MITIGATING MODIFICATION:

UNDERSTANDING THE UK HUMAN

GERMLINE GENOME-EDITING DEBATE

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For Callum.

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ABSTRACT

This mixed-method qualitative study examines debates surrounding the socio-ethical implications of human germline genome-editing (hGGE) technologies, focusing on how hybrid elite stakeholders' discursive and argumentative strategies have shaped the UK hGGE debate within the unique regulatory landscape of the UK. I utilise conceptual approaches from science and technology studies (STS) and ethics to explore how hGGE debates are architected through tools, such as the inclusion and exclusion of actors, rhetorical devices, and argumentative patterns.

The thesis identifies multiple agorae in the UK where preparatory debates on hGGE occur, building upon approaches from NEST-ethics to produce a taxonomy of argumentative patterns employed by hybrid elite stakeholders in ethical discussions of hGGE. I argue that argumentative patterns identified — such as the creation of boundaries or the use of metaphors — are reified and stabilised by the agora. I conclude that these argumentative patterns contribute to the compression of UK hGGE debates in several ways, for example, by excluding various social actors and their viewpoints.

The study describes hGGE as the latest in a series of biotechnology debates in the UK that encourage the liberalisation of embryo policy through a process whereby successive technologies are regulated, referred to as regulatory slippage. I argue that if steps are not taken to develop the quality of debate, hGGE may be legalised prior to comprehensive ethical discussion on the topic. I conclude by suggesting a series of practicable policy recommendations for improving hGGE debates.

LAY SUMMARY

This thesis examines debates surrounding the socio-ethical implications of human germline genome-editing (hGGE) technologies, focusing on how hybrid elite stakeholders' discursive and argumentative strategies have shaped the UK hGGE debate within the unique regulatory landscape of the UK. I explored how hGGE debates are architected through tools, such as the inclusion and exclusion of actors, rhetorical devices, and argumentative patterns, reflecting how metaphors, boundaries and arguments have been used strategically by stakeholders to imbue these discussions with normativity.

Common themes across my findings from the metaphors, boundaries and argumentative patterns can be organised into three broad categories: (1) the construction of 'legitimate arguments' and the compression of debate; (2) repertoires of risk and the utilitarian framing of discussion, and (3) nationalistic performances and the purification of ethical debate.

I make a number of policy recommendations to address my concern that UK hGGE debates are not as comprehensive as they could be — or as they are presented by actors in the debate — due to the compression of arguments in the debate, the lack of heterogeneity of perspectives in discussion and the polarity of the differing ethical approaches. These policy recommendations are:

- Including a greater number of actors, the agorae of UK hGGE debates
- Improving the heterogeneity of actors included in the debate
- Ensuring that a greater breadth of ethical arguments is included in the debate
- Considering alternative approaches to traditional policy-making such as citizens' assemblies
- Ensuring a breadth of perspectives constitute public engagement activities

These recommendations will be particularly important because of the role of preparatory debate in UK biotechnology debates. Preparatory debates are early upstream policy debates that take place in the agora. Actors in the agora use preparatory debate to practise discussion, draw boundaries and set out what types of arguments are considered legitimate. After the period of preparatory debate ends, actors and organisations then lobby political decision-makers with the aim of promoting legitimate arguments crystallised in the agora with the hope they will travel to the arena and be used in political debate.

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LIST OF ABBREVIATIONS

ART	Assisted Reproductive Technologies
CAQDAS	Computer Assisted Qualitative Data Analysis Software
CDA	Critical Discourse Analysis
CRISPR	Clustered Regularly Interspaced Short Palindromic Repeats
DNA	Deoxyribonucleic acid
hGGE	Human germline Genetic Editing
GM	Genetically Modified
HFEA	Human Fertilisation and Embryology Authority
IVF	In Vitro Fertilisation
MD	Mitochondrial Donation
MRTs	Mitochondrial Replacement Techniques
MST	Maternal Spindle Transfer
mtDNA	Mitochondrial DNA
NEST	New and Emerging Science and Technology
PET	Progress Educational Trust
PGD	Preimplantation Genetic Diagnosis
PhD	Doctor of Philosophy

PNT	Pro-nuclear Transfer
STS	Science and Technology Studies
TALENs	Transcription Activator-Like Effector Nuclease
UK	United Kingdom (of Great Britain and Northern Ireland)
UNESCO	United Nations Education Science and Cultural Organisation
US	United States (of America)
ZFM	Zinc Finger Motifs

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CHAPTER ONE: INTRODUCTION

On the 1st of February 2016, the UK became the first country to permit a researcher to edit the genome of a human embryo. The decision, made by the British regulator, the Human Fertilisation and Embryology Authority (HFEA), was applauded by many in the scientific community as a "[…] triumph for common sense" (Griffin, cited in Siddique, 2016), citing examples of medical contexts in which human germline gene-editing (hGGE) could eradicate inherited disease. However, opponents to the ruling expressed concern that the HFEA's decision put scientific advancement before ethical principles.

The ruling by the HFEA renewed conversation regarding the ethics of hGGE, a process whereby the DNA of embryos can be modified before implantation to eradicate inherited disease. My research explores the tension between two visions of hGGE in the UK context. On the one hand, genome-editing technologies may be a versatile, therapeutic tool potentially able to pioneer cures for multiple deleterious diseases such as Duchenne muscular dystrophy or Huntington's disease (Doudna, 2016). On the other hand, the use of genome-editing on human embryos represents a moral tipping point, where the UK must decide whether, or not, it is now ethical to manipulate the human germline.

Whether it is permissible to edit the human germline is the newest question in a series of UK biotechnology debates and is intrinsically linked to a landmark ruling in 2015 when the UK became the first country in the world to legalise mitochondrial donation and various mitochondrial replacement techniques (MRTs). MRTs are a collective of reproductive technologies that prevent the transmission of mitochondrial disease, including pro-nuclear transfer (PNT) and maternal

spindle transfer (MST). The techniques are considered controversial by some ethicists (see (Baylis, 2017; Haimes and Taylor, 2017)) due to their potential for hGGE in female offspring[1].

The regulation of MRTs was shaped by a UK Government working definition for germline modification, stipulating that "[…] genetic modification involves the germline modification of nuclear DNA (in the chromosomes) that can be passed on to future generations" (Department of Health, 2014, p. 15). By reframing what constitutes germline modification (i.e., excluding MtDNA and including only nuclear DNA), this change in meaning allowed for groups in favour of the technology to argue that MRTs were, in fact, not hGGE (even in cases of female offspring). In the aftermath of the MRTs debate, the groups who lobbied for the regulation of MRTs cited the discussion as an example of an excellent policy debate and sought to implement analogous strategies to hold a similar discussion on the editing of nuclear DNA in human reproduction (Dimond and Stephens, 2018, p. 138).

Until recently, ethical perspectives on hGGE have been confined to theoretical deliberation in lieu of technological innovations that would make such interventions possible (see Agar (2014), Fukuyama (2002) and Harris (2007) for accounts). However, in January 2013, the CRISPR-Cas9 system was first harnessed for genome-editing. The innovation demonstrated a genome-editing platform that scientists considered efficacious enough to use in humans and therefore prompted an urgent need for a contextualised and robust ethical debate on hGGE to establish acceptable uses of the technology. As such, the ethical discussion of hGGE has been transported into a new context, one which raises not only the question of can humans make germline interventions to inhibit the transmission of hereditary diseases but should they?

[1] Mitochondrial DNA (MtDNA) is maternally inherited, and therefore any alteration to a female offspring's mitochondria would technically constitute a germline intervention.

This thesis will frame hGGE as the latest in a series of embryo debates in the UK context, drawing upon previous embryo debates to show commonalities and differences between these discussions. It is important to distinguish at this point that hGGE need not edit embryos specifically, the technology can also be used to alter germ cells[2]. Debate on hGGE is contentious in part because it exists in the shadow of eugenics (Sandel 2007, p. 68) and because it touches on concepts such as human nature, personal identity, and public reason. Moreover, disagreement concerning the ethics of hGGE is rooted in its potential to impact what it means to be human and how changes made on a molecular level can shape the politics of life itself (Rose, 2009).

1.1 Research questions and approach

This study examines the dynamics of UK hGGE debates and argues why the discourses used in these debates are important. My thesis explores the role these dynamics play in shaping regulation and further development and application of technologies. I focus on elite hybrid stakeholders[3] (Desmond, 2004) and their role in the UK hGGE debates. What arguments do they use? What metaphors do they draw on and why? The study analyses how participants in the debate see their own roles in shaping discussion and how this translates to other settings (such as the conference or within documents). My analysis focuses on how key stakeholders understand and use language and discourse in the UK debate on hGGE, identifying individuals and groups who participate in the debate and shows how they work together, or at cross-purposes, to influence the debate, construct legitimate arguments, interpret existing legislation and imagine future regulation.

[2] I will discuss this further in Section 2.1.
[3] Desmond's conception of 'hybrid elites' describes them as inhabiting "[…] blurred academic, industrial and political fields" (2004). I discuss hybrid elites further in Section 4.2 of my methodology (Chapter Four).

Central to my argument is how discourses pertaining to hGGE are situated within broader cultural heuristics on genetic modification. As my literature review demonstrates, these shortcuts have been salient in shaping the previous discussion on hGGE, and it is necessary to take account of them to fully address my research aims.

The research questions that guided this study were:

1. Who are the key actors and organisations that have participated in these debates (bioethicists, scientists, policy experts, etc.)?

    a. How do they describe the hGGE debate in the UK?

2. What are the spaces in which these debates are conducted (labs, conferences, advisory councils, etc.)?

    a. Who can access these spaces?

    b. Who can speak in these spaces?

    c. Does anyone control who can access and who can speak in these spaces?

    d. Are there written documents that arise from these spaces, and how do they impact the hGGE debate?

3. How do key stakeholders understand and use language and discourse in UK hGGE debates?

    a. What are the similarities and differences between the hGGE debate and other UK debates on emerging biotechnologies?

Given my exploratory aims, I have taken a qualitative approach. I draw upon various data, including 18 elite stakeholder interviews and non-participant observations at conferences, supported by quotations from key documents in the debate, in order to research stakeholders whose interests shape the UK debate on hGGE.

I identified the UK as a site of exploration due to the jurisdiction's atypical legal and regulatory frameworks. The UK has been the first country to regulate several biotechnologies for clinical application (including *in vitro* fertilisation (IVF) and MRTs) as well as genome-editing in human embryos. Furthermore, the existence of an oversight body that deals specifically in issues of human fertilisation and embryology[4] is a unique feature of the UK policy landscape, making it a pertinent site for researching debates on hGGE.

I chose to focus on hGGE because the advent of the CRISPR-Cas9 genome-editing platform transformed this discussion from hypothetical to real-world, creating an urgent need for ethical debate. Academic scrutiny of previous controversy surrounding biotechnology regulation, such as research on human embryos and MRTs, has been integral to uncovering how competing visions of technology can influence policy debates. As such, I considered that a project that investigated the underlying mechanisms of the UK policy debate on hGGE through prospective research would provide a unique perspective on the debate and address a gap in the academic literature.

[4] The Human Fertilisation and Embryology Authority (HFEA)

1.2 Chapter outlines

In Chapter Two, I begin with some context, examining the history of regulatory debates in the UK concerning new and emerging biotechnologies. I will outline critical shifts in UK embryology legislation and discuss how actors and groups influenced these policy changes. I will draw similarities between these debates, concluding that UK biotechnology debates are iterative, and that the patterns that exist are a product of British biomedical culture. I will conclude by introducing the term 'regulatory slippage'[5] to describe the linear progress of regulation I observe from the existing literature. This term is used in contrast to existing terms in the literature, such as Evans' 'slippery slope' to describe the specific manner of regulatory erosion that is unique to the UK context.

Following this brief historical account, I will explain the CRISPR-Cas9 genome-editing system and describe how, combined with IVF, the procedure of hGGE might exist in a clinical context. I will then outline an international history of genome-editing before focusing on the UK's hGGE debate. I will show that although there is a great wealth of literature on preceding UK biotechnology debates and an adequate amount of literature on hGGE in an international context, there is less literature that examines the hGGE debate's mechanisms in the UK specifically. I conclude the chapter by arguing that this gap in the literature represents an opportunity for this PhD thesis to contribute to the existing academic debate in a small but essential way.

The first half of Chapter Three reviews existing research and theories relevant to my thesis. I explain how previous scholarship has informed my research questions and demonstrate how my own study addresses previously unanswered questions and introduces concepts and theories

[5] I use the term 'regulatory slippage' to describe the notion of regulation going beyond its original intention and the linear progression of regulation in the UK context across historical lines in the sand.

pertinent to my analysis. The chapter begins with a discussion of prior research and theory on hGGE, focusing on the perceived societal and ethical impacts of editing the human germline for therapeutic and enhancement purposes. In this section, I identify that most research precedes the discovery of the CRISPR-Cas9 system and has not engaged with the topic of genome-editing in the current context. I argue that my research would address this gap in the literature and that the UK hGGE debate would benefit from social science research, stating that by synthesising descriptive and normative interpretations of the debate, my research could provide concrete, socially embedded accounts (Novaes and Salem, 1988) of the hGGE discussions. I also argue that the ethical axes of current germline editing debates (known as the therapy-enhancement line and the somatic-germline distinction)[6] do not adequately capture the nuances of how demarcations are constructed in the context of hGGE and explain how my research will go on to capture these distinctions more fully.

The second half of Chapter Three explores a body of literature that addresses arguments, rhetoric and strategy in debates concerning new and emerging biotechnology and embryo research. I use this literature to demonstrate a fundamental premise that biotechnology debates have systemic and repeated problems regardless of the technology discussed. These problems include prioritising scientific accounts over ethical concerns and the asymmetrical relationship between scientific claims and public reasoning. Therefore, I argue that existing approaches to debate are not conducive to moral decision-making in pluralistic societies, justifying research into the hGGE debate in the UK to identify specific barriers to robust ethical deliberation on the topic.

[6] I discuss these boundaries more in depth in Section 3.3 of my literature review (Chapter Three) and in my boundaries chapter (Chapter Six).

Chapter Three then focuses on conceptual literature that describes ethical debates concerning new and emerging science and technology (NEST ethics). This literature argues that NEST ethics debates are formulaic, and that tropes and patterns emerge over time. The authors (Swierstra and Rip, 2007) offer an inventory of NEST ethics arguments and identify proponents and opponents in the arenas of discussion. I conclude that while NEST-ethics will be a vital tool in my deconstruction of the hGGE debate in the UK, I disagree with the authors' conclusions that pragmatist ethics can address this problem. In contrast, I argue that the agora model still holds value in NEST ethics discussions and that the elimination of repetitive patterns and tropes can be achieved by welcoming more diverse actors into NEST discussions.

I then explore traditional approaches to boundary-work, which describe how demarcations between fields of knowledge are created, advocated, attacked, or reinforced (Gieryn, 1983), before exploring ethical boundary-work (Wainwright et al., 2006), which shows how actors in the debate are deferring authority onto 'non-science' organisations, for example, regulatory bodies.

Chapter Three's closing section offers my conceptualisation of the agora as both a NEST discussion site and as a conceptual tool. Building upon Nowotny and colleagues' (2003) work, I argue that the agora not only represents a 'consensus model' as argued by Swierstra and Rip but instead can be used as a tool to expose existing power relations within the debate. The chapter concludes by encapsulating the normative claim synthesised from the literature review: that UK discussions of emerging biotechnologies require improvement. I will then use the arguments I have generated throughout the literature review to reinforce why research into the UK hGGE debate is needed and timely.

In Chapter Four, I detail the methodology through which I collected and analysed the data presented in this thesis. I explain the decisions I made throughout the research process, including how the study was designed and carried out. I justify using a qualitative approach to address my research questions and why I elected to employ the methods of elite stakeholder interviews, documentary analysis and non-participant observation at conferences to gather data on the UK hGGE debate.

The methodology section details how the research sites were selected, how participants were recruited, and my resulting demographics. I analyse my experiences of conducting interviews, fieldwork, and data analysis, highlighting how challenges I faced shaped the knowledge I produced. Additionally, I examine ethical issues associated with the project and how I sought to address them. I conclude the chapter by examining the limitations of my decisions and their consequences for my research.

In Chapter Five — the first of my empirical findings' chapters — I explore how the debate's landscape is shaped through metaphor and allegory and assess why some features of the debate's language have become more prominent over time, whereas others have been eroded into obsolescence. I give an overview of the dominant metaphors employed in the debate and split them into mechanical metaphors and moral threshold metaphors. I argue that metaphors can be used as heuristics to signal a type of argument without expanding on the argument fully in debate. Drawing upon the rich qualitative data that I have collected, I argue that rather than being a useful shorthand for explaining scientific ideas, these heuristics are blackboxing (Latour, 1999) concepts relied upon for a full ethical debate of hGGE. I conclude by suggesting that these metaphors constrain discussion and imbue normativity upon important narratives in the debate.

