinations are possible if they get a child together. The prospective parents can already worry about their not-yet-even-conceived child. Once the fertilization happens, one of the possibilities that the genetic tests could more or less predict, becomes reality, which further shapes the perception of the unborn. Just to note, the unborn is now closer to becoming a human, but it is still only just a zygote.

The technology reduces the child to an assemblage of information about their genetic make-up and the prospective parent interacting (indirectly) with the technology imagines a child with this information in mind. The future child, even though technically it is only a zygote, is represented to the future parents through the technology as an individual with certain conditions. This hermeneutic relationship amplifies a certain aspect of reality. The child is not perceived only as an 'unknown' newcomer to the family, but it is already imagined as an individual with certain characteristics or medical conditions. The focus is on whether he or she will be healthy, and the idea of the child is focused on its medical well-being. The unborn in this sense, is already perceived as a separate being from the mother, just like in the case of the ultrasound example by Verbeek.

Perception of being a (biologically) 'good' enough parent

HGGE also affects how the future mom or future dad perceive themselves. Their genetic make-up becomes known to them, which in turn shapes their perception about themselves. She or he is represented as her or his genetic information, which might include information about undesired genetic factors. This can lead to perceiving herself or himself as someone whose certain conditions and thus herself or himself may have to be “fixed” in order to have a healthy child. In other words, the question arises: is their body ‘good’ enough as it is to create a life worth living?

Perception of genetic diseases and disorders

Because HGGE provides the option to correct certain deficits in the DNA, it also shapes how we perceive diseases and disabilities. The concept of a healthy individual is perceived as free of known genetic variations that cause diseases. HGGE amplifies the want to have healthy children and the idea that it is something we should all aim for. It also conveys the message that we are seeking for the perfect life, and we are aiming for finding the solutions to the problems, which are in this case the disorders. This can lead to amplifying the perception of people with disabilities and disorders as something we should feel sorry for. Their life can appear less valuable in this sense.

Mediation of actions:

The action on having to choose between using the technology or not

As already touched upon, the prospective parents are faced with decisions. The changes in perception eventually lead to action. With HGGE available, the couple who decided to have a child has to make the choice whether they would like to have a genetic examination to see whether HGGE would be needed in their case or not. The prospective parents are approaching the idea of reproduction from a different way. They might not even start a natural way of trying to conceive but turn to do a genetic examination first.

The action on deciding what child to choose

Once the couple decided to do a genetic examination and they got the results, they can now decide on what child they want to have. If the results tell them that their kid might develop certain conditions, they can decide to go through IVF and potentially HGGE. Once the fertilization happens and the genetic make-up of the embryo is known, the prospective parents again, can make a decision about the life of the unborn. They can choose the ‘healthiest’ zygote, or a zygote that is free of life-threatening conditions. In case all zygotes carry

some condition, they choose between them. What's more, parents can decide not to implant any of the zygotes and go through the whole preceding process again in light of being more 'successful' the next time.

The action of weighing risks

In all of these decisions, the prospective parents are in a position where they have to evaluate the implications of implanting a certain embryo with certain conditions. They have to weigh the risks they want or not want to take. Of course, probably medical professionals also offer advice, but the final decision is in their hands.

3.3.4. Reflection on moral implications - identifying affected values and concepts

The unborn as the subject of moral decisions

As I elaborated on above, the perception of the unborn is in a new light if prospective parents have HGGE as an available option. Because of how the technology shifts the focus on the genetic conditions of the unborn, the question of what kind of a child, health condition wise, the parents want gets attention. Prospective parents are evaluating what is the right kind of life they should allow to come to life. Their decisions reflect what kind of life they consider to be worth living.