In Chapter Six I highlight the role of boundaries in the 'preparatory debate'[7], setting out a full taxonomy of the boundaries employed in the discussion before focusing on the therapy-enhancement line and the germline. I describe the strategic role of boundaries for actors in the debate, describing how actors may seek to establish, maintain, or erode boundaries, to benefit particular actors' positions in the debate. Similarly to metaphors, boundaries can be used by actors who want to limit debate as a way of shutting off avenues for argument, or acting as a proxy for signally what types of debate are seen as legitimate. Boundaries are fluid, and could be configured by actors in a number of different ways, for example the same boundary could be considered ontological by one actor, and ethical by another.

In the latter stages of this chapter, I will employ the concept of ethical boundary-work (Wainwright et al., 2006) to show how actors in the debate are deferring authority onto 'non-science' organisations, for example, regulatory bodies. I conclude by arguing that boundaries in the debate are used strategically by actors to compress or block off areas of debate. For example, I argue that the continued separation of 'technical' issues of safety and efficacy from 'moral' issues is a key feature in the UK hGGE debate. This argumentative shift towards emphasising a technology's application suggests that actors in the debate kick the ethical can down the road, leaving the technology's morality to be assessed in terms of how it is applied. As a result, such future ethical engagement will tend to be more utilitarian, leaving little space for value-based discussion regarding the broader societal impact of these technologies.

[7] Preparatory debates are early upstream policy debates that take place in the agora. Actors in the agora use preparatory debate to practise discussion, draw boundaries and set out what types of arguments are considered legitimate. After the period of preparatory debate ends, actors and organisations then lobby political decision-makers with the aim of promoting legitimate arguments crystallised in the agora with the hope they will travel to the arena and be used in political debate.

The final empirical chapter (Chapter Seven) will introduce the concept of the agora and explore the role this conceptual space has in shaping the rhetoric of hGGE debates in the UK. I show how agorae, actors and arguments are co-constitutive and argued that proponents of hGGE worked strategically to maintain the stability of the agorae through particular arguments and argumentative patterns. I give examples of how ethical developments in the debate — such as, the legalisation of MRTs — have contributed to the shifts in the actors' arguments in the agora. I conclude by suggesting that the stable agora consolidates argumentative patterns in the debate. Furthermore, because the agorae of the UK hGGE debates are exclusive and not easily accessible, the heterogeneity of actors and arguments in the debate means that the debate is not as comprehensive as it could be. Rather, it reflects a narrow range of actors and their viewpoints.

In the conclusion of Chapter Seven, I argue that the agora is not the idealised democratic space envisioned by the metaphor — nor is it an arena for the fighting of ideas — as these representations imply fairness and a level playing field. Rather, the agora stabilises and centralises power: establishes dominant narratives, reinforces boundaries and dictates legitimate versus illegitimate types of arguments. I conclude this chapter by citing examples of key ethical shifts in the debate, showing that the agora is not so entrenched that it cannot respond when the hGGE debate environment changes.

The concluding discussion section of the thesis (Chapter Eight) will start by examining how the UK hGGE debate can be different, avoiding the slow march that invariably leads to the regulation of novel biotechnologies (Scully, 2005), regardless of the quality of debate. Here, I suggest a series of practicable policy interventions that, I will argue, may have the potential to combat some of the limitations of the discussion. I suggest that the debate's existing power structures require destabilisation. One way that these power structures could be destabilised is by welcoming a more

heterogeneous group of actors into the debate. The outcome of welcoming a more diverse group of actors into the discussion might increase the types of metaphors and narratives that are considered acceptable, avoiding strict reframings of technologies that benefit particular actors' policy agendas.

In the conclusion of Chapter Eight I reflect on my findings' limitations and indicate future avenues for academic research. I conclude by arguing that the policy interventions and suggestions for new academic research I have outlined are timely and required amidst increasing calls for 'inclusive and deliberative debate', in an international context where, as Hurlbut and Jasanoff point out, "The value of most applications of the technology [genome-editing] has barely been exposed to public review" (2018).

1.3 Argument

This thesis argues that the UK debate on hGGE is extensive but flawed in many ways. Most importantly, discussions on hGGE recycle tropes from preceding biotechnology debates to create new heuristics and are reliant upon inappropriate cultural visions and repeated metaphors. Furthermore, important actors in the UK debate are adept at reframing technologies to better fit into existing regulatory structures, curtailing avenues for policy debate.

My findings demonstrate that the debate on hGGE is increasingly focused on harms to the individual and on what types of regulatory instruments could help mitigate these harms. This consequentialist approach prioritises individual liberty at the expense of value-driven arguments that might better determine biotechnology's impact on society. I argue that this approach eschews robust ethical reasoning and may lead to unintended consequences at a societal level. My thesis introduces the term 'regulatory slippage' to describe the linear progression of regulation in the UK

context across historical lines in the sand, arguing that the centrality of consequentialist ethics to the UK's biomedical culture contributes to this phenomenon.

My work explores how actors' arguments are situated within and reified by the agorae of the debate[8] and explores how actors seek to limit the variety of arguments in the agora, because they want their own arguments to dominate. I describe how the UK hGGE debates are in the preparatory phase. 'Preparatory debate' is a term I use throughout the thesis to describe a debate where actors are arguing their points, but there is no clear policy impact for the discussion because the technology is so new. In the preparatory debate, arguments are parsed out by key elites to test whether they stand up to scrutiny. 'For example, in the context of genome-editing there is no legislative agenda to alter the regulation of embryology to allow for hGGE. Therefore the debates that are happening today about the ethics of hGGE are 'preparatory' in nature, as actors 'prepare' their arguments for future policy debates.

In the agora, where these preparatory debates happen, actors have the opportunity to examine the effectiveness of their arguments, trial rebuttals to counter-arguments, establish metaphors and boundaries in the debate and secure the language used to term and describe the techniques. Arguments considered by proponents to be 'legitimate' receive more time and attention in this space. Actors in the agora regularly reference waiting for the 'policy moment' or upcoming reform to the HFE Act (2008) as a future milestone. When this milestone arises, actors in the agora will

[8] With thanks to Klaus Hoyer for introducing me to the term, agorae are an important conceptual tool that I use to illuminate how different social spaces can accommodate different types of debate. The agora is defined as a metaphorical interpretation of the central public space in Hellenic society. Therefore, it is conceptualised as an open space and a democratic platform where different perspectives are brought together and are "ultimately creating different visions, values and options" (Barr, 2001; Frederiksen et al., 2003). I discuss this more in Section 3.6 in my literature review (Chapter Three).

have to use the arguments they refined during the preparatory debate to shape emerging policy debates.

However, this study identifies problems in the preparatory debates as they are currently progressing in the UK. This thesis identifies how important arguments are regularly compressed, how value-based ethical stances are often diminished and how boundaries and metaphors are used heuristically as a proxy for wider ethical debate.

The study concedes that there will likely always be problems with controversial biotechnology debates and that new approaches will invariably cause new and different challenges. However, a strategy for disrupting the harmful patterns of biotechnology debates in the UK is needed to prevent regulatory change that serves no clear aggregate benefit to society, or that defers too much power to regulatory bodies or permits the regulation of novel biotechnologies prior to high-quality debate.

My primary concern with UK hGGE debates is that they are not as comprehensive as they could be[9] because of the compression of arguments, due in part to the lack of heterogeneity of perspectives in discussion and the polarity of the differing ethical approaches. Without comprehensive discussion that considers a range of perspectives and ethical approaches, it is likely only a narrow selection of arguments around hGGE will move from the agora to the arena. The result would be that regulatory reform will mean hGGE is regulated prior to a full debate on the ethics of hGGE. While I do not take a normative stance on whether the use of hGGE would be

[9] By 'comprehensive' I mean that the debates cover a wide range of perspectives and ethical arguments.

ethical, I take a normative stance that up to this point the ethical discussion has not been robust enough to determine whether or not the clinical application of hGGE would be ethical.

This thesis concludes with a series of suggested policy interventions to assist in disrupting the debate to introduce new types of voices and, potentially, a greater variety of arguments as a result. These practical suggestions reflect on what I see as the systemic problem with biotechnology debates in the UK. This problem is one in which similar groups of actors participate in consecutive debates. This homogeneity causes arguments that have been effective in previous debates to be recycled in future debates and ensures that alliances formed between organisations with similar policy goals transfer from one biotechnology debate to the next. To address the problems I have identified in the UK hGGE debate, and prevent similar problems in future debates, the conclusion of this thesis recommends a series of practical policy suggestions. These policy recommendations include:

- Including a greater number of actors in the agorae of UK hGGE debates
- Improving the heterogeneity of actors included in the debate
- Ensuring that a greater breadth of ethical arguments are included in the debate
- Considering alternative approaches to traditional policy-making such as citizens' assemblies
- Ensuring a breadth of perspectives inform public engagement activities

A predicted outcome of a more diverse group of actors in the discussion is that it might increase the types of metaphors and narratives that are considered acceptable with the current agorae of the debate. This would avoid the use of strict reframings of hGGE that benefit particular actors' policy agendas and as a result, fostering a greater tolerance of atypical topics and arguments, I

argue, widening participation in the debate will lead to more multifaceted, nuanced, ethical debate. Finally, by adopting a global perspective, the UK can move away from nationalistic rhetoric of 'being the first' to regulate new biotechnologies and focus on what responsibilities the UK has to other nation-states.

CHAPTER TWO: BACKGROUND

Human embryology in the UK is governed at a national level by legal instruments of the Human Fertilisation and Embryology (HFE) Act (2008), enforced by the Human Fertilisation and Embryology Authority (HFEA). As the national regulator, the HFEA has powers and responsibilities to oversee all technologies related to embryology and fertilisation. The HFEA can pass new regulations that will affect embryology and fertilisation; however, significant reform to these areas (for example, The Human Fertilisation and Embryology (Mitochondrial Donation) Regulations 2015) must be written into law and passed by the UK Parliament. Germline editing of human embryos is regulated in the UK under licence. In 2016, the first licence was awarded following a research application from the Francis Crick Institute (HFEA, 2016). The licence permits genome-editing for embryo research, and the embryos must be destroyed after 14 days. Any proposed clinical applications of genome-editing (for example, genome-editing combined with IVF) would require a law change.

This background chapter will set out the historical developments that have contributed to the UK's policy of a permissive yet highly scrutinised approach to embryo regulation (Dimond and Stephens, 2018, p. 6; Mikami and Stephens, 2016, p. 222; Reubi, 2013, p. 216). I then will situate the UK in the broader international debate on genome-editing. I will explore the case made in the literature from philosophy, social science and science and technology studies (STS) that the hGGE discussion is the latest in a series of British policy debates that have contributed to the liberalisation of embryo policy. I will explain the CRISPR-Cas9 genome-editing system and describe how, combined with IVF, the procedure of hGGE might exist in a clinical context, and conclude by

explaining how the British approach to embryo regulation has cemented the country as an influencer on the world stage.

2.1 The international context

Before exploring UK debates on the ethics of hGGE, I will first outline the international context so that readers may better understand how discussions on the ethics of germline modification have been configured on the world stage. This section will first provide an overview of how genome-editing technologies (combined with IVF) could achieve hGGE, before charting critical developments in the international debate. The section demonstrates that despite many opportunities for discussion, and significant effort from those involved, these discussions have not yet been able to establish the consensus on the ethics of hGGE internationally.

Although this section focuses on global approaches and perspectives, it is essential to note that the UK is a critical player in these international debates. The succeeding sections of this chapter — which focus on the UK specifically — will expand on claims made in this section that the UK's ability to shape the debate has been predicated on its reputation for pioneering both the regulation and use of emerging assistive reproductive technologies (ARTs). I will then build on these claims in the conclusion of this chapter, describing how the British approach to embryo regulation has contributed to the liberalisation of embryo policy over time.

Germline genome-editing

The human genome is contained in 23 pairs of chromosomes encoded in DNA that are present in the majority of the body's cells. The genome refers to a complete set of genes (short sections of DNA) together with interspersed non-coding regions that regulate when the genes are expressed. In addition to the DNA sequence, the genome has associated chemical compounds, referred to as

the epigenome, that regulates gene expression within the genome. Environmental influences, such as a person's diet and exposure to pollutants, can impact the epigenome; these changes can then be inherited and passed down to future generations. Although all people have similar genes, no two people have the same genome (Border and Kaur, 2020); even identical twins have different genomes, resulting from somatic mutations and epigenetic changes.

Genome-editing is a type of genetic engineering that uses a group of technologies to make specific changes to a cell's DNA (Genetics Home Reference, 2020). These technologies have two main functions; they first identify specific DNA sequences for individual genes by engineering certain proteins to then recognise a sequence of DNA. After the correct region of DNA has been identified, genome-editing utilises enzymes called 'engineered nucleases' to make specific single or double-strand breaks to the DNA at the pre-programmed site (Ormond et al., 2017). It is these double-strand breaks (referred to as a cleavage event) that can be exploited to remove DNA (gene knockout) or 'edit' the targeted gene by introducing a new DNA sequence (knock-in) (Ormond et al., 2017). After the DNA has been edited, the cell's standard repair system attempts to repair the DNA break (Gupta and Musunuru, 2014). Following gene knockout, this process is referred to as non-homologous end-joining (NHEJ). In cases of gene knock-in, "[…] the cuts must be repaired very precisely, with no extra insertions or deletions. This requires harnessing a second DNA repair mechanism called homology-directed repair (HDR)" (Nowogrodzki, 2019).

Genome-editing has wide applications and can alter the DNA of plants, animals, and humans. The focus of this thesis will be hGGE. hGGE is defined as "[…] using genome-editing techniques in a human germ cell or embryo" (Ormond et al., 2017, p. 167). When a germ cell or embryo has been edited, the resultant human will pass on the altered genetic information to its progeny (germline genome-editing).

CRISPR-controversy

Contemporary debate on genetic engineering technologies has been prompted by the innovation of 'Clustered Regularly Interspaced Short Palindromic Repeats' (CRISPR). This acronym refers to the way short, repeated DNA sequences in the genomes of bacteria and other microorganisms are organised (Doudna and Charpentier, 2014). CRISPRs are found in approximately 40% of sequenced bacterial genomes, and the CRISPR-Cas9 system uses an adaptive immunity system in the bacteria Streptococcus Pyogenes to "[...] memorise, cleave and interrogate foreign DNA" (Pennisi, 2013). Although the CRISPR-Cas9 system is seen as the breakthrough innovation in genome-editing, other technologies can be used for this technique. The CRISPR-Cas9 platform represents a genome-editing technology that is affordable and accurate when compared with other genome-editing platforms, such as zinc finger motifs (ZFM) and transcription activator-like effector nuclease (TALENs). Furthermore, CRISPR has been described as more accurate and reliable than competing platforms (Veres et al., 2014), even though, in many circumstances, it produces numerous unwanted edits in the gene.

Concerns surrounding the CRISPR genome-editing platform amongst scientists first came to the fore following the publication of a paper by Puping Liang and colleagues in 2015. The paper represented the first use of genome-editing on non-viable human embryos. At the time, it was reported that distinguished scientific journals Nature and Science refused to publish the paper "[…] on ethical grounds" (Cressey and Cyranoski, 2015). The editorial team cited that hGGE is an ethically complex issue that should be developed within the context of social norms through a consensus-building process (Cressey and Cyranoski, 2015). However, despite international efforts to facilitate elite discussion — such as the Global Congress on Genome-editing — there remains no global ethical agreement on how or whether CRISPR should be used for hGGE in the future.

The controversy of the Liang study came as a reaction to it being the first study to use genome-editing on human embryos. However, it was also related to the inefficiency of the technique used. The study used "CRISPR-Cas9 to edit the β-globin gene of 86 non-viable human embryos, but efficiency was low (52%), and there were many off-target mutations (Addison and Taylor-Alexander, 2015). The lack of efficiency signified to some scientists (Reardon, 2015) that the accuracy of this technology needed to be improved ahead of further studies that used human embryos.

Following the publication of the Liang paper, Nature published a commentary where scientists called for a voluntary moratorium on genome-editing activities until ethical discussion had taken place (Lanphier et al., 2015). This publication was highly controversial because it represented a prestigious scientific journal using its institutional power to dictate what should or should not be published for reasons related to morality. What concerned many proponents of the technology further, was that as the Liang study performed CRISPR on non-viable human embryos, the low efficacy rates seen in the study were reportedly due to the poor quality of the embryos (Reardon, 2016). Thus, scientists who supported the technology, discounted calls for a moratorium stating that had the study used healthy, viable, human embryos, the results would have shown better efficacy in the technique (Reardon, 2015). Following calls from the scientific community for a voluntary moratorium in October 2015, a United Nations Education Science and Cultural Organisation (UNESCO) moratorium was called on CRISPR in human embryos due to concerns related to ethics and efficacy, such as unintended consequences of this technology. The UNESCO report stated that CRISPR has the potential to "[...] jeopardise the inherent, and therefore equal, dignity of all human beings and renew eugenics" (UNESCO, 2015).

The application of CRISPR in humans raises many ethical issues. These ethical issues fall into two broad categories: harms associated with its failure and harms arising from its success (Ormond et al., 2017). Examples of harm arising from the failure of hGGE include:

1. off-target cleavage activity (also known as 'off-target effects') where the wrong area of the DNA is cleaved (Zhang et al., 2015);

2. undesirable mutations that are introduced during the cells repair process (Nowogrodzki, 2019); and

3. mosaicism, where following genome-editing, the cells contain more than one genotype (Mehravar et al., 2019).

These unwanted edits are often difficult to predict and may result in genetic diseases such as Down's Syndrome and Turner Syndrome (Otieno, 2015). Examples of harms arising from the success of hGGE include broader impacts on the individual, the family and society more generally (Ormond et al., 2017).

A further area contributing to the controversy of hGGE is that the technology may be used for eugenic practices. Defined by Francis Galton, eugenics was first proposed as a scientific approach to generating the best possible human stock to facilitate the best possible lives (Agar, 1998). Historical applications of eugenics, such as those enforced by Nazi regimes during the Second World War, have been universally condemned as immoral. However, developments in reproductive technologies have prompted a resurgence of the term eugenics and its original aims of promoting the ethics of the good life (Aristotle, 2009). Contemporary advocates of eugenics argue that the unethical dimension of eugenics was rooted in its state interventionist approach. These advocates argue for a softer approach, which is often referred to as *liberal* eugenics (Agar,

1998), to refer to non-coercive enhancements that do not impact the autonomy of the resultant child. Despite the manoeuvrings of liberal eugenicists, the potential for the technology to be used for non-medical purposes remains one of the primary reasons against the regulation of hGGE.

hGGE: an international timeline

'The International Summit on Human Genome-editing: A Global Discussion' was held in December 2015 in Washington, DC (Fisburn, 2015). The conference aimed to lift the soft law UNESCO moratorium or impose a binding legal ban. The results from the conference were wide-ranging (Reardon, 2015) and supported further in vitro research on early-stage embryos. However, the committee report advised that this research should happen within a broader ethical and societal dialogue combined with a cross-national ethical oversight so that no country may 'go it alone' (International Summit on Human Genome-editing, 2015).

On 14 January 2016, the HFEA held a licensing committee to consider a licence application submitted by Kathy Niakan and colleagues at the Francis Crick Institute. The activities of the licence application included "[…] the use of a genome-editing technique, CRISPR-Cas9, in human embryos" (HFEA, 2016). The Committee discussed critical concerns such as the availability of zygotes, technical concerns such as whether CRISPR was the most efficient genome-editing platform available, and whether the decision would inform a licence extension or a licence renewal. The minutes of this meeting show superficial discussion of ethics; however, it did not go past that of research ethics. There was no discussion of the recommendations from the US summit, such as the suggestion of broader ethical and societal dialogue surrounding the technique combined with a cross-national ethical overview.

The Second International Summit on Human Genome-editing was held in November 2018 at the University of Hong Kong. The three-day summit was co-hosted by the Academy of Sciences of Hong Kong, the Royal Society of London, the US National Academy of Sciences, and the US National Academy of Medicine. The purpose of the second international summit was to discuss how the science of human genome-editing has advanced rapidly since the first international summit and how to advance the global discussion on these issues by bringing together a broad range of stakeholders — including researchers, ethicists, policymakers, patient groups, and representatives from science and medical academies and organisations worldwide. Despite the intention of the first international summit to address prospects for developing international regulatory frameworks and efforts to engage the public on ethical and societal issues. These questions about genome-editing technologies' ethics, governance, and application remain unanswered.

The Second International Summit proceedings on Human Genome-editing were disrupted by a surprise YouTube announcement on 25 November 2018 (two days prior to the Second International Summit on genome-editing) by the Chinese biophysicist He Jiankui. The video streamed from the Southern University of Science and Technology in Shenzhen announced the birth of twins who had undergone genome-editing to prevent HIV infection.

He Jiankui's announcement prompted outrage from the international scientific community. The summit's organising committee responded that the experiment was irresponsible and that Jiankui's work failed to conform to international norms (National Academies of Sciences, Engineering, and Medicine and Policy and Global Affairs, 2019, Box. 2). Moreover, the design of the experiment was criticised for its lack of rigour and transparency and its research ethics. The summit chair,

David Baltimore, condemned He Jiankui's actions, stating the experiment represented a "failure of self-regulation by the scientific community" (Zhongming et al., 2018).

In response to Jiankui's announcement, a number of scientists, particularly those based in the West, presented a united front that condemned Jiankui's actions. There was, however, some positive press coverage in Russia and Ukraine (Meyer, 2020). In response to Jiankui's work, Russian scientist Denis Rebrikov announced in Nature that he planned to produce genome-edited babies, targeting the same gene as Jiankui (Cyranoski, 2019).

The announcements of Jiankui and Rebrikov prompted calls for a moratorium on clinical applications of genome-editing technologies (Lander et al., 2019) following a call for scientists to act in a Nature editorial (Act now on CRISPR babies, 2019). The aim of calling for a global moratorium was not to institute a permanent ban but rather to "[…] call for the establishment of an international framework in which nations, while retaining the right to make their own decisions, voluntarily commit to not approve any use of clinical germline editing unless certain conditions are met." (Lander et al., 2019, p. 165).

Since Lander and colleagues' call for a moratorium on clinical applications of genome-editing technologies, few developments have moved the dial on international approaches to the ethics of genome-editing. In 2020, the Global Observatory for Genome-editing was established to expand the range of questions arising at the frontiers of emerging biotechnologies. However, there remains an impasse between those who would seek to ban the use of heritable applications of genome-editing in humans and those who think that it would be permissible to do so, subject to safety conditions and regulations.

On 14 January 2022, the third International Summit on Human Genome-editing was postponed to 2023 to ensure that a range of expertise and international perspectives could participate, unimpeded by COVID-19 travel restrictions (The Royal Society, 2022). The third International Summit will be held in the UK and, pending no shock announcements, will likely discuss regulatory approaches to governing hGGE and the ethics of its use. For now, the international community is waiting patiently for the opportunity to reconvene on the ethics of hGGE in 2023.

2.2 A brief history of biotechnology debates in the UK

The UK has a long history of permitting embryo research and use within a highly regulated context. Rapid developments have shaped this regulatory context, beginning with the first IVF baby in 1978 (Steptoe and Edwards, 1978). Several concerns were cited in response to Louise Brown's birth, including the impact of IVF on future generations (Strathern, 1992, p. 5). In response to these concerns, the Committee of Inquiry into Human Fertilisation and Embryology was set up to oversee and provide independent oversight to research involving human embryos (Dimond and Stephens, 2018, p. 6). Chaired by philosopher Dame Mary Warnock, the Committee published a UK Government report in 1984 titled Report of the Committee of Inquiry into Human Fertilisation and Embryology (known as the Warnock Report). Written to reflect the competing values of a pluralistic society (Warnock, 1984, p. 2), the Warnock Report covered many issues, from access to IVF, embryo donation, and time limits for keeping embryos alive *in vitro*. Although the report faced some backlash from scientists at the time over concern that arbitrary regulations might curtail future research (Mulkay, 1997, p. 20—22), the Warnock Report, alongside a white paper published in 1987 (Warnock, 1987), is widely acknowledged to have been used as the basis of the HFE Act 1990.

The debate on the HFE Act 1990 was hard-fought on both sides (Mulkay, 1997, p. 37—42) and produced a framework for discussing embryos which is still observed in debates today. British sociologist Michael Mulkay discusses the sequence of the parliamentary debates of the HFE Act in his book *The Embryo Research Debate: Science and the Politics of Reproduction*, detailing some of the unusual features of the debate, for example, how the Act was debated in the House of Lords, prior to its debate in the House of Commons. This peculiarity was because the pro-research lobby had been more confident that they would receive support for embryo research in the House of Lords (1997, p. 38) and hoped that a definitive victory in the House of Lords might sway undecideds in the House of Commons. Following the passage of the Bill in the House of Commons (by a majority of 364 votes to 193), Mulkay noted that "[…] participants suggested that many of the uncommitted had been alienated by the heated and confusing rhetoric of the anti-embryo-research lobby. Others emphasised the efficiency of the campaign in support of embryo research" (1997, p. 41). Mulkay's research highlights strategic decisions made on the part of the Government to get the Bill passed and how lobbyists can be influential in shaping the debate.

The HFE Act 1990 provided for the establishment of the HFEA. The HFEA is an executive, non-departmental public body and the first statutory body of its type in the world. As well as licensing reproductive medicine, the HFEA regulates all research with human embryos and grants licences for research projects on a case-by-case basis. The significance of establishing a separate institution responsible for human fertility and research with embryos resolved some debate raised by the Warnock Report in the 1980s by acknowledging that the human embryo has a distinct moral status from other research objects (Hauskeller, 2004, p. 514). While the HFEA is important in establishing the embryo's distinct moral status, the HFE Act 1990 does not prohibit embryo

research generally; rather, it restricts permissions under which the HFEA can grant licences for research.

Following the establishment of the HFEA, the Nuffield Council on Bioethics (NCoB) was founded in 1991 by the Trustees of the Nuffield Foundation to "[…] identify, examine and report on the ethical questions raised by advances in biological and medical research" (Nuffield Council on Bioethics, n.d.). At the time of writing, the NCoB is comprised of eighteen members and is jointly funded by the Nuffield Foundation, the Wellcome Trust and the Medical Research Council. Although independent of Government, the Medical Research Council does utilise taxpayers' money, and therefore, the Nuffield Council receives some state funding indirectly.

British bioethicists John Harris and Sarah Chan, who performed an external review of the NCoB, described the organisation as a "[…] liberal democratic, secular body that attempts to span both theoretical ethics and practical policy." (2015, p. 3). Their report noted that the NCoB conducted its work under a pluralism of ethical frameworks; however, they did argue that over time, the organisation had become more explicit in its use of ethical frameworks, which conferred increased clarity and authority to these reports (Chan and Harris, 2015, p. 57).

What is particularly unique about the UK's policy landscape is that while the UK is active in bioethics, it has not adopted the approach of establishing a standing national bioethics committee. Instead, the NCoB serves as the UK's de facto national Committee (Shapiro, 1995, p. 263), with a number of reports produced by the NCoB proving influential in subsequent House of Commons Select Committee hearings (Shapiro, 1995, p. 265). Therefore, the NCoB does not only represent an unusual institution; it is also an example of how the third sector organisations in the UK can impact government policymaking.

Following the establishment of the HFEA and the NCoB, a decade of both political and technological change ensued. In 1997 the Conservative Government was replaced by New Labour, and a series of successive and highly visible public debates shaped biotechnology regulation in the UK. These included the world's first use of preimplantation genetic diagnosis at a London hospital (see (Bickerstaff et al., 2001)), the public presentation of Dolly the sheep in February 1997, created using somatic cell nuclear transfer (SCNT) (see Franklin, 2016; García-Sancho, 2015 for accounts) and the first derivation of human embryonic stem cells (hESCs) from the inner cell mass of blastocyst-stage embryos in 1998 (Thomson et al., 1998). Following these controversial discoveries, which sparked public debate in 1999, a review of the UK government biotechnology advisory framework led to the establishment of the Human Genetics Commission (HGC) in 2000.

Around the same time as the establishment of the HGC, a Report by Donaldson Commission, chaired by the Chief Medical Officer, Sir Liam Donaldson, was published. The report recommended that research using surplus human embryos (from IVF) to increase understanding of human disease should be permitted subject to controls in the 1990 HFE Act. The Donaldson report also stated that cell nuclear replacement techniques were to be allowed to develop treatments for mitochondrial diseases (Donaldson, 2000). Finally, the report encouraged UK research councils to establish a stem cell research programme.

In 2001, the Government drafted regulations to turn the recommendations of the Donaldson report into law. In December of the same year, the HFE (Research Purposes) Regulations 2001 and the Human Reproductive Cloning Act 2001 received Royal Assent. The HFE Act 1990 extended permissible reasons for embryo research around stem cells and nuclear replacement.

Despite the legal reforms of the HFE (Research Purposes) Regulations 2001 and the Human Reproductive Cloning Act 2001, in 2004 the UK Government announced that they would review the HFE Act 1990. The review was that due to scientific and clinical advancements, the HFEA was repeatedly in the position of regulating practices that were not covered in the 1990 law (Haran, 2013, p. 568). Therefore, to precipitate reform to the HFE Act 1990, in 2005, the Science and Technology House of Commons Select Committee published their report: *Human Reproductive Technologies and the Law*. The report contained a series of controversial proposals for the regulation of human reproductive technologies, including challenges to the HFEA's precautionary principle approach (HoC, 2005).

The select committee report was similar to an earlier NCoB (2002) report, *Genetics and Human Behaviour: The Ethical Context*. For example, they both expressed antipathy towards the use of PGD for social reasons (Mittra, 2007). However, the right to procreative autonomy was cited as an argument for prenatal genetic selection (Nuffield Council on Bioethics, 2002, p. 152). Similarly, the House of Commons (HoC) report "[…] espoused the normative argument that individual choice ought to guide regulatory decision-making in the absence of any compelling evidence of harm to individual patients or society" (Mittra, 2007, p. 161). Another critical commonality between the NCoB and HoC reports was their rejection of the use of the phrase 'designer baby' in the context of PGD for medical reasons, stating that the term was misleading (NCoB, 2002, p. 149) and that the term should be reserved if choices made during PGD were made for *social* reasons (HoC, 2005, p. 53); however, there was little clarity on what constituted a social reason.

The regulation changes of the HFE (Research Purposes) Regulations 2001 and the Human Reproductive Cloning Act 2001 allowed scientists to use a nuclear replacement in human embryos, subject to licence. In May 2004, Newcastle University applied for a research licence from the

HFEA to conduct research into using pronuclear transfer (PNT) on non-viable human embryos to avoid the transmission of mitochondrial disease. After an extensive review by the HFEA, the team was granted a licence in September 2005.

When the HFEA was reviewing the research application submitted by Newcastle University in 2004, a new international consortium was formed on stem cell ethics and the law. The Hinxton Group, funded in part by UK institutions including the Wellcome Trust, the MRC and the Biotechnology and Biological Sciences Research Council (BBSRC), convened an interdisciplinary consortium of scholars in science, ethics, law, and policy interested in ethical and well-regulated science (Chan, 2015). Although the group has an international membership, the steering committee is comprised of UK and US members only. In February 2006, the Hinxton Group published their first consensus statement on stem cell research, concluding that stem cell research should minimise harm and that risks associated with this type of research should be commensurate with the overall expected benefit. The report also stated that "When enacted, laws or regulations governing science nationally and internationally ought to be flexible to accommodate rapid scientific advance" (The Hinxton Group, 2006, p. 1).

The international embryology policy landscape shifted again in 2006 with the discovery of induced pluripotent stem cells (iPSCs). IPSCs were first reprogrammed from human skin cells by Shinya Yamanaka's lab in Kyoto, Japan (Takahashi and Yamanaka, 2006) (see Scudellari, 2016 for a historical account). The research proved that by manipulating human somatic cells, scientists could produce pluripotent cells for research purposes without the need for tightly regulated hESCs. The Hinxton Group then met for a second time, producing a consensus statement on pluripotent stem cell-derived gametes, which discussed the social and ethical issues and made recommendations about policy and practice, including that:

> Policymakers should refrain from interfering with scientific inquiry unless there is substantial justification for doing, reaching beyond disagreements based solely on divergent moral convictions. Any interference with scientific inquiry should be derived from reasonable concerns about demonstrable risks of harm to persons, societal institutions, or society as a whole. (The Hinxton Group, 2008, p. 3)

The Hinxton Group's consensus statement's policy recommendations also advocated that iPSC-derived gamete research must comply with existing regulations and that scientific principles in debate be adequately represented.

While the innovation of IPSCs circumvented some ethical issues that had been the subject of fierce contestation both in the research and public spheres (Zheng, 2016), such as using HESCs for research, the technology sparked further debates on controversies such as stem cell-derived gametes in clinical applications of IVF. Furthermore, in 2006 the HFEA received two research licence applications to derive stem cells from embryos created by SCNT. However, rather than utilising traditional approaches to cloning, the research applications planned to insert human nuclei into enucleated non-human animal eggs. This process created what is referred to as cytoplasmic hybrid embryos, different from hybrid embryos that utilise an egg and sperm from two different species. The research licence applications from Newcastle University and King's College London (KCL) aimed to research embryonic development (Newcastle) and to better understand Alzheimer's and Parkinson's diseases (KCL). These applications raised several ethical and regulatory questions, including if the licence applications were within the remit of the HFEA, given that the research would combine DNA from both humans and non-humans. In 2007, the HFEA confirmed that they would have the authority to grant these research licences. They did not consider the content of the research applications from Newcastle and KCL to be prohibited by

the regulation (HFEA, 2007). Although research involving cytoplasmic hybrid embryos represented a promising new technology for the UK, the HFEA were reluctant to grant licences involving this technique without first seeking public views. In 2007, the HFEA launched a twelve-week public consultation titled: *Hybrids and chimaeras: A consultation on the ethical and social implications of creating human/animal embryos in research* (2007). In January 2008, both licence applications were approved (Sinclair, 2008) despite some academics raising concerns about the integrity of the consultation process, pointing to a policy preference in support of research involving cytoplasmic hybrid embryos on the part of the HFEA (see Baylis (2009) for an overview).