Moral responsibility

The above explained mediations have a moral relevance as well. The way humans perceive the world affects their actions. These actions are often morally loaded actions. The question of what the right thing is to do appears in these situations. Because HGGE makes people face new situations, with new decisions, the moral decision-making space expands. In our society today, in principle, the individuals who decide to have a child are responsible for that child. Of course, in ideal situations, parents do want the best for their children. Now this technology brings this responsibility to another level. Prospective parents have to make decisions even before the fertilization happens, which is way before the baby is born. The question of how to be a responsible parent already appears when the thought comes to mind of wanting to have a child. Through the series of decisions that the prospective parents have to take, they are constituted as a moral subject. And the fact that they are deciding about a future individual's life makes these decisions morally different, maybe in some respects more serious, compared to how and what decisions couples have to make nowadays.

Reproductive autonomy

The concept of reproductive autonomy plays an important role as well. By definition reproductive autonomy is the power and choice of an individual making free informed decisions regarding reproduction (Purdy,

2006). With HGGE, our idea about reproductive freedom might shift. It is no longer the case that the individual is only free to choose when they want to have children or if they want to do some genetic tests at the beginning of a pregnancy and decide about aborting, but they can now choose to decide about what kind of child they want. This means that the realm of reproductive autonomy is expanded. HGGE can be seen as something that adds to reproductive autonomy, by giving parents the chance to have more well-informed decisions about their future child. On the other hand, as the technology gives information about the health conditions of the child, it nudges the parents towards certain decisions. By indicating that the unborn has a high probability developing a health condition, it suggests the decision of not choosing to implant that zygote. In this sense, it reduces autonomy, because the results already suggest a direction for a 'good' decision, which is getting a child free of known genetic conditions.

Reproductive autonomy in this sense, does no longer mean being able to choose when to conceive, or to do PGS tests. Reproductive autonomy might incorporate the notion of having the freedom to decide about the genetic health conditions about the future child.

Moral uncertainty

When we imagine the couple receiving the genetic information about their embryo, a moment of moral uncertainty can arise. If the results tell them that their future kid has a genetic condition, they are facing a decision about the life of the unborn where conflicting arguments arise. On the one hand, they can choose not to bring to life an individual who would suffer from a genetic condition. On the other hand, they are considering taking away a life. The moral obligations towards a human embryo are somewhat unclear. To note, officially, embryos are permissible to destroy that are not being used for implantation. In that sense, by regulations it is ethically permissible to destroy embryos. This might not be new, since the debate on how we should treat embryos already exists in regard to other technologies like PGD.

Furthermore, uncertainty can arise around the decision of the prospective parents of having to choose a life for the future child, and thus also for themselves as parents. They have to make a choice about what life is worth living, which might not always be the most clear-cut idea.

3.4. Generating ethical discussion - NEST-ethics:

With exploring the meditations, I could see which concepts and values are being mediated by the technology. Taking these findings into account, in this step the NEST-ethics framework will be used to see what arguments could arise around the technology. The mediations give a solid grounding to what concepts could probably be negotiated. By doing this we are arriving at the meso-level of morality. As said earlier, on the meso-level of

morality, the abstract values and concepts are being debated and specified. Different social groups and actors are negotiating about how they understand certain concepts, which then eventually can lead to the formulation of new rules or regulations.

To stay as realistic as I can I am aiming at reducing speculation as much as possible at this step. To this end, I will focus only on describing the content of the debate that can arise. In the TMS some events are usually imagined that lead to the generation of discourse around the new technology. I, rather, will not engage in imagining such events, because although this is how it usually happens in real-life to the aim of mapping the moral impact it is not necessarily relevant to engage in a story telling about hypothetical situations. The main goal is to see how the technology generates a discussion around morally questionable and uncertain situations and what mostly matters is the content of the discussion. I am not saying that the actors, institutions and other factors are totally irrelevant regarding how the technology will develop and therefore impact morality. I am only claiming that they are highly uncertain and therefore engaging in speculations about them they do not add to the analysis at this point.

Generating arguments

In the table below we can find the arguments that would potentially appear in the debate around the technology. Based on what the technology mediates, the content of the consequentialist and arguments about rights and principles can be quite rich. The arguments about justice and the good life are not really affected by the mediations. They are rather generally applied to the technology as such.