In 2008, the HFE Act 2008 was debated in Parliament. The Act constituted a significant reform of the Human Fertilisation and Embryology Act 1990. The lead up to this reform was characterised by a number of public controversies around stem cells, cloning, 'designer babies' and GM foods. The purpose of the HFE Act 2008 was to account for the technological advancements that had impacted the field of embryology in the years since the HFE Act 1990 and regulate some of the scientific advancements (such as iPSC-derived gametes) and human-admixed embryos that were, at the time, licenced outside existing regulatory structures. Furthermore, the proposed HFE Act 2008 would create a more streamlined approach to embryology in the UK as it would replace both the HFE Act 1990 and the Human Reproductive Cloning Act 2001.

The schedule of the parliamentary debates on the HFEA Act 2008 included issues such as hybrid human-animal embryos, saviour siblings and abortion limits. In advance of the parliamentary debates, the Science Media Centre (SMC) coordinated a public relations campaign. Formed in 2002, the SMC is a London press office that was originally based in the Royal Institution of Great Britain (Science Media Centre, n.d.). By coordinating their efforts with input from embryologists and MPs (Haran, 2013), the SMC's campaign aimed to ensure that permissions for research

involving animal-human hybrids were included in the passage of the HFE Act 2008 despite concerns raised by publics during the DOH consultation (2006).

Although the Government whipped Labour MPs at the Bill's final reading, free votes were permitted by the Conservatives and Liberal Democrats. Challenges to the Government included a cross-party attempt to ban hybrid human-animal embryos was defeated on a free vote by 336 to 176, and a separate attempt to ban 'pure' hybrid embryos, that would mix a human egg with animal sperm or vice versa, was also defeated in the Commons with a government majority of 63. In 2008, thorough revisions to the 1990 Act were passed by a significant majority in both Houses following nearly two years of debate.

The debates of the HFE Act 2008 were marked both by the differences in discursive strategies between proponents and opponents, and the different sources they drew upon to generate arguments. Where proponents were more likely to make arguments rooted in science, opponents were more likely to appeal to moral or religious arguments or delegitimize the government process, pointing to insufficient time for debate, and the immorality of the Government whipping votes in a vote of conscience (Mulkay, 1997). Finally, there were claims by pro-choice campaigners that "[…] Parliament had already debated and settled the moral and ethical issues involved, and accused those tabling amendments to the Bill of trying to hijack the parliamentary process" (Kettell, 2010, p. 797).

Biotechnology debates in the UK prior to the HFE Act 2008 were marked by a series of scientific developments that forced regulatory reform so that regulators would not have to regulate beyond the letter of the law. While the passing of the HFE Act 2008 cemented the UK's governance position (legally permissive but highly regulated) on the world stage, the controversies that

precipitated reform to the HFE Act 2008 would be the legacy of HFE Act for proponents and opponents in the debate — reporting in the media of cloning, GM food and human-animal hybrid embryos polarised debate, resulting in the Government resorting to whipping votes of conscience to push their agenda through.

The time between the publication of the Warnock Report and the passing of the HFE Act 2008 was when the UK cemented its position as a world leader in ARTs and their regulation. This reputation was built upon in the intervening years between the HFE Act 2008 and the legalisation of mitochondrial replacement techniques in 2015.

2.3 The UK debate on mitochondrial replacement techniques

Following the passing of the HFE Act 2008, debates around reform to embryology regulation in the UK turned to the use of mitochondrial replacement techniques (MRTs) to treat mitochondrial disease. This section will give an overview of the MRTs debates in the UK, outlining the arguments and tactics used by opponents and proponents of the techniques in the debate. Three main aspects have governed the UK MRTs debate. These include the role of language in the social construction of the techniques, the specification of an unmet medical need, and the UK's biomedical culture. These three tactics allowed proponents of the technology to push through reforms to the HFE Act 2008 that both allowed the UK to be the first country to regulate MRTs, and further liberalise embryology policy in the UK.

A reform of the 2008 Act that was less publicly discussed gave the secretary of state the power to permit future clinical applications of techniques to avoid the transmission of mitochondrial disease (Dimond and Stephens, 2018, p. 7), subject to parliamentary approval. Techniques devised to avoid the transmission of mitochondrial disease (for example, PNT), referred to as mitochondrial replacement techniques (MRTs), were considered controversial because, if used to create female

offspring, they would introduce heritable germline changes that would be passed on to that female's offspring in turn.

Mitochondrial diseases can take many forms, from severe and life-threatening disorders such as Pearson's syndrome (Rotig et al., 1989) to generalised fatigue (Mancuso et al., 2012). The impact of mitochondrial disease on a future generation is difficult to predict due to the variability of presentation in the illness (Herbrand, 2016). If the level of mutation in the mitochondria of offspring is very high, they are likely to be highly symptomatic and vice versa. This problem is compounded by the phenomenon of the 'mitochondrial bottleneck,' the bottleneck occurs during embryogenesis, which can cause offspring to have higher rates of mitochondrial deficiency rates than their mother's (Cao et al., 2009). While fifteen percent of mitochondrial diseases affect only the mitochondria of the cell (Dimauro and Davidzon, 2005), the remaining eighty-five per cent occur in the nucleus of the cell also, meaning that most mitochondrial disease sufferers cannot benefit from MRTs (Herbrand, 2016).

In 2010, the HFEA's Scientific and Clinical Advances Advisory Committee discussed the potential use of mitochondrial donation to avoid the transmission of mitochondrial disease. The Government was then invited to consider exercising the regulation-making power added to the 1990 Act to make it possible for mitochondrial donation to be used as a clinical treatment. Following a proof-of-concept study in 2010 by the Newcastle research group (Craven et al., 2010), the DOH requested that the HFEA convene an expert panel to assess the safety and efficacy of the group's findings (HFEA, 2011). Following several meetings, the expert panel concluded that the techniques were not unsafe (HFEA 2014, p. 4), and in 2014 the Parliamentary office of Science and Technology (POST) organised an evidence session regarding the science of mitochondrial

donation with a particular focus on translational research and future regulation, intending to inform future parliamentary process.

Alongside the review of the science was a process of public consultation and engagement, with the first public consultation being conducted by the NCoB in 2012 and further consultations performed by the HFEA and the DOH. The reviews of safety and efficacy by these public consultations culminated in two parliamentary debates on the topic of MRTs, and on 03 February 2015, where the result was the passing of the Human Fertilisation and Embryology Act (Mitochondrial Donation) Regulations passed (382 in favour, 128 against). The regulations allowed for MST and PNT to be used in a limited context, stipulating that only non-identifying donor information could be released, and that the mitochondrial donor had no parental rights or responsibilities towards the child. The regulations also confirmed that it would not be permissible for the donor to withdraw consent once consent had been provided (Dimond and Stephens, 2018).

The 2015 Human Fertilisation and Embryology Act (Mitochondrial Donation) Regulations debate was highly contested. Major UK institutions, such as the DOH and the HFEA, gathered evidence on the 'appropriateness' of changing the law, including scientific reviews on safety and efficacy, public consultations and calls for evidence to explore ethical issues. Academics have described how, as a result of the number of consultations and engagement activities, MRTs became "[...] one of the most scrutinised reproductive techniques in UK history" (Dimond and Stephens, 2018a, p. 2).

The role of language in the social construction of MRTS

Key sites of contestation in the MRTs debate were captured firmly in the parliamentary debates of the Human Fertilisation and Embryology Act (Mitochondrial Donation) 2015. However, the

lexicon of these debates was established long before this debate, through documents produced by organisations such as the HFEA, previous debates hosted by the Science and Technology Select Committee and the drop-in events held by PET and the Wellcome Trust on site the evening before the House of Commons Vote (Dimond and Stephens, 2018a, p. 111). According to Dimond and Stephens, it was important for the debate to move away from such terms as germline gene replacement therapy and nuclear transfer technique in order to allay concerns that the MRTs debate might draw on similar lexica to previous policy debates around cloning and hGGE (2017, p. 11). The introduction and securing of 'mitochondrial replacement' and 'mitochondrial donation' in the nomenclature of the debate served three main functions in the UK debate. First, it set mitochondrial DNA (MtDNA) as being wholly separate and less important than nuclear DNA. Secondly, it implied that it was the donor mitochondria that was transferred, rather than the pronuclei of a patient's embryo (or spindle in MST). As Canadian Bioethicist Françoise Baylis points out, it is not, in fact, the mitochondria of the cell that is replaced, but rather a nuclear transfer (Baylis, 2017, p. 12). Finally, the language of mitochondrial 'donation' sets up the egg provider as a mitochondrial 'donor' rather than a genetic contributor (Stephens and Dimond, 2018).

Haimes and Taylor also found 'mitochondrial replacement' terminology erroneous (2017, p. 2). They also argue that the terms' replacement', 'donation' and 'donor' all inaccurately imply a direction of travel for the mitochondria, which is the opposite of what actually occurs (2015, p. 364). Simply put, it is not the MtDNA that is replaced during MRTs, but rather the patient's pronuclei that is transferred into an enucleated (donor) egg with normal mitochondria. As well as crudely attributing a direction of travel to the mitochondria during MRTs, the added benefit of the pro-science UK stakeholders securing the terms of 'mitochondrial donation' and 'mitochondrial

replacement technique' in debate meant that terms more closely associated with cloning (Baylis, 2017, p. 11), for example' nuclear transfer' and 'nuclear genome transfer', weren't prominent in discussion. This point is reiterated by clinical researcher Jeff Nisker who stated that the "[…] term "mitochondrial replacement" being substituted for 'germline nuclear transfer' is reminiscent of other euphemisms used in reproductive genetics to […] to gain clinical and public acceptance." (2015, p. 829).

The demarcation between nuclear and MtDNA was a critical distinction in this debate. Because it differentiated MRTs from germline-nuclear transfer, which remains illegal in the UK (Nisker, 2015), navigating this boundary meant that proponents of MRTs could shift the narrative away from cloning, genetic modification, and 'designer babies'. Importantly, during the UK debate, in a consultation response on draft regulations to permit the use of MRTs, the DoH included a government working definition for germline modification - which was later made a *de facto* definition by fiat - stipulating that […] "genetic modification involves the germline modification of nuclear DNA (in the chromosomes) that can be passed on to future generations" (2014, p. 15). In the context of this UK Government framing, MRTs resulting in female offspring would not constitute germline modification. Another example of the downplaying of the importance of mtDNA is a representation of mitochondria as the 'batteries of the cell'. This notion underplays the genetic contribution of the mitochondrial donor and implies that the 'replicability and dispensability of batteries' is a quality of mtDNA (Stephens and Dimond, 2017).

The specification of an unmet medical need in the MRTs debate

British sociologist Kenneth Taylor expanded on this idea during his presentation at a workshop in London (MitoSoc 2017), where he stated that other ways to have a baby did not feature in the debate (2017). This 'closed down' debate on existing alternatives and instead promoted these new

alternatives. Taylor argued that a more rounded discussion of the types of blended families would have significantly benefited the debate. The more rounded discussion would have given a balanced approach to alternative parental narratives and turned emphasis away from genetic essentialism. However, as alternative parental narratives were not unpacked, the rhetoric of choice, heteronormativity and the valorisation of genetic relatedness engulfed this area of discussion, leaving no space for alternative discussion. Herbrand (2017) argues that it is likely that the egg donors were written out the narrative on MRTs for purposes related to maintaining a conservative image that these technologies will produce children in as close to a 'normal' way as possible for 'normal' (genetically related and heteronormative) families.

Questions of autonomy are integral to bioethical enquiry, but should patients suffering from mitochondrial disease have a right to genetically related children? Françoise Baylis argues that despite the very narrow circumstances in which MRTs would be an appropriate treatment, this outlook "[…] presumes that the only relevant considerations are patient autonomy and reproductive liberty and, moreover, that it is reasonable to endorse (and respond to) the acquired desire for a genetically-related child(ren)" (sic) (Baylis, 2017). Despite the prevalence of procreative liberty regarding ARTs in the practical ethics sphere (Bostrom, 2003; Bostrom and Roache, 2007; Harris, 2015; Savulescu, 2001, 2005). Social scientists have been more prepared to unpack the suitability of procreative liberty in this context (Baylis, 2017; Haimes and Taylor, 2017; Herbrand, 2017; Stephens and Dimond, 2016). Baylis argues that rather than the desire for genetically related children being a 'right' or a 'need' she considers it to be "[…] at most a want (an interest, a preference)" (sic) (2017, p. 13). Representing the 'want' for genetically related children as a 'need' stems from socialisation to consider our wants as needs. Haimes and Taylor argue that "'Choice' is arguably a word that has become near ubiquitous in UK political discourse" (2017, p. 6), showing

that debates on MRTs in the UK valorised genetic connections. Haimes and Taylor contend that stakeholders assumed the centrality of concerns around genetic relatedness in the debate. This idea became an oft reproduced trope within the mainstream media coverage of the topic (2017). The valorisation of genetic connection was weaponised in the discussion to obscure alternative narratives of how to have children (such as adoption or PGD) and drive the conceived unmet medical need that MRTs would fulfil.

Herbrand (2017) also argues that a broad range of families was not adequately represented in the media coverage. Not only were people affected by nuclear mitochondrial disease rendered invisible, but there was also little to no variation in the types of families shown. Mainstream media accounts of mitochondrial diseases showed asymptomatic mothers presented with very acutely symptomatic offspring and little else. The idea that families that live with mitochondrial disease have the same experiences is problematic mainly because this does not reflect the reality of many patients' experiences and is not conducive to a nuanced debate on familial experience.

Some groups who felt ostracised from the social narrative of these technologies were mothers so affected by their mitochondrial disease that they would not be able to carry a pregnancy to term and, therefore, unable to benefit from MRTs. Conversely, egg donors who did participate in MRTs (by providing the mtDNA) were made invisible from the debate (Dimond, 2015; Haimes and Taylor, 2017; 2015), and little or nothing has been said about the contributions of the mitochondrial donors (or egg donors) during the debate. Their role has been strategically minimised in the debate (Haimes and Taylor, 2017; 2015) to justify their deidentification. The de-identification of egg donors in the case of mitochondrial donation stems from the NCoB recommendation that mtDNA donors be given less status than egg donors for gamete donation.

Herbrand argues that it is likely that the egg donors were written out of the narrative on MRTs for purposes related to maintaining a conservative image, that these technologies will produce children in as close to a 'normal' way as possible for 'normal' (genetically related and heteronormative) families. The status of the mtDNA donor has been written out of the narrative of MRTs in the debates, but their legal status has also been diminished, especially when compared with egg donors for gamete donation. Downplaying the importance or the significance of mtDNA has been an important political tactic used by proponents of MRTs in debates (Haimes and Taylor, 2017) to promote the narrative that these technologies produce heteronormative, genetically related families. The idea of placing 'conservative boundaries' on the debate (Stephens and Dimond, 2017) is also evident in who can legally access these technologies. Although MRTs could be used as ART to assist healthy, older women in achieving better outcomes in geriatric pregnancy (Herbrand, 2016), they are denied access because MRTs utilised in this context would not "[…] seek to avoid a serious mitochondrial disorder" (Herbrand, 2016). In a similar vein, MRTs are not legally permitted to allow lesbian women to create a genetically related child to each mother (Herbrand, 2016), despite the dominant narrative in the debate about the importance of having genetically related children. The regulation of MRTs set forth a critical precedent whereby heritable changes to the embryo are permitted in specific medical contexts to avoid disease in the mitochondrial DNA (mtDNA).

On the other hand, Erica Haimes and Ken Taylor argue that the applicability of MRTs is overstated in debate (2017, p. 10). Haimes and Taylor argue that this 'misselling' of MRTs stems from information conveyed in the mainstream media, where these diseases' complexities and nuances were lost. The lack of clarity regarding who may benefit from MRTs derives from the presentations of mitochondrial disease in affected patients. One of the most common misinterpretations by

stakeholders in the debate was that mitochondrial diseases could be 'prevented' or 'eliminated' or 'eradicated' by MRTs. This claim is misleading in two important ways. First, low heteroplasmy rates have been reported in early treatment models (Amato et al., 2014). Secondly, although MRTs can be described as 'eradicating' mtDNA disorders, they will only reduce mtDNA disorders in a tiny number of specific pregnancies and not in the general population (Herbrand, 2017). Catherine Herbrand highlighted (2016) that MPs remained unaware that mitochondrial diseases will still exist in society after MRTs due to mitochondrial diseases arising from nuclear DNA, even during the House of Commons debate on MD. The lack of nuance in the MRTs debate in the UK (Haimes and Taylor, 2017) that led to the conflation of these two types of mitochondrial diseases have inflated hope for perceived potential recipients of these technologies. This false hope, performed by raising unrealistic expectations (Borup et al., 2006) in patients with mitochondrial disease, is one of the many potential harms of MRTs (Haimes and Taylor, 2017).

The potential harms of MRTs were keystone to opponents of the techniques in debate. Haimes and Taylor argue that it is not just the technology itself that can be considered a potential harm, but some aspects of the regulatory process. In their paper 'Sharpening the Cutting Edge: Additional Considerations for the UK Debates on Embryonic Interventions for Mitochondrial Diseases,' Haimes and Taylor outline ten key problem areas they identified during the MRTs debate in the UK. One of the problems identified is the rapid legislation of these techniques, and the phrase repeated by stakeholders during the discussion was the theme that 'time was of the essence' (2017, p. 14)[10]. Haimes and Taylor argue that […] Parliament would (and did) vote on legislation with an incomplete understanding of the safety of PNT/MST and, therefore, with an incomplete understanding of the possible long-term consequences for the affected women and

[10] This sense of urgency was likely due to the UK seeking to be the first country to regulate MRTs.

any offspring they may have using these techniques (2017, p. 15). Ahead of the parliamentary debates, the HFEA produced a report on the safety of MST and PNT, concluding that the techniques were 'not unsafe' (HFEA, 2014). However, MRTs are different to other methods the HFEA have reviewed because they have "[…] the potential to change the whole human species, rather than a series of individuals, as they change the germline" (Haimes and Taylor, 2017, p. 7), which is contrary to the DOH definition. Even after the HFEA safety reports, there are enduring concerns over the safety and efficacy of MRTS. These safety concerns were set out by Dr Paul Knoepfler, an associate professor in the Department of Cell Biology and Human Anatomy, the Genome Centre, and the Comprehensive Cancer Centre at the University of California, Davis School of Medicine. His letter advised that the UK government "[…] would most likely be making a historic mistake by allowing 3-parent technology to proceed in the near future" (Knoepfler, 2014). His concern regarding the safety of these techniques included the epigenetic effects of these interventions (Ishii, 2014), mito-nuclear mismatch (Reinhardt et al., 2013) and 'preferential replication' of damaged mitochondrial transferred through heteroplasmy (Burgstaller et al., 2014). Indeed, these technical problems that could occur because of MRTs may create new, untreatable genetic diseases.

British biomedical political Culture in the UK MRTs Debate

The UK's 'biomedical political culture' is a term coined by Stephens and Dimond to describe the UK's approach to biotechnology policy, legislation, and governance over the past four decades. Stephens and Dimond describe how this biomedical political culture is characterised by "[...] consultation processes, arms-length bodies, and a permissive but highly regulated and bureaucratised licensing approach to conducting ethically sensitive biomedical work." (2016, p. 315). The authors describe how the British biomedical political culture model has predicated a

succession of embryo research programs, including IVF, embryo research activities, and MRTs. These successes both highlight and reinforce UK's global leadership in these areas.

As well as showing global leadership in research and clinical applications of new and emerging biotechnologies (and reaping the reputational and monetary value of being at the forefront of biotechnology regulation), the UK also prides itself on hosting high-quality policy discussions on new and emerging biotechnologies. A critical factor that has cemented British biomedical political culture is the UK's regulatory context. The regulatory arrangement in the UK for embryology and biotechnologies is unique. The lack of a national bioethics body (with this space being filled by the NCoB) and the role of the HFEA as an expert regulator for embryology, with a history of having to regulate beyond the letter of the law. (Pro-embryo research lobbying around changes to the 14-day rule).

Hauskeller has described the HFEA as "[…] the major institutional difference between Britain and the rest of the world" (2004, p. 515). The liberal regulation of embryo research in the UK (Hauskeller, 2004) has allowed the UK to make strides to be a world leader in the field of embryology (Homer and Davies, 2009). In fact, the technopolitical culture (Felt and Müller, 2011) of the UK is ingrained in their reputation as leaders in the field. This idea is conveyed in the 2015 UK parliamentary debate on MRTs, where many proponents drew on a rhetoric of national pride when discussing the UK's relationship with assisted reproductive technologies (ARTs), referencing previous successes in IVF and the proficiency of the HFEA as an expert regulator. In debate, parliamentarians drew on rhetoric of being 'the first' and 'lead(ing) the way' (column 71) (House of Commons Hansard Debates for 03 February 2015). 'Leading the way' was considered a responsibility of the UK, which needed to be maintained so that the UK could retain its reputation as the leader in the field of ARTs.

I will argue in my thesis that a critical reason for the UK retaining its reputation as a world leader in ARTs and their regulation is its emphasis on utilitarian approaches to bioethics and approaches to reproduction that increasingly prioritise parental authority. This characterisation can be linked back to the Warnock Report, which emphasised the inclusion of utilitarian ethics to cater to a pluralistic society. Christine Hauskeller also argues that this utilitarian ethics has been essential to shaping the British biomedical culture:

> The high status of biomedical science, accompanied by extensive ethical reflection and practical efforts to secure a better future — understood in the utilitarian tradition of Bentham and Mill — underlie and shape the process of a side-by-side evolution of science and regulation in Britain. (Hauskeller, 2004, p. 512)

Utilitarian approaches to biotechnology debates in the UK are increasingly focused on harms to the individual and on what types of regulatory instruments could help mitigate these harms. This approach prioritises procreative liberty at the expense of value-driven arguments that might better determine biotechnology's impact on society. In my thesis, I argue that this approach eschews robust ethical reasoning and may lead to unintended consequences at a societal level.

As well as emphasising that the model of British biomedical political culture catalysed a succession of embryo research programs, reinforcing UK's global leadership in these areas. Baylis speculates that MRTs have paved the way for hGGE in other meaningful ways. She describes how there is "[…] perhaps also a 'want' on the part of some researchers who see the technology as a useful precedent — one that provides them with 'a quiet way station' in which to refine the micromanipulation techniques essential for other human germline interventions […]" (2017, p. 7). As Baylis describes, MRTs do not only provide a policy environment that would be well-equipped

to debate and regulate hGGE but also a research environment where scientists would have the technical skills to utilise the technologies.

Regulatory slippage

As discussed in the previous section, the UK's approach to embryology regulation is unique in several ways. Before delving into the concept of regulatory slippage I will set out the novel features of the UK's regulatory approach. The most important feature is the establishment of the HFEA in 1991 following the passage of the Human Fertilisation and Embryology Act 1990. The HFEA was the world's first regulatory body to oversee research and clinical practice involving human embryos and gametes. The role of the HFEA is to licence and monitor all UK clinics that carry out IVF, and to regulate the use of gametes and embryos in research means that the authority is responsible for ensuring that all embryology research and clinical practice is carried out in accordance with established ethical guidelines. Another unique aspect of the UK's approach to embryology regulation is the principle of 'permissive regulation'. This permissive approach means that the HFEA does not seek to impose strict rules on the use of embryos and gametes, but rather aims to strike a balance between the potential benefits of research and clinical practice and the need to protect the welfare of individuals involved.

There have been several critical regulatory shifts in UK embryology legislation. I described how these regulatory shifts contributed to the liberalisation of embryo policy over time. Combined with the specific mechanisms of HFEA governance, these shifts have contributed to the concept I term 'regulatory slippage'. This term is used in contrast to existing terms in the literature, such as Evans' 'slippery slope' to describe the specific manner of regulatory erosion that is unique to the UK context.

Evans describes the 'slippery slope' in his book *The Human Gene-editing Debate* (2020). In his book, hGGE debates are configured as a slope with barriers positioned up and down the slope. Evans describes that the top of the slope is what society finds morally acceptable, and the bottom of the slope as what society finds morally unacceptable with regards to hGGE. Evans' describes each of these barriers in turn, including potential future barriers, and sets out their strengths and weaknesses. For example, Evans sets out the 'liberal eugenics barrier', where an 'upslope' would be any autonomously chosen selection or modification that does not harm anyone else and a 'downslope' would be coercion or a modification that would harm the individual or others (Evans, 2020: p. 127).

Evans uses the 'slippery slope' as a conceptual lens for analysing hGGE debates, describing the slippery slope as the central micro-structure of public bioethics debate on HGE (2020, p. 9). Building on the work of Eugene Volokh, an Ukrainian-American legal scholar, who describes 'attitude altering slippery slopes' (Volokh, 2003, p. 1077—1104), Evans argues that 'slippery slopes' are not logical — in the sense that; where if A then B; if B then C; if C then… Z, therefore A implies Z — rather, these slopes are empirical, based on probabilistic predictions of the future (p. 10). In his work, Evans describes legitimate empirical slippery slope arguments as able to "[…] identify the social mechanisms that will, in the future, result in an increased likelihood selecting B" (p. 10).

Evans makes the point that many public bioethics debates are set up as slopes, with more morally acceptable applications at the top and less morally acceptable at the bottom (p. 12). The mechanism of the 'slippery slope' described by Evans has the potential to cause society to slip further down the slope may be legislative change, societal change or a change in technical knowledge (2020, p. 11).

Regulatory slippage, the term I use to describe regulatory erosion in the UK hGGE dates is similar to Evans' 'slippery slope' in three key ways. Firstly, these terms both refer to how — in bioethics debates — what is morally acceptable can change over time. Regulatory slippage also examines how boundaries in the debate can be eroded. Finally, regulatory slippage also sets out how moral boundaries are eroded over time focusing on the empirical nature (rather than the logical nature) of these shifts.

However, my approach of regulatory slippage is also distinct and different to Evans' approach of slippery slopes. Firstly, I am interested in the regulatory changes that can allow for boundaries in the debate to shift. I argue in my thesis that the regulatory structures of the UK are one of the key components of regulatory slippage. For example, the HFEA can allow for regulatory slippage through licensing activities where they permit activities that would not be legal without a licence, under licence. This is subtly different from Evans' approach which focuses more on the attitude altering nature of slopes, rather than how regulatory changes can contribute to moral change.

Another component of regulatory slippage is that the character of embryo research in the UK is marked by a linear path toward the regulation of new embryo research practices that promise transformative medical advancement — however, they are generally only used in a scientific context, and although they help scientist learn more about conditions, they do not always translate into the 'cures' promised. The promissory nature of regulatory slippage is a key component of the term and differentiates my approach from Evans'. I use the term 'regulatory slippage' to describe the linear progression of regulation in the UK context across historical lines in the sand, arguing that the centrality of consequentialist ethics to the UK's biomedical political culture contributes to this phenomenon.

One of the critical components of regulatory slippage is the instances of ethical shift and ethical drift that underpin it. Ethical drift is a term borrowed from professional decision making and generally refers to an incremental deviation from ethical practice that goes unnoticed by individuals who justify the deviations as acceptable and believe themselves to be maintaining their ethical boundaries (Kleinman, 2006, p. 76). In my work, I use ethical drift to refer to the non-deliberate reframing of the assumed morality of an act based on changing societal preferences over time (e.g., children outside of marriage) rather than individuals; it refers to normative change on a societal level. I use ethical drift as a contrast to ethical shift, which describes actors' deliberate and successful attempts to change legal, ontological and ethical definitions to enable new narratives, arguments and legal instruments.

Ethical shift and drift contribute to what Lucivero and colleagues refer to as changes to a technology's desirability over time (2011). Interactions between technology and ethics bring about these changes. Lucivero and colleagues describe how norms and values inform technological development and how new and emerging technologies can raise new ethical concerns that existing moral resources cannot cope with (2011. p. 137). I focus on how actors use ethical shifts to affect regulatory slippage. In Chapter Six I will discuss the role of boundary-making, and unmaking, which characterises regulatory slippage in the UK hGGE debates.

In the narrative of the UK's success as an expert innovator and regulator (what is referred to by Stephens and Dimond as the UK's biomedical culture (2018)), every new biotechnology that is regulated becomes a new success story for the UK regulatory regime. I argue that the regulatory slippage I describe is unique to the UK, due to the role of the HFEA, which governs embryology and fertilisation specifically. However, I think some of the conceptualisations of the slippery slope in the literature draw on similar themes to my concept of regulatory slippage, for example, Jackie

Leach Scully's description of technological advancement as a slow march that invariably leads to the regulation of novel biotechnologies (2005), regardless of whether there is a clear pathway to the clinic.

Regulatory slippage is underlined by the UK's transitional performance (Stephens and Dimond, 2016) following the regulation of MRTS, where the focus of the debate shifted to genome-editing. The UK's Government Chief Scientific Adviser at the time, Sir Mark Walport, asserted that "[...] approval in the United Kingdom of mitochondrial donation provides a blueprint for future decisions on modifying the genome" (Hawkes 2015). In December 2015, Walport also said of the UK, "[…] we are good at the science, we're very good at the regulation, and we're very good at the public discussion." (Knapton, 2015). (Haimes and Taylor, 2017). Mechanism of regulatory slippage is evident in Mulkay's work where he argues the HFEA's procedures of ethical review could contribute to towards social change as "the moral boundaries that define the limits of research will gradually be revised, in a piecemeal fashion, as scientists repeatedly press for permission to explore newly discovered therapeutic possibilities" (1997, p. 154).

2.4 Introduction to the UK debate on hGGE

On 01 February 2016, the UK became the first country to permit a researcher to edit the genome of a human embryo. The decision, made by the British regulator, the Human Fertilisation and Embryology Authority (HFEA), was applauded by many in the scientific community as a "[…] triumph for common sense" (Griffin, cited in Siddique, 2016), citing examples of medical contexts in which human germline gene-editing (hGGE) could eradicate inherited disease. However, opponents to the ruling cited concern that the HFEA's decision put science before ethical principles.

Whether it is permissible to edit the human germline is the newest question in a series of UK biotechnology debates. While germline editing of human embryos is regulated in the UK under licence, any proposed clinical applications of genome-editing (for example, genome-editing combined with IVF) would require a law change. The hGGE debate is not an isolated discussion of biotechnology in the UK. It sits within a series of debates in which technology proponents have demanded increasingly permissive approaches to embryology regulation in the UK context. Moreover, the UK has a reputation for being a world leader in regulating new ARTs and therefore is likely to be at the forefront of regulatory advances in this area. Finally, The UK has a global seat at the table in international debates on genome-editing; given previous approaches by the UK to other technologies, many on the global stage will be looking to see how the UK approaches the regulation of genome-editing technologies.

CHAPTER THREE — LITERATURE REVIEW PART ONE: EMBRYO DEBATES

My literature review is split into two halves that examine the existing research and theory that has informed my study. The first half of the literature review explores embryo debates, whereas the second half explores the conceptual literature that I build on the create my approach to studying the UK discussions of hGGE.

The first part of my literature review follows the journey of the embryo through the debate. I start by examining how embryos are represented, before situating embryos in hypothetical debates that discuss future persons. I then move from the hypothetical debates to real-world debates, where I discuss how the Warnock report[11] gave rise to the concept of pre-embryo and how this was used to create boundaries at the genus of existence, shaping ethical discussion.

As we move from the pre-embryo to the embryo proper, I discuss how embryos are constructed and configured in moral debate, contrasting literature from the US and UK literature. I then discuss how embryos are talked about in hGGE debates specifically. The three phases of this discussion chapter are interwoven through examples of how the concepts at hand — the future person, the pre-embryo, the embryo — are socially and ethically configured through debate. As such, my review draws heavily upon literature from the traditions of Science, Technology, and Innovation Studies (STIS), sociology and bioethics.

[11] The 'Warnock report' refers to a document published by the UK Government in 1984 titled *Report of the Committee of Inquiry into Human Fertilisation and Embryology*. Written to reflect the competing values of a pluralistic society (Warnock, 1984, p. 2), the Warnock Report covered many issues, from access to IVF, embryo donation, and time limits for keeping embryos alive in vitro. I discuss the report in more detail in section 2.2.

It is important to note that hGGE debates, included in this chapter, are slightly distinct from other embryo debates — such as PGD — because hGGE need not involve embryos per se, if germ cells were altered. However, in the UK context, the regulation of hGGE would still fall under the remit of the UK regulator, the HFEA, regardless of whether the subject of alteration was an embryo or a germ cell. The UK's position is quite different from other contexts, such as the US, where the term 'embryo' is often excluded from discussions of hGGE due to cultural sensitivities around the use of embryos in research and reproductive technologies. While there are different approaches to how to conceptualise the debate — I prefer to think of hGGE as an embryo debate due to the regulatory structures in the UK — what is also clear from my review of the literature is that there is not yet an empirical account of the hGGE debate solely from the UK perspective.

The second part of my literature review explores the literature around the dynamics of argument and disagreement more generally. Here, I move away from the contextualised debates that address embryos and future humans to discuss literature that explores *how* new and emerging science and technology is debated. Here, I explore literature on ethics of new and emerging science and technology (NEST-ethics), on metaphors, boundaries and boundary-work. I then consider the conceptual spaces *where* these debates take place, exploring literature on agora, the arena and the observatory. I close this chapter by arguing that debates concerning the pre-embryo, the embryo and the future persons happen in these conceptual spaces and conform to patterns that shape all NEST-ethics debate.

In this chapter, I review literature that captures different approaches to the character of embryo debates (e.g., Evans (2002: 2020), Baylis (2017), Hurlbut (2018) and Dimond and Stephens (2018)). This literature shows that there is a great deal to unpack when it comes to debating the embryo and that there are many ways to approach academic analysis of these types of discussion. Although

the literature I will review comes from many different academic traditions (philosophy, STIS, bioethics)[12], what is striking is how the different texts sit on a spectrum from highly descriptive to highly normative, with most texts falling somewhere in between.

As well as covering both descriptive and normative accounts, I also examine literature from the US and UK embryo debates. This approach captures the problems associated with embryos and highlights that it is not only indicative of UK discussions. What all these literatures have in common is they discuss an embryo debate or a series of embryo debates without contending their debate is the *last* embryo debate. It seems inevitable to all of the authors that more debates are to come, with some authors (for example Stephens and Dimond (2018) and Baylis (2017)) even going so far as to chart out the next potential discussion.