The arguments can be found in the table below and are not put into chains of argument, even though probably in real life they are not appearing at the same time. Nevertheless, it is very likely that they all enter the debate at some point and eventually they will have an influence in the outcome of the discussions. These arguments are not meant to create a normative dimension of this approach. It is solely descriptively sketching the content of the ethical debate that would come about around the NEST in question.

With green I indicated the arguments related to the change of perception regarding the unborn, with orange for the change of perception regarding responsibility and with blue for the change of perception regarding reproductive autonomy. The arguments were generated based on the mediations. This is to show how the change in perception brings about new arguments in terms of content. For example, if we take the pro consequentialist argument and specify more clearly what the technology promises us to control, we end

up with a new, more specific argument. Namely, that with the new technology the newborn's health can be controlled to another extent than before.⁵

Consequentialist arguments				
PROs	CONs			
<p>It increases our control and thus our well-being. The newborn's health can be controlled. Parents can be more responsible by making genetic tests and if needed choose HGGE. The reproductive autonomy of prospective parents are expanding with HGGE.</p>	<p>Is the promise plausible, or are we dealing with hype and over-promising? Not necessarily can we control the newborn's health because it is over-promising. The technology cannot do it perfectly. Being 'more responsible' is not necessarily the best, because prospective parents are relying more on technology's suggestions. Reproductive autonomy is not necessarily enhanced because parents are nudged to take certain decisions that the genetic results tell us.</p>	<p>Aren't adverse side-effects overruling or neutralize benefits? We can control but only to a certain extent since there is mosaicism and off-target effects. The benefit of being more responsible by choosing HGGE might turn out to be even showing less responsibility because of the unwanted alterations that the technology can cause. Despite having also, the option of HGGE to choose, because of the side-effects it might not be worth it.</p>	<p>Isn't there an alternative way to reach the envisioned goal? We have alternative options, like embryo selection and PGD by which we can have some control over the characteristics of a child while remaining safe. Being a responsible prospective parent is also possible by choosing these technologies. In fact, because they might be safer, they can be the more responsible choice. Our reproductive autonomy can take the form of choosing PGS and genetic tests.</p>	<p>Is the envisioned good really that good? Do we really want to have control over the health conditions of a child? Is having the technology and thus the responsibility really that good? Having the option of HGGE and thus expanding our reproductive autonomy is really what we should aim for?</p>

⁵ Some of the arguments generated here can be found in the bioethics literature on HGGE (see for example Nuffield Council on Bioethics, 2018). However, making connections to this debate is way out of the scope of this thesis. Nevertheless, this is also proof that since the technology already exists, the arguments around these new moral situations arise. What becomes clear in my analysis is that some of these arguments arise from how morality is mediated by the new technology. The changes in perception disrupt some of our concepts. With the changed perceptions and changed concepts, new arguments come about.

Arguments about rights and principles					
PROs		CONs			
<p>People have the right to use the new technology. People should have the right to choose to have a child free of hereditary genetic diseases. Prospective parents have the right to choose to be responsible by using HGGE. People have the right to have their reproductive autonomy enhanced through the use of HGGE.</p>	<p>People have the right to get the technology because it does not harm others. [Cannot be claimed for HGGE since the future child might be harmed due to the side-effects.]</p>	<p>The principle is wrong. People should not have the right to decide about their children's characteristics. Prospective parents should not have the right to take on the responsibility that comes with using HGGE. People should not have the right to reproductive autonomy in the form of HGGE.</p>	<p>The principle is fine but does not apply to the concerning technology. People should have the right to choose a child free of hereditary genetic diseases, but not with the use of HGGE. People can choose to take responsibility by using the technology, but not HGGE. People have the right to have reproductive autonomy, but HGGE does not belong to this category because it is so different from other technologies.</p>	<p>The principle is fine but works the other way around. It is true that people should be able to have a healthy child with the use of HGGE, but this affects other parents as well, who might not necessarily want to use the technology, but still, they would feel the pressure to do so. Therefore, using the technology infringes with other parents' freedom of choice by having to choose the technology because of others. Regarding responsibility the same argument can be made because of other people using the technology it can infringe on some parents' rights to freely choose to be responsible in the way they want. Reproductive autonomy is in fact if the technology does not nudge parents to take a certain decision, just because the genetic results suggest a certain 'right' decision.</p>	<p>The principle is less important than some other principle. There are more important things than having a child free of genetic diseases by HGGE. The responsibility of parents is not more important to use HGGE than some other principle. Enhancing reproductive autonomy with HGGE is less important than some other principle.</p>