My literature review is novel in the sense that it brings together many perspectives on embryo debates and combines them with the conceptual literature of NEST-ethics (Swierstra and Rip, 2007), boundary-work (Gieryn, 1983) and ethical boundary-work (Wainwright et al., 2006). The conceptual section of the literature review also captures the various spaces where the debates occur — the arena, the agora and the observatory — to introduce a backdrop to the discussion. My review of the literature makes clear that there is not yet an empirical account of the hGGE debate solely from the UK perspective. It is, therefore, my aim that this study addresses this gap in the literature whilst building on the research I have outlined.

My literature review will underscore that debates about embryos are difficult, and that the difficulties associated with debating the embryo has led to problems in embryo debates. One of these difficulties stems from the way that embryos are contested, and that people in the debate

[12] I have excluded literature from a legal perspective which falls outside of the scope of this literature review. This includes *CRISPR People: The Science and Ethics of Editing Humans* by Henry T. Greely (2022).

cannot always agree on their moral status. I also think, similarly to Evans (2002) that embryo debates are (ideally) examples of public reason, therefore these debates should be challenging, and include a diverse range of perspectives. However, many of the debates I discuss are not high-quality examples of public reason, and many of the patterns I and other authors observe in the embryo debates are repeated. The aim of my thesis is to understand why these patterns are repeated and if the repetition of these patterns could stop, if it would improve the quality of hGGE debates in the UK.

3.1 Representing embryos in debate

This section addresses the question of what an embryo is, and how people talk about them. Embryos are not visible to the naked eye; therefore, they often have to be represented in discussion. As such, this section will discuss metaphorical representations of embryos, genes and genome-editing. For the purposes of my thesis, I define metaphors as figures of speech in which a word or phrase is applied to an object or action to which it is not literally applicable. For example, a common metaphor found in discussions of genome-editing is 'molecular scissors'. In this section, I describe how while metaphorical representations can help communication in debate, they also reinforce normative ideas about what it means to be human, erasing those who fall outside of these norms.

Regardless of *how* embryos are represented, actors cannot always agree on what embryos *are*. Embryos have different meanings to different actors in the debate, where some describe a collection of cells, others envision the precursor to life, and others discern life itself. I will briefly conclude by discussing the construction of the embryo's moral status. I will introduce the idea that metaphors can be used to imbue the debate with normativity, especially by conferring moral status unto embryos.

The role of the scientific metaphor is central to the remit of STS, with authors like Keller and Haraway contributing to this area of study. Haraway's work in organicism examines the demarcation between mechanism and vitalism in molecular biology in the first half of the twentieth century. Haraway's book *Crystals, fabrics, and fields: Metaphors that shape embryos* aims to understand the role of imagery in visualising embryos in a post-positivist age, outlining a shift from machine metaphors to organic metaphors (1976, p. 2). Evelyn Fox Keller's work also examines the metaphorical visualisations, through the digitisation of biomolecular life. Her book *Reconfiguring Life: Metaphors of Twentieth-century Biology* (1995) explores the uses of metaphor in scientific descriptions of the gene, and it transposes molecular biology into technologically driven scientific disciplines, including systems engineering and computing.

Reconfiguring Life's final essay examines the relationships between systems engineers, computer scientists, and molecular biologists to explore the computer's impact on biological representations of organisms. Keller explains how the two groups (the biologists and the engineers) sought to borrow references from each other's work. The engineers sought to construct their technologies as 'smart'. In contrast, molecular biologists wanted to convey the organism's model as a straightforward machine reduced to molecular information. The idea that an organism could be reduced to molecular information gave rise to the metaphor of 'genetic code', and computer processing metaphors have dominated discourses on genetics ever since.

Metaphors around embryos often draw upon the context in which they are used. In the context of IVF, embryos are regulatory represented metaphorically particularly in the context of surplus cryopreserved embryos (see for example De Lacey (2013, 2007, 2005). De Lacey describes how frozen supernumerary embryos were configured as 'virtual' siblings of existing children, 'babies' and 'persons' by some and as 'seeds' or 'cells' by others (2007). Whereas Delaunay and colleagues

synthesised metaphors around frozen supernumerary embryos into the categories of 'possibilities', 'utilities', 'offspring' and 'counter-gift' (2021). 'Possibilities' based metaphors, for example, captured the opportunity for pregnancy whereas 'counter-gift' metaphors signalled the embryos' 'clinical worth' (Delaunay et al., 2021).

Marie Fox explores how embryos are represented metaphorically in a legal context, describing how prominent discourses that configure embryos as metaphorical 'legal subjects' or 'persons' (2000). Fox described how this narrative was developed to counter claims of a dominant discourse that represented "[...] embryos as commodifiable objects, which fits with a trend towards legal recognition that reproductive materials such as sperm may be classified as property which may be donated or sold." (2000: p. 171).

Metaphors are used to describe new technologies and mediate public understanding of innovations. A prominent example of the use of metaphor in a genetic context is Jeffery Lewis' study of the Human Genome Project (HGP). In his paper "The Performance of a Lifetime: A Metaphor for the Phenotype", Lewis argues the HGP was indicative of a trend in the biological sciences of using reductionist strategies to understand human health problems, illness, and identity (1999). One of the central metaphorical concepts in this debate was that "[...] genes are the essence of our personal identity" (Lewis, 1999). The promotion of the geneticisation of humanity in the Human Genome Project subordinated everyday aspects of human life, for example, constructing individuality or free will as no more, or less, than a function of our genes. The impact of this metaphor's deterministic dimension is profound, given that genetics raises deeply personal questions about health, illness, and human identity. Moreover, the metaphor that: 'we are our genes' conflates the genotype (the genes of an organism) with the phenotype (the observable characteristics of an organism determined by both its genotype and its environment) (Lewis, 1999).

Furthermore, Lewis argues that whether explicitly or implicitly, the sequencing of the human genome was a normative goal in and of itself by successfully presenting the idea that there is a normal human genome rather than numerous normalities (Scully, 2005, p. 51). Therefore, the metaphors produced from this enterprise, such as 'discovering the book of life', were complicit in erasing many altered ways of living (Scully, 2005, p. 51).

Making moral status: constructing the identity of embryos in debate

I have discussed up to this point how genes, embryos and CRISPR are represented in debate. It is clear that metaphorical representations of embryos and practices involving embryos are fertile ground for academic study. I have outlined metaphorical representations of these constructs showing that while metaphors can be useful in communicating how new technologies work, they can reinforce harmful normative ideas. Therefore, the study of these representations raises important ontological questions about hGGE, but they also explore how normative ideas are configured and conveyed in social spaces.

One of the themes this section of the literature review has uncovered is that one of the aims of using metaphors to describe embryos is to construct their moral status. Using metaphors to describe morality will be an important theme that I will revisit later in the thesis as I describe how metaphors can be used to imbue biotechnology debates with normativity.

Later in my literature review, in the section on the pre-embryo (section 3.3) I will describe how many of the arguments around the moral status of the embryo pertain to drawing lines or having demarcation criterions around what is and what is not an embryo. For example, in the case of MRTS where MtDNA was portrayed as being 'alien' and definitions around genetic modification were changed to include only nuclear DNA. As such, these differentiations and arguments are not

philosophical hair splitting, but rather, they can create narratives that underpin debates and have real-world policy impacts.

3.2 Debating Future persons

As well as the moral status of the embryo — which is often tied to personhood — another important question is how selection and editing of embryos might impact the identity of, or be seen to harm, future persons. These arguments are taken from the bioethical literature and are speculative.

The arguments around future persons aim to unpack harm and our obligations to avoid harm, enhancement, what it means to alleviate disease, and what it means to be human. These concepts that are both referenced in my empirical data, and that I draw upon in the discussion section. Although these arguments exist as part of a broader normative debate, I discuss them here to raise the readers awareness of their importance, rather than signal that the thesis will take a normative stance on hGGE.

The most important question relating to future persons in the context of embryo debates is whether the selecting and editing of embryos might impact the identity of, or be seen to harm, future persons. This question is referred to as the 'non-identity problem'. The non-identity problem was originally proposed by Derek Parfit in *Reasons and Persons* (1984) and is derived from population ethics; however, I will be discussing the problem only insofar as it is relevant to reproductive choices. The problem arises because the identity of future people can be affected by people in the present, which raises the question of whether one may harm a person by an action that impacts their life, when that action also creates their identity (Woodward, 1986, p. 804). For example, if during PGD a couple selects a deaf embryo over a non-deaf embryo, are the couple

harming the future child by allowing the perceived disadvantages the child will face due to its being deaf.

American Philosopher Dan Brock, for example, would argue that in choosing whom to bring into existence, prospective parents should act "[…] for the sake of a world with less diminishment of well-being or limitation in opportunity" (2005, p. 89). The PGD example that Brock presents is referred to as an "identity affecting choice" (Wasserman, 2005, p. 133). The choice is 'identity affecting' because the deaf child would not have been born had they not been selected. Therefore, according to the non-identity problem, they cannot be seen to have been harmed by the choice. This is because the choice caused the child's existence in the first place.

Although the non-identity problem has been a significant feature of the MRTs debate in the UK, the subject of whether we face the non-identity problem in the case of genome-editing is unclear (Omerbasic, 2018). This is because genome-editing is different from PGD. In the PGD selection if a different embryo is chosen the non-identity problem holds because the two embryos are not *numerically identical* (Parfit, 1986, p. 201). Whereas in the case of the edited embryo, the numerical identity of the embryo before and after editing is the same, and therefore it is only the embryo's qualitative identity that is altered. Parfit gives the example of someone who's character has changed as the result of being in an accident, *qualitatively* they are different (as the result of the accident), but *numerically* they are the same person (1986, p. 201—202). Therefore, if genome-editing is only qualitatively impacting the individual, genome-editing represents a post-conception harm (Omerbasic, 2018, p. 79) and the non-identity problem does not apply. However, there is still a question of whether subsequent generations of offspring — who receive the edits through the germline — are subject to the non-identity problem as their existence conforms to narrow conventions of 'health' as opposed to disease and diversity. Omerbasic concludes that as a result

of the non-identity problem affecting future generations "[...] makes it surprisingly hard to oppose invasions in the human germline with the help of the principle of nonmaleficence." (2018: p. 67). However, I think this point focuses too much on the individual and does not consider broader societal harms caused — for example — harms caused through the erosion of diversity.

Due to advances in modern genetics, what comprises 'human nature' is becoming increasingly within reach of technoscientific intervention. hGGE has the potential to ensure that future generations are genetically predisposed to be healthier than previous generations. The field of practical ethics has long grappled with the question: is there anything wrong with using hGGE to produce the best possible children? This line of inquiry raises two important demarcations in the hGGE debate — the somatic-germline barrier and the therapy-enhancement line — and numerous ethical questions, including whether these interventions pose harm to future individuals and society and what 'best' means.

Genome-editing has a wide application and can be used to alter any type of cell. hGGE, on the other hand, is confined to "[…] using genome-editing techniques in a human germ cell or embryo" (Ormond et al., 2017, p. 167). When germ cells (reproductive cells) or embryos are edited, the resultant human will pass on the altered genetic information to its progeny, referred to as germline editing. This editing is counter to somatic genome-editing — such as gene therapy — where non-germ cells (for example, skin cells) are harvested from a patient, edited, and then injected back into a patient's body. In the gene therapy scenario, the cells that are altered are somatic. As a result, the changes introduced will not be passed onto future generations—this distinction between somatic cells versus heritable germ cells is an important scientific and moral issue. Somatic genome-editing is widely accepted, whereas hGGE raises a number of ethical issues.

Ethical issues raised by hGGE fall into two broad categories: harms associated with the failure of hGGE and harms arising from its success (Ormond et al., 2017). Examples of harm arising from the failure of hGGE include (1) off-target cleavage activity (also known as 'off-target effects') where the wrong area of the DNA is cleaved (Zhang et al., 2015); (2) undesirable mutations introduced during the cells repair process (Nowogrodzki, 2019); and (3) mosaicism, where following genome-editing the cells contain more than one genotype (Mehravar et al., 2019). These unwanted edits are often difficult to predict and may result in genetic diseases such as Down's Syndrome and Turner Syndrome (Otieno, 2015). Examples of harms arising from the success of hGGE include eugenics, broader impacts on the individual, the family and society more generally (Ormond et al., 2017).

The therapy-enhancement distinction has featured heavily in contemporary ethical discussions of human genetics. Whereas the discussion of the somatic-germline barrier is an ontological distinction, the therapy-enhancement divide is a moral taxonomy. The therapy-enhancement distinction aims to understand what can be considered a therapeutic intervention and what is deemed to enhance rather than treat. As a result, the divide is entangled in our social and cultural understanding of what human disease *is* and what practices go beyond treatment.

One of the primary reasons genome-editing is considered such a controversial technology is how it challenges preconceived notions regarding illness, medicine, and human enhancement (Ellis and Terry, 2015). The concept of medicalisation has dominated medical sociology for some years, and it describes how social deviances are transformed into diseases or illnesses. Many medical sociologists, most prominently Adele Clarke and Janet Shim, have expressed a view that where medicalisation is inherently tied up within modernity, the concept of biomedicalization represents the state of affairs in the postmodern era (2009).

Biomedicalization emphasises the transformation of medicine and bodies alike through technoscientific artefacts, which are used therapeutically and for optimisation or enhancement purposes (Clarke and Shim, 2009; Rose, 2009). The concept of biomedicalization in the context of germline genome-editing echoes Nik Bostrom and Rebecca Roache's concern that we may use medicine to alleviate societal ills (Bostrom and Roache, 2007) as medicine shifts from treating specific illnesses to securing future health and optimising one's life chances (Clarke and Shim, 2009). In the context of hGGE, biomedicalization could refer to how genome-editing could be used by parents to prevent diseases, for example by altering the CCR5 gene to confer resistance to HIV.

The therapy-enhancement line is fiercely defended by those who argue that not to do so is to slide into eugenic practices. It is the responsibility of lawmakers "[…] to maintain that any genetic therapies should be used only to treat genetic diseases and not to enhance various non-disease traits." (Moseley, 1991, p. 641). Some proponents of GLM for therapeutic purposes concede that enhancement is permissible, where it is a 'secondary consequence' (Lappé, 1991) of the technology (where the primary outcome is disease eradication). This weak stance employs the doctrine of double effect.

Originally proposed in Thomas Aquinas' *Summa Theologica* (1950) the doctrine of double effect stipulates that if a morally good action has two outcomes, a morally good outcome and an unintended morally bad side-effect, it is morally permissible to commit the act if and only if the morally bad side-effect was unintended. Using this principle, some authors (see (Harris, 2010, p. 25) for an overview of this position) argue a weak stance on enhancement, concluding that it is ethical because it is merely an unintended consequence of a morally good act, which is treating disease.

In the post-genomic age, stronger stances on enhancement have emerged as bioethicists have reclaimed the term eugenics from *authoritarian* eugenicists such as Robert K. Graham and Francis Galton to propose a softer approach to enhancement led by the individual parent rather than the state. Adopted from earlier philosophical works (for example, Rawls (2009), Robert Nozick (1974) and Johnathon Glover (1984)), the term *liberal* eugenics was coined by New Zealand philosopher Nicholas Agar to refer to non-coercive enhancements that do not impact the autonomy of the resultant child. Agar proposes that in the context of liberal eugenics, the state would make available a suite of 'technologies for enhancement', which parents would choose between guided by their conception of what constitutes the good life (2008, p. 5). Agar's conceptualisation is ostensibly an enhancement criterion for pluralistic societies, as he states that "Liberal societies are founded on the insight that there are many different and often incompatible ideas about the good life" (p. 5) and argues that the freedoms that define liberal eugenics will be defended in the same fashion as other liberal freedoms. Agar's position stops short of radical enhancement which involves improving significant human abilities to levels that greatly exceed what is currently possible for human beings (2010, p. 2).

Agar's stance on enhancement is relatively conservative when compared with other proponents of liberal eugenics, who go as far as to state a moral obligation to edit the human germline from a medical or scientific perspective, for example, British bioethicists John Harris (2010) and Julian Savulescu (2001). Indeed, John Harris spearheads a significant movement within modern British bioethics that employs utilitarian reasoning to justify ethical decision-making. Although utilitarianism is a well-regarded view within philosophy, its application in a medical context is very unusual, and some have argued unique to the British context (Baumann, 2016). Harris goes

beyond the doctrine of double effect defence of enhancement to argue that enhancement is not only permissible but perhaps obligatory.

In his book *Enhancing Evolution: The Ethical Case for Making Better People,* Harris (2010) argues that enhancements are good if, and only if, those things we call enhancements are good, and if those enhancements *are* good, we have a moral duty to enhance. *Enhancing Evolution* argues a position of 'democratic presumption' in favour of reproductive choices around enhancement and takes aim at the traditional counterarguments to enhancement, such as the precautionary principle[13], issues of risk and naturalistic arguments ('playing god') and theoretical contributions from other ethicists who oppose enhancement, for example, those of Michael Sandel, Leon Kass and Habermas) (Harris, 2010). Harris concludes by positing a broadly utilitarian argument obligating the pursual of enhancement technologies underpinned by the principles of non-maleficence and fairness.