3.5. Evaluating arguments and constructing plausible closures

At this step we have to look at the previously generated arguments and evaluate them. I am still refraining to engage in a normative discussion therefore the arguments generated earlier will not be weighed in terms of what

is right and wrong. In different closures, different arguments can “win”, but external factors play a role in which arguments will be stronger than the other. The goal in this step is to construct probable outcomes of the debate. We can turn here to social and moral trends that are prevalent in our current society and fit the technology in these patterns. We can also base our judgment on how previously ethical debates were resolved, what common conclusion has been reached in the context of the concerning technology or a similar technology. Investigating what moral concepts and considerations have been proven to be robust in the past and therefore are likely to stay as they are in the future. Changes to morality have to be considered on the three levels. The most robust level is the macro-level, where change takes place really slowly. On the meso-level change usually happens if some niche on the micro-level is perceived as successful.

Also, the ethical debate around the technology will never really be completely gone. The shaping of technology and morality is a continuous process. There are more intense periods where the debate is heated, while there are times when the ethical discussion becomes more silenced. Also, we have to keep in mind that although in this approach the focus is on the interaction between morality and technology, the influencing factors of the future are more diverse than that.

The scope of outcomes can depend on multiple factors which will result in various future paths. One of the most important one is the successfulness of the technology. Therefore, to represent how constructing closure would look like, I will consider two different paths in this example. One where the technology proves to fulfill most of its promises and expectations in the majority of cases and another where it rather fails to do so. In the direction when the technology works as expected I am not picturing a scenario where there cannot be disruptions and some technological failures, but the idea is that the overall acceptance of the technology goes smoothly because it is mostly working as expected. The same holds for the direction when the technology doesn't perform as expected. In that case there are some successful applications, but overall, the technology fails to fulfill the expectations.

- I. HGGE proves to be successful once it has been started to be used and monogenic hereditary diseases are being cured with the technology. In some cases, minor side-effects appear, but overall, the treatment is successful.

After the first genetic tests some people, who have no other option, are getting advised to proceed with IVF and in case there are no healthy zygotes, they should do HGGE. After a series of successful treatments, it becomes a more and more normalized practice for couples who decide to have children to make the genetic tests and if needed perform HGGE on the zygotes. That parents use HGGE to have children free of hereditary genetic diseases becomes more common. The notion of how it is perceived to be a responsible parent extends to this procedure. The decision still remains in the hands of prospective parents, but the socially dominant

trend will be the use of the technology. Reproductive autonomy in the future entails the idea of being able to decide to have a child free of known monogenic genetic conditions. The moral responsibility of the parents is commonly understood as the act of making genetic tests before deciding to have a child and if the results suggest undergoing HGGE. The concepts on the macro-level do not really change. The considerations are still operating on the values of beneficence (benefiting others), nonmaleficence (avoiding harm), respect for autonomy, and justice.