Oxford ethicist Julian Savulescu argues both for reproductive autonomy and the principle of 'procreative beneficence' (2001, p. 415) to describe the principle of selecting the best child of the possible children one could have. Savulescu follows John Robertson (1996) and Parfit in arguing that to have the best child possible is a moral obligation, but not going as far as to state that the child that is born is harmed if it is not the best child possible. Savulescu explains that GLM should not just be used for therapeutic purposes, but it should also be used to enhance advantageous traits, such as impulse control (2001, p. 37). In his 2005 paper, "New Breeds of Humans: The Moral Obligation to Enhance", Savulescu asserts two controversial and important points. Firstly, he argues that previous advancements in medical technology such as PGD have changed evolution

[13] The precautionary principle is an epistemological position, and associated legal approach, concerning innovative technologies (with potential for harm) when scientific knowledge is lacking. In these circumstances the precautionary principle advocates caution before adopting new technologies or practices that could harm citizens.

irreversibly, and the next logical stage in this process calls for a new age of 'rational evolution': "[…] Where we select children who not only have the greatest chance of surviving, reproducing and being free of disease but who also have the greatest opportunities to have the best lives" (2001, p. 38). Secondly, Savulescu argues that "Enhancement is a misnomer" (2001, p. 38) in that enhancement implies luxury (2001, p. 38). He argues, in turn, that enhancement in the context of GLM is not a luxury at all "[…] it is the very essence of what is necessary for a good human life" (2001, p 38).

Savulescu's paper "Deaf lesbians, "designer disability," and the future of medicine" (2002) is oft cited for prompting concerns around his principle of procreative beneficence. In response to Savulescu's claim that requests to deliberately select a disabled child were to push respect for autonomy to its limits (2002, p. 773), Oxford bioethicist Michael Parker commented that the principle of procreative beneficence was "[…] underdetermining, paradoxical, self-defeating and overly individualistic" (2007, p. 281). The primary reason being that it was not possible to know *a priori* what constituted the best life. In response to Parker's article, Savulescu defended procreative beneficence, stating that it is a useful principle in reproductive decision making and that "It is necessary to be more active in making selection decisions about what kind of child to have" (2007, p. 284). Savulescu concluded that physicians should encourage parents to reflect on their reproductive choices rather than engaging in paternalism.

Parker is not alone in his objections to the liberal eugenics' movement in British bioethics, maintaining that to cross the therapy enhancement line is not permissible. Arguments against enhancement include: harm to future generations stemming from unintended consequences of hGGE, harm caused by 'closed futures' where the child is denied the opportunity to be the "undivided author of his own life" (Habermas, 2014, p. 63), harms associated with dignity and

dehumanisation, and potential risks to broader society such as issues concerning the conceived accessibility. These moral objections to hGGE are compounded by the view that changes made to the human germline are uniquely hazardous because it brings irreversible changes (Baltimore et al., 2015).

The use of 'human dignity' as a counterargument to enhancement is a concept that has dominated literature in the bioethical tradition for some years (Caulfield and Brownsword, 2006). Adapted from the 1948 Universal Declaration on Human Rights (Lauterpacht, 1948) 'inherent dignity' is acknowledged to be the "equal and inalienable rights of all members of the human family." (Lauterpacht, 1948, p. 37). Arguments about the loss of human dignity, such as the argument that GLM violates future persons' right to an open future is a prominent theme within philosophical literature. For example, Habermas argues that GLM infringes on the freedom of the resultant child (2014, p. 62) in ways that ordinary parenting does not because the child cannot actively resist this form of parenting. Bostrom and Roache, argue however that Habermas' concern about autonomy is 'misplaced' (Bostrom and Roache, 2007) and that a child whose genes are selected, is just as autonomous as a child with any other genetic constitution, resulting from natural selection. However, certain traits that we value today may not be of value to subsequent generations. For example, piety may have been important to parents in Victorian society, but less so now (John Mackie quoted in (Glover, 2006, p. 98)). This poses a challenge to Savulescu's idea of 'procreative beneficence' (2001) as the guiding hand to enhancement.

On the other hand, some academics argue that enhancement could undermine the human dignity of the unenhanced, given that the enhanced could potentially lay claim to more human rights than the unenhanced because of their enhanced abilities (Fukuyama, 2003). Many scholars are more concerned with the loss of dignity of the enhanced (Glover, 2006; Kass, 2003; Silver, 1999). The

enhanced could potentially find themselves dehumanised through mechanisms such as the commodification of 'designer babies' confounding parental love. As well as the risks of dehumanisation for specific individuals, there are also broader concerns of the moral implications of GLM on groups and wider society. Societal concerns relating to access to genome-editing technologies have been prominent within the literature on GLM, with writers on the topic citing concern that "[…] those with high social capital and the relevant information are more likely to gain access to enhancement than others" (Bostrom and Roache, 2007).

Habermas argues that despite access concerns, the appeal of GLM to society is entrenched in its economic promise of gains in prosperity and productivity (2014, p. 24) through improved health and lifespan. This argument echoes Sheila Jasanoff's (2015) point that it is inevitable that commercialisation and biomedical advances must coexist in tandem, rooted in concepts of biopolitics (the mechanisms through which human life is managed) and social control. Thus, the two-tiered democracy argument outlined by Bostrom and Roache above takes on new meaning as the implications of biopolitical structures further divide the enhanced and the unenhanced. Biopolitical divisions between the enhanced and unenhanced raise the need for the inclusion of disability studies literature such as Liggett (1988) and Chadwick (1996).

Disability studies literature aims to challenge the way in which biopower configures impaired bodies as 'grotesque' (Hughes and Paterson, 1997, p. 333) and seeks to reconstruct them regarding pride and positivity. If technologies that seek to modify the embryo to 'eradicate' disease are regulated for clinical use, this will transform the way in which bodies can be configured, forever changing the way in which disability is socially constructed. Disability studies is also an important counterpoint to genetic essentialism. Genetic essentialism asserts that genes comprise the essential self and thereby the essence of human identity (Adashi and Cohen, 2018, p. 2531), ignoring how

disability only exists when embodied in society. A primary concern of bioethical commentaries on genome-editing is how this technology could further marginalise or 'endanger' disabled groups (Shakespeare, 2015) through increased homogenisation of society narrowing what is considered 'normal' (Kass, 2003). As well as the risks of dehumanisation for specific individuals, there are also broader concerns of the moral implications of hGGE on groups and wider society.

The relevance of future persons for embryo debates

In the previous section I have addressed how speculative bioethical discussions of future persons are relevant to hGGE debates. These arguments sensitise us to very real problems raised by hGGE, including: harms and our obligations to avoid harm, enhancement and what it means to alleviate disease and dignity and what it means to be human. While these debates are speculative, they do a lot of the heavy lifting when it comes to how we should think about the ethics of hGGE and how we should approach public reason around the technology's proposed use. However, while debates on future persons are highly relevant, they often get lost in 'real world' debate on hGGE.

3.3 Debating the pre-embryo

The first, non-hypothetical, embryo debate I will address is that of the 'pre-embryo', which occurred in the UK in the 1980s. Pre-embryo is a term that was constructed specifically for these debates and refers to an embryo that does not yet have embryo status. The construction of the pre-embryos is the subject of British Sociologist Michael Mulkay. In his book, *The Great Embryo Research Debate: Science and the Politics of Reproduction* Mulkay documents the public debate on embryo research in the UK. Mulkay's work is a good example of how debates around future persons were excluded from embryo debates by drawing lines around personhood. Moreover, Mulkay's work describes how rhetoric, metaphors and boundaries were essential to creating a version of embryo

that could be palatable for the use of embryo research. This is one of the first examples of what I describe as the 'ethical purification' of embryo debates.

Mulkay outlines the threefold approach taken by the pro-embryo research-lobby and records its lasting impacts on embryology law today. These strategies were the creation of the concept of a pre-embryo, the insistence that embryo research would help infertile couples *and* treat genetic disease, and the rhetoric of hope associated with promissory accounts of technological innovations. Mulkay approaches the topic of embryo research from a sociological perspective, analysing how rhetorical strategies and representations moved between pressure groups, scientists, parliament, and the media. Mulkay is interested in how the ontology of the embryo was secured by actors in the debate and describes how the pro-research lobby was able to change ideas about the biological and the moral status of the embryos by creating the idea of 'pre-embryo'. Mulkay's study examined the political impact of the term, which saw the initial vehement rejection of research being conducted on human embryos under 14 days old turn to gradual acceptance. Mulkay argues that "[…] support for, and opposition to, embryo research were closely associated with contrasting conceptions or images of the human embryo" (1994, p. 614) Furthermore, Mulkay argued that the term 'pre-embryo' lent legitimacy to the recommendations of the Warnock Report[14] that suggested embryo research should be permitted up to a period of 14 days.

In *The Great Embryo Research Debate* Mulkay describes how in the initial stages of the debate the anti-research lobby was able to mobilise the anti-abortion lobby and quickly capitalise on fear and

[14] The 'Warnock report' refers to a document published by the UK Government in 1984 titled *Report of the Committee of Inquiry into Human Fertilisation and Embryology*. Written to reflect the competing values of a pluralistic society (Warnock, 1984, p. 2), the Warnock Report covered many issues, from access to IVF, embryo donation, and time limits for keeping embryos alive in vitro. I discuss the report in more detail in section 2.2.

distrust, which culminated in Enoch Powell's Unborn Children (Protection) Bill[15]. However, as time passed the pro-research lobby was able to foster ties with parliamentarians inviting them to engage in activities, for example, attending labs. In doing so, the pro-research lobby was able to reclaim the agenda back from the anti-research lobby. Not only did this approach help foster support for embryo research (resulting in the defeat of the Enoch Powell Bill which failed to pass in Parliament after it was filibustered by a coalition of opponents from all parties) but it also gave the opportunity to create a common understanding and a shared rhetoric amongst pro-research parliamentarians. Mulkay contrasts this with the anti-research parliamentarians, who were uncoordinated by comparison, and left citing vague moral arguments.

Mulkay locates the critical difference between the pro-research and anti-research lobbies not as a contrast between scientific and religious approaches, but in their differing beliefs about when the developing human embryo acquires personhood. The ontological status of the embryo was deliberately avoided by the Warnock Commission on the grounds that such questions are complex amalgams of factual and moral judgments (1984, p. 3). Ironically, the admission of pluralism did not impact the recommendations of the report which made a *de facto* judgement that the fourteenth day (prior to the primitive streak) was the latest point in development that embryo research could be conducted as it is that last stage that twinning[16] could occur (p. 66), or indeed tetragametic chimerism[17] (Cavaliere, 2017).

[15] Enoch Powell's Unborn Children (Protection) Bill passed a second reading in the British House of Commons on 22 February 1985. The Bill would have criminalised "[...] in vitro fertilisation of any human oocytes except for purposes of "embryo insertion" (Evans and McLaren, 1985). The Bill failed its third reading and was not passed into law.

[16] 'Twinning' is where an embryo cleaves into twins.

[17] 'Tetragametic chimerism' is where two embryos could merge into one.

This ontological demarcation was used in debate to make a moral distinction between embryos and pre-embryos; suggesting that the fourteen-day point in development is the point at which personhood *might* occur. However, as British bioethicist Sarah Chan points out that when creating the fourteen-day limit the Warnock Committee were "[…] explicitly demurring to address the question of moral status and whether the embryo should be considered a 'person' in the moral sense" (Chan, 2018, p. 229) and this claim is echoed by Hurlbut who stated the ontological status of the embryo was deliberately avoided by the Warnock Commission (Warnock, 1984, p. 3). Therefore, the ambiguity created by the Warnock Committee not ontologically defining the embryo (either *a priori* or through public reason) made space for pro-science lobby groups to create this demarcation between embryo and pre-embryo using the authority of the Warnock report.

Although the fourteen-day rule is rooted in contested ontological claims about embryos this does not necessitate that the line must be drawn at that point. Baroness Warnock reflected on the process stating: "The number 14 was not arbitrary in the sense that we drew it out of a hat. But it was arbitrary in the sense that it might have been a different number, though not very greatly different." (Warnock, 2017). Moreover, even where there is ontological evidence for a boundary, that does not stop boundaries being weaponized, or attacked, in social contexts (i.e., debates).

The fourteen-day rule is a boundary that represents different things to different actors, and some have argued that the fourteen-day rule was never meant to represent a firm moral boundary for embryo research, but instead a practical time limit (Hyun et al., 2016), or a "[…] solution of compromise" (Cavaliere, 2017, p. 1). Sarah Franklin, who designated the development of fourteen-day rule as a 'certain kind of English pragmatism' ((Franklin, 2016) cited in (Shaikly, 2017)), describes the Warnock report as a social contract, and that any new limits "would have to be based on what was alright to enough people to enable successful legislation" ((Franklin, 2016) cited in

(Shaikly, 2017)). If Franklin refers to laypersons in this circumstance, her position is reminiscent of Hurlbut's Rawlsian interpretation of public reason in bioethics. However, it is not clear if she refers to publics, or another expert group, like the Warnock committee.

In the conclusion of *The Great Embryo Research Debate* Mulkay argues against the existence of a slippery slope in British bioethics. Instead, he states that:

> […] the moral boundaries that define the limits of research will gradually be revised, in a piecemeal fashion, as scientists repeatedly press for permission to explore newly discovered therapeutic possibilities. Similarly, the moral boundaries that restrict the clinical use of reproductive science will also change as science-based techniques extend the range of reproductive possibilities and as people come to accept that human reproduction has no set form. (p. 154)

Mulkay argues that there will be no 'mad rush' down the slippery slope (p. 154), but instead there will be a steady march into a future where the values and morality associated with embryo research and reproductive practices are transformed.

What is clear from the pre-embryo example is that the Warnock committee was central in shaping the ontological boundaries that lent authority to the concept of the pre-embryo. The result of the boundary-work around the pre-embryo for the pro-research lobby was that the moral status was offloaded to the embryo after fourteen days, where the 'embryo' and the 'foetus' represent a continuum of cell divisions and differentiations (Fox, 2000; Post, 2003).

The significance of the pre-embryo for embryo debates

The example of the pre-embryo shows how rhetorical strategies used can be used to confer moral status unto the embryo, or rather remove moral status from an embryo before 14 days. What the

example shows is how bioethical principles can be translated into debate, and how drawing boundaries can lead to the avoidance of further unpacking these arguments[18]. The pre-embryo example therefore does raise questions around the ontology of the embryo, this will be important for the next section where I explore embryo debates from UK and US perspectives.

3.4 Debating the embryo

This section analyses influential texts that explore late modern and contemporary debates on embryo research and embryos' use in clinical practice from the US and UK perspectives. These hail from various academic traditions, including philosophy, sociology, medical sociology, history, STS and interdisciplinary perspectives. While this literature lacks unanimity on the surface, in my literature review I demonstrate how these accounts dovetail together, most notably because they employ various constructivist approaches and explore some aspect of the *character* of embryo debates as to their subject of study. Another strength of drawing on literature from a range of perspectives means that I can achieve greater insight into both descriptive and more normative accounts. By comparing the US and UK, I will be able to identify subtle differences between the debates on previous biotechnology debates to better understand how discursive patterns in previous embryo debates have institutionalised the norms, arguments, and discourses for the UK hGGE debates.

US debates

In his book *Playing God? Human Genetic Engineering and the Rationalization of the Public Bioethical Debate* (2002) US sociologist John Evans explores the social forces that have contributed to a 'thinning' of the public debate regarding human genetic engineering (HGE). Evans' research analyses

[18] The idea of how demarcation can lead to the avoidance of further unpacking arguments will be important for Chapter 6 where I discuss boundaries in the UK hGGE debates.

patterns of citations in the literature on HGE from 1959 to 1995. While Evans' focus is on HGE in general, rather than in embryo's specifically, his work is highly relevant as this literature, Evans describes, is representative of professional debate on the ethics of HGE (2002, p. 43), and from his analysis, he uncovers various institutional alliances and patterns in claims made by those involved in the debate. The primary aim of Evans' book is to show how early ('thick') debates on the values of HGE devolved into the 'thin' debates of our own time (2002: p. 12), suggesting that debates have shifted from being formally rational to substantively rational; a demarcation derived from Weber and Habermas.

Evans cites the Weberian distinction between arguments of substantive rationality (the pursuit of ultimate ends) and formal rationality (pursuing predetermined or assumed ends) (p. 13) and employs Habermas' 'discursive spin' (p. 14) on the Weberian distinction "[…] stating that the system (institutions governed by formal rationality) is colonizing (*sic*) the "life world" (governed by substantive rationality)." (p. 14). However, Evans rejects Habermas' claim that formal rationality will replace substantive rationality due to the efficiency, practicality, and cost-effectiveness of the substantive rational approach. Instead, Evans argues that the rationalisation of the HGE debate is due to a type of reasoning that particular actors pursue in particular interests.