II. Due to recommendations, HGGE was applied in some cases. However, the treatment has not always been successful and the elimination of genetic diseases in most of the cases were not achieved

The skepticism towards the technology becomes dominant in society and certain social groups raise their voices against the use of the technology. The moral questions and concepts discussed earlier get a lot of attention and arguments defending the current moral concepts and values are being raised with success. Because of the failure of the technology, it got restricted and further research initiatives have taken place to improve HGGE. Until proven to be more successful, it is not suggested by the government to implant zygotes who went under HGGE. Nevertheless, the government does not declare it to be illegal and therefore some people still choose to use the technology. The common perception of the technology is that it is more irresponsible to use it, unless the disease they want to eliminate is deadly. People rather turn to other technologies that are proven to be safer. Future parents' responsibility is shaped to the direction where it is better to do PGS tests, then to go for genetic tests before deciding on getting a child. Reproductive autonomy still covers the option to be able to choose HGGE and some people do live with the opportunity. The idea of getting a child free of genetic conditions is prominent, but not at all costs. Choosing other, alternative technologies remains the more common practice. In this scenario as well, the considerations are still operating on the values of beneficence (benefiting others), nonmaleficence (avoiding harm), respect for autonomy, and justice. Therefore, the macro-level of morality remains stable.

4. Final thoughts on the approach

Of course, these two closures are not the only probable scenarios. Other closures can also be constructed by considering other factors influencing the technology, such as changes in political views, ideological changes, economic factors, the development of other technologies, environmental factors, etc. For example, if in the future genetic diseases become widespread and the working population largely decreases, it can happen that the government intervenes. In that case, for instance, even values on the macro-level can be subject to change. The autonomy of people might decrease if the government decides to take action and assigns the use of

HGGE, for instance, in order to prevent a crucial decline in the economy. These scenarios can be more realistic if we carefully analyze the above listed factors and connected trends.

Also, as it is suggested in the guidance ethics approach, the involvement of different groups of people can be highly beneficial when assessing a technology. The MIMA can also be more fruitful and rich in content if it is applied with a variety of actors together, including scientific experts, ethical experts and stakeholders. In this sense the demonstration of this method in this thesis is limited.

Finally, it is worth to reflect on what this approach brings to technology assessment. First, it makes us see more clearly how a new technology influences our morality and moral concepts. Starting from the micro-level mediation analysis, we become aware of how a new technology impacts the very concepts we are working with in assessing a technology. Second, as said earlier, this approach is unique in encouraging self-reflection when doing ethical technology assessment. Practitioners of technology assessment need to be open to the idea that our current morality is subject to change and has changed earlier as well. This helps to not to take concepts, beliefs and tacit morality for granted but to always do a check-up on whether these often tacitly embedded norms and values still hold and should be accepted or not. Third, connected also to the previous point, MIMA can be helpful in broadening the discussion about emerging technologies. It is also suitable to involve the public in the scenario creation and in the after-discussion. If we try to use simple language the inclusion of social groups can be more successful.

Since this is the first attempt to integrate mediation theory and the technomoral scenario approach for technology assessment, there are also limitations to the approach. First of all, ideally using MIMA should be a group activity, rather than only a one-person analysis as I did in this thesis. Incorporating more viewpoints can enhance the approach even more. Second, the transition from the mediation analysis to generating the arguments can be much more elaborative, by considering all the different stakeholders and their connection to the technology. Same holds for generating closures. We can construct more scenarios by analyzing more in-depth how external factors might influence the future. Third, the notion of what we exactly mean by moral (value) change could be explored in order to make the analysis more nuanced and specific. In this thesis I was working with a rather broad concept of technology induced moral change, also because, as far as I have seen the literature in this regard is limited.

5. Conclusion

In this chapter I presented the Moral Impact Mapping Approach which is a combinatory approach using certain elements of the technomoral scenario approach, augmenting it with a mediation analysis. This approach enables us to analyze how an emerging technology could impact morality, our moral concepts and

considerations in the future. With mediation analysis we can see how a new technology would influence morality on the micro-level by shaping the perception of certain concepts which then are also affecting the actions of people. By engaging in how these mediations would generate the ethical debate about the technology it also accounts for the meso-level. Here we can see how the concepts and understanding of certain values are affected and shaped by the new technology. By highlighting what values are at play in the macro-level we can make a reflection on them as well taking into account the meso- and micro-level impacts.

Conclusion and final thoughts

In this thesis I set the goal to construct an approach that accounts for anticipating the moral impact of emerging technologies on all three levels of morality. These three levels entail the micro-, meso- and macro-level.

In Chapter 1 I started off with analyzing the field of Ethical Foresight Analysis. I explained that Technology Assessment practices always operated on ethical considerations, but they were not explicitly addressing the impacts of technologies on morality itself. I showed that two recent approaches, the technomoral scenario approach and the threshold technology analysis were the only attempts to provide frameworks to anticipate how a new technology might change our morality, our moral values and concepts. I ended the chapter by highlighting another dilemma in the field of ethical foresight: anticipating moral change on the micro-level is easier, while investigating the macro-level becomes problematic due to the plenty of variables at play. When we see the micro-level changes, intervention with the technology is still possible, but we have little clue about the macro-level. When the macro-level changes become visible, changing the technology becomes more difficult. To overcome the dilemma, I proposed to combine mediation theory and certain steps of the technomoral scenario approach.

In Chapter 2 and 3 I have dived into the theoretical foundations of both approaches, and I showed that their focus in analyzing the interaction between humans, technology and morality is addressing the different levels of morality. Technological mediation theory provides the right conceptual lens to analyze human-technology relations on the micro-level, which then has implications for the micro-level of morality. The technomoral scenario approach, on the other hand, is focused on investigating morality on the higher levels. By engaging in exploring how ethical debates about a NEST would come about, it allows us to see the dynamics on the meso- and macro-level of morality. In Chapter 2 I argued that mediation theory is best applied in hindsight, but in Chapter 4 I showed that by augmenting it with the right conceptual steps it can be used in an anticipatory manner as well. In Chapter 3 I claimed that the technomoral scenario approach can be too speculative, but in Chapter 4 I demonstrated that by grounding it with mediation analysis, this speculation can be reduced.

The results of my criticisms and analysis of technological mediation and technomoral scenario approach is what I called the Moral Impact Mapping Approach. This five-step approach allows for a systematic analysis of how new technologies might impact morality, accounting for the micro- meso- and macro-level. Starting with the exploration of morality on the micro-level with a mediation analysis, we can make a more grounded anticipation on the meso-and macro-level. In this way we are mitigating the concerns

in the above stated dilemma. Starting off from the micro-level by doing a mediation analysis we create the ground to construct arguments that might arise around the NEST. In this way we arrive at analyzing the meso-level of morality, where the changed concepts are being debated. The macro-level impacts are the most uncertain, but by contrasting the outcomes of the ethical discussions in the form of scenarios with the sketched moral landscape in the here and now we get an idea of how morality could be impacted on the macro-level in the long run.

MIMA is a descriptive approach and therefore does not result in normative outcomes and suggestions. The aim of this approach is not to tell what is right or wrong. What it does is that it helps us explore how a new technology might cause changes in our morality. Whether that is good or bad should be discussed with the stakeholders of the technology in question. This approach, first and foremost, helps us see that with the decisions about new technologies, we are not only steering technology development but our moral development as well. If we engage in analyzing the impacts on morality, we are not only judging the technology, but we are also analyzing our own ethical considerations. This is how the Moral Impact Mapping Approach can be of help. It provides the framework for a systematic analysis of our morality concerning a specific technology in the present and in the future. This approach contributes to enrich the debate on NEST in terms of ethics. It tries to encourage us to open up to the idea that concepts, definitions and perception of moral values are not fixed. But after all, these are the ultimate guiding lines along which we make decisions, create rules and regulations. To come to fruitful debates therefore, it is key to first explore how these concepts are shaped and interpreted in the light of a new technology. This reflection can contribute to a more critical but comprehensive and broad ethical discussion on the NESTs to come.

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