Evans' cites the expansion of bioethics jurisdiction and the creation of a 'professional bioethics' as a critical catalyst in the 'thinning' of the debate. The professional bioethicists' intent was to adapt the HGE debate to reflect an increasingly pluralist late modern society, which prompted the exclusion of theologians from debates and a shift from a value-based discussion (a hallmark of theological debate on HGE) to a principlist approach. This shift is traced back to the 1978 *Belmont Report,* which institutionalised a formally rational system that created calculable rules from which the *principles* of principlism grew (p. 89). The four tenets of principlism are: respect for autonomy,

nonmaleficence, beneficence, and justice, and they state *prima facie* moral obligations for particular contexts (Beauchamp and Childress, 2001).

The critique of principlism in Evans' book is that it sidesteps more complex philosophical debates to provide a more practicable approach to grappling with ethical issues. He argues the approach of principlism in the US made the HGE debate more formally rational and excludes more substantive issues — for example, value-based discussion. Evans' states that consequentialist reasoning is the hallmark of formally rational debate. He protects himself from criticism that principlism is derived from both utilitarian (nonmaleficence and beneficence) and deontological (respect for autonomy and justice) tenets by demonstrating that in debate the nuances of principles tend to be lost. This results in formally rational debate with deontologically derived principles functioning more or less as ends as opposed to ultimate ends, that is, ends in themselves (2002, p. 91). Although Evans points out that some would say the shift to principlism was born from the need for a common ethical language that respected pluralistic societal demands (2002, p. 175), he states that the reason for the rise of principlism in late modern bioethics was better to align bioethicists and scientists in formally rational discussion.

After demonstrating that theological discourse throughout the debate remained substantively 'thick' while bioethical discourse quickly became formally rational and 'thin', Evans then argues that bioethics' thin formal rationality is precisely the reason why bioethical discourse displaced theological discourse. Bioethics succeeded because, in substituting thin, formal rationality for thick substantive debates over ends, it made itself amenable to the bureaucracies that control economic systems and produce public policy. The thinning of the debate that Evans describes will be important to remember when I evaluate that UK approaches to bioethics discussion tend to eschew principles in favour of utilitarian reasoning. Moreover, it is likely that non-maleficence was

seized upon as the most important principle because it is more measurable than the other three, and therefore the only one of Beauchamp and Childress' four principles that the commission would be able to operationalise.

While Evans examines public reason in US embryo debates from the 1950's to the 1990s Benjamin Hurlbut offers a more recent account of public reason in US bioethical debate. In his work: *Experiments in Democracy: Human Embryo Research and the Politics of Bioethics* Hurlbut uses his chapters as case studies examining the practices of deliberative democracy and how scientists and ethicists contribute to this activity in processes concerning embryo research and governance. Hurlbut positions himself as building on the work of Evans, by citing Evans' claim that professional bioethics — such as those on the Presidential Commission for the Study of Bioethical Issues — "[…] carved out its jurisdictional space by narrowing the parameters of public debate to exclude other discursive and intellectual approaches such as theology." (Hurlbut, 2017, p. 12). The way Hurlbut describes Evans' contribution is a thinly veiled reference to boundary-work (Gieryn, 1983), making apparent that although *Experiments in Democracy* explores a similar topic to Evans' book - US embryo debates — it does so from an STS-leaning interdisciplinary perspective rather than mirroring Evans' sociological approach.

Hurlbut presents a thoroughly researched chronological account of human embryo research in the US from the 1960s to 2017. Hurlbut's case-study approach is in his words a 'historical project', tracing the development of the controversy as well as practices, discourses and imaginaries (p. 32). Although Hurlbut describes the study as "[…] a genealogical project in the Foucauldian sense" (p. 32) his approach more broadly resembles an STS controversy study (see (Jasanoff, 2012) for overview). The STS component of the text is highlighted when Hurlbut explains that his conceptual approach builds on work by Sheila Jasanoff (see (Jasanoff, 2013, 2011, 1997)) that

demonstrates that political and ethical theory are shaped by social life, established through discursive and institutional practices. This is mirrored in the key claim of Hurlbut's book that normative principles in policy debates are underwritten by the "[…] ostensibly exogenous authority of science" (p. 18) arguing that the distinction between rational scientific and irrational non-scientific claims are negotiated through social processes.

Although *Experiments in Democracy* draws on Jasanoff's conceptual frame, Hurlbut states that a Rawlsian approach of public reason has been influential in contemporary political theory (p. 19) and is a key conceptual frame in his study. Hurlbut presents the fact-value boundary, which is considered "[…] definite and unambiguous in Rawlsian deliberative democracy theory" (p. 21). This boundary reflects the assertion in Rawls' work that value statements are political and therefore open to contestation, whereas 'facts' are extra-political and therefore neutral and not open to contestation. Originally proposed as a solution to pluralism, which poses an inherent challenge to collective political judgement, in the Rawlsian approach to deliberative democracy, aggregative decision-making processes (e.g. voting) are seen as inferior because they suppress *reasonable* pluralism. Political judgements borne of collective reason, on the other hand, are recommended, as they can account for a diversity of views in discussion. Hurlbut highlights that, for Rawls, it is the responsibility of those in the political community to offer public reasons when engaged in debate, and that where a reason is not commonly held, it is excluded, thus the norms of public reason define the terms of participation (p. 22).

Hurlbut states that Rawls' idea of public reason does not extend to scientific facts because scientific reasoning represents a legitimate foundation for political authority but highlights the tension that science is therefore, in Rawls' view, "[…] simultaneously figured as outside politics and as achieving the forms of pure reason to which politics should aspire" (p. 25). Although, as Hurlbut

points out, scientific claims enjoy a special authority in public reason and argues this is exemplified by how public bioethics consolidated its power through boundary-work that systematically excluded views deemed non-scientific, such as value-based perspectives.

Experiments in Democracy details how bioethics institutions positioned scientific knowledge as "[…] prior to and a prerequisite for moral judgement" (p. 277) and silenced religious opponents to embryo research dismissing their opinions as irrelevant. Hurlbut describes how institutions such as the Human Embryo Research Panel (HERP) and National Bioethics Advisory Commission (NBAC) drew upon a Rawlsian approach to public reason to construct themselves as in their own sort of 'original position'[19], separate from their own social position (p. 284). They were also able to cite scientific knowledge to ensure their claims were uncontested in the realm of public reason. Hurlbut describes this as a veil of knowledge (in an allusion to Rawls' veil of ignorance in the original position), stating:

> Unlike the veil of ignorance which renders individuals ignorant of their interests in order to make their reasoning universal, the veil of knowledge attributes ignorance to the external social world, placing those behind the veil in a privileged position of reason. (p. 285).

By invoking this veil of knowledge, bioethics institutions were able to secure contested knowledges, for example the ontology of the embryo, as scientific facts, rendering them beyond the scope of public reason.

[19] The original position is a feature of Rawls' social contract account of justice (see (Rawls, 1958)). The position is an impartial point of view that is adopted in deliberative decision making. The main feature of the original position is the 'veil of ignorance' which ensures impartiality by depriving parties all knowledge about their own personal characteristics and social circumstances.

Similarly to Evans, Hurlbut accounts for how debates on embryos in the US have become more limited over time and how more diverse perspectives (for example those of theologians) have been silenced. However, while Evans' argues that this is due to the rationalisation of the debate, Hurlbut points out that from the mid-1960s on, ethics committees would often look to scientists to define the biological facts for debates about the human embryo, using these facts to inform their moral reasoning. Not only did this reinforce a tendency to elevate science as the ultimate value-neutral source of knowledge for reasoning about policy, but it also had the effect of silencing voices that disagreed with the ontological positionings of the scientific claims.

One way that ontological positionings of theologians might interact with scientific claims is on the point at which life begins in human embryos. Similarly to Mulkay, Hurlbut is interested in how the ontology of the embryo was secured by actors in the debate and describes how the pro-research lobby was able to change ideas about the biological and the moral status of the embryos by creating the idea of 'pre-embryo'. Hurlbut also cites the use of the term pre-embryo in the US debates, however he states that the discursive abstraction of 'pre-embryo' was used strictly as a scientific term, whereas in *Designs on Nature: Science and Democracy in Europe and the United States* Sheila Jasanoff states that the UK pre-embryo was "[…] safely bounded off from personhood, and hence [the pre-embryo] could be an object of research, as opposed to the embryo proper, the authentic precursor of human life." (2011, p. 152).

In her review of Hurlbut's text, British bioethicist Gulia Cavaliere draws parallels to British historian Duncan Wilson's *The Making of British Bioethics* (2014) citing Hurlbut's contribution as an American counterpart to Wilson's work (2018, p. 163). However, the books are not only studies of different geographical areas; where Wilson's book examined the actors in British bioethics

debates, Hurlbut focuses more on the bioethics bodies, and the titular 'experiments' in democracy that characterised the pursuit of governing emerging technologies and practices in the US.

UK debates

In the introduction of his book *The Making of British Bioethics* (2015), British historian of science Duncan Wilson notes that "Although bioethics first emerged in the United States, the term and the approach it signifies quickly became a global phenomenon" (2015, p. 3). Wilson's book builds on Evans' insights into how bioethics was made a profession in the UK, by exploring the growth and influence of bioethics in the UK, beginning in the 1980s. Wilson describes specifically British influences on bioethics, for example the Warnock Report, the NCoB and the growth of hospital ethics committees. Wilson builds on the work of Jasanoff, by explaining that:

> The ethical guidelines categorised the legal and ontological status of entities such as in vitro human embryos by combining scientific theories and moral frameworks such as utilitarianism; and this categorisation subsequently reaffirmed or challenged existing notions of human development, personhood. (Wilson, 2015: p. 15)

A key theme of Wilson's work is that he describes the impact of utilitarianism on UK bioethics, this is similar to Evans' approach to US bioethics which is influenced by principlist ethics. Wilson also cited how in the context of UK bioethics Baroness Warnock's views were influential, not because of their 'rightness' of 'wrongness', but because they conferred 'moral authority' (2015, p. 257).

In *Legalising Mitochondrial Donation: Enacting Ethical Futures in British Bioethics* Dimond and Stephens describe how Wilson's interpretation of Warnock's influence over UK bioethics was "[...] accomplished this through both encouraging philosophers and lawyers to work on influencing

public policy and by a promise to scientists that this endeavour would confer legitimacy to their work" (Dimond and Stephens, 2018: p. 17). *Legalising Mitochondrial Donation* picks up where Wilson left off, describing the MRTs debates of the mid-2010s, however, the book can also be seen as a sequel to Mulkay's *The Great Embryo Research Debate*. Not only do Dimond and Stephens explore a UK debate and utilise a similar approach and terminology to Mulkay, but their book represents the next step on the steady march down the slippery slope. *Legalising Mitochondrial Donation* charts the regulation of MRTs debate in the UK. Dimond and Stephens employ a thematic analysis that is both 'structural' and 'microsocial'[20] (p. 16) to argue 'The legalisation of mitochondrial donation is the latest iteration of a particular UK sociotechnical around human embryo research and its use rendered ethical through a permissive but highly scrutinised system' (p. 1).

Dimond and Stephens' book utilises stakeholder interviews and documentary analysis collected between 2012 and 2015 to generate a thematic analysis that captured events as they were unfolding. Dimond and Stephens ground their claim of the UK's significance as a case study by citing its historical reputation as a permissive regulator of biomedical technologies. The book's establishment of the lens of 'for' clusters and 'against' clusters represents a continuation of the adversarial approach taken by Mulkay (in the pro/anti-embryo research lobbies), which is both typical of the preceding debates about embryological research.

The book draws upon a theoretical base from STS utilising Gieryn's boundary-work and Wainwright's ethical boundary-work to explore how scientists draw ethical boundaries, Hurlbut made a similar claim when he used boundary-work to emphasise how actors located scientific authority within a wider normative and political imagination of secular public life (2017, p. 244).

[20] Relating to society on a small scale, or in small groups.

As I previously mentioned, conceptually, Dimond and Stephens' book also builds upon Jasanoff and Kim's work on sociotechnical imaginaries. Sociotechnical imaginaries are defined by Jasanoff and Kim as '[…] "collectively imagined forms of social life and social order reflected in the design and fulfilment of nation-specific scientific and/or technological projects." (2009, p. 120). Dimond and Stephens highlight the importance of the sociotechnical imaginary and its relevance for the mitochondrial donation debate in the introduction of their primary theoretical contribution: "[…] enacting ethical futures" (2018, p. 14, emphasis in original). The sociotechnical imaginary around embryo research and use generated from the work is described in the concluding chapter of the book as:

> […] one in which strict but permissive oversight and licencing from the HFEA operates to legitimise practise. This imaginary has an embedded notion of the good society as ethical, consultative, concerned about the welfare of its citizens and economically successful. (Dimond and Stephens, 2018, p. 131)

I have previously stated, in my background chapter, it is not uncommon for the HFEA to regulate embryo research and practice where new technological innovations mean that there are no legal instruments to do so. Therefore, the claim that the HFEA legitimises practice in the UK is an important contribution of Dimond and Stephens' work.

Another important piece of work by Dimond and Stephens is a 2016 paper where they detail how one of the key 'for cluster' institutions, the Progress Educational Trust (PET) is described as facilitating a 'transition performance' at a conference held in 2015[21]. This paper captures three important outcomes of this performance: first that it enacted the successful resolution of the

[21] I also attend this event as part of my data collection for my non-participant observation.

mitochondrial donation policy debate, second, that it performed the success of British biomedical politics, and third that it opened the space for a public debate on CRISPR-Cas9 in line with a specifically configured set of legitimacy practices (Stephens and Dimond, 2016, p. 312). The paper supports the claim made in *Legalising Mitochondrial Donation* that the MRTs debate in the UK is one of a series of iterative debates, because the authors effectively show the 'for-cluster' is transitioning into the next debate (CRISPR-Cas9) and how they are seeking to enact this transition in a stable way. Moreover, the authors also effectively define in this paper a British 'biomedical culture' described as facilitating high-quality policy discussions on new and emerging biotechnologies (as well as the reputational and monetary value of being at the forefront of biotechnology regulation) (2016, p. 314).

Legalising Mitochondrial Donation captures comprehensively the 'what' and the 'how' of legalising mitochondrial donation, the text does not aim to make any normative judgements about the value of the debate. The descriptive nature of the text is particularly pronounced when compared with contemporaneous articles (for examples see (Baylis, 2017; Haimes and Taylor, 2017, 2015)) which argued normative stances more fully, but did not contribute such rich empirical research. Moreover, the 2016 paper by Stephens and Dimond does explore the issues of power and legitimacy in debates, and their claim that the UK is now transitioning into the new debate of CRISPR-Cas9 is also mirrored in Philosopher Françoise Baylis' claim that the UK debate on MRTs might be used as a 'quiet waystation' (2017, p. 12) between mtDNA manipulation and the regulation of the manipulation of nuclear DNA.

Baylis paper "Human Nuclear Genome Transfer (So-Called Mitochondrial Replacement): Clearing the Underbrush" states of the MRTs debate that "[…] too much of the discussion and debate about the ethics of human nuclear genome transfer has been distorted by those who would have

us focus on the potential benefits of this technology" (p. 19) and she instead encourages a broader focus, with attention paid to public reason and social justice. Here, Baylis mirrors the findings of Mulkay — namely that promissory approaches to technologies are a tactic used by for-clusters in embryo debates — in the context of MRTs. Furthermore, Baylis takes up the mantle of Evans, Hurlbut and Jasanoff in her claims about public reason.

3.5 hGGE debates

The preceding sections have described how embryos have been represented and configured in UK and US debates. This final section will focus on hGGE debates in particular. As I have previously mentioned there is no UK account of hGGE debates, therefore I will draw on a broad base of international literature (mostly US) that addresses these discussions. It is important to note that while preceding sections in this chapter have discussed embryo research and manipulation, as I discussed in Section 2.1 hGGE can be applied either to embryos, or to germ cells.

As well as writing on MRTs, Baylis has also written on the international genome-editing debate. Her book, *Altered Inheritance: CRISPR and the Ethics of Human Genome-editing* starts from the position of wanting to improve both the scientific and ethical literacy of those who wish to reflect on the governance of hGGE, stating that questions about the governance of these technologies are not only for elites but society more broadly. The book is a call to action, with Baylis asserting, "[…] I want for all of us to reflect on whether heritable genome-editing is a boon or a threat" (2019, p. 8).

Baylis provides criticism for science's efforts thus far to expand the conversation about genome-editing, criticising scientists for their lack of breadth and depth in discussion. Baylis makes the case

for *slow science*[22], showing how 'fast science' may assume because a technological 'advance' is possible, that it ought to be permissible — and therefore doing science without broader sociological consent. In this context, value-based questions are eschewed, with the increasing intolerance for dissent itself becoming a genuine ethical problem (Baylis, 2020). Baylis points out this shift has already happened in the debate, and the question has changed to 'how should it happen?' and argues that to allow science to do whatever is technically feasible for every new instance of a technology without question is unethical, but it is even more dangerous when, like hGGE, the technology would affect not only future persons, but also their descendants. When thinking about the ethics of hGGE Baylis suggests a maxim of "All of Us' for 'Us All." (2019) to promote a sense of collectivism and public responsibility. She argues that too much of the discourse regarding genome-editing has taken place in small circles of technical experts, who advance the interests of hypothetical individuals whose reproductive choices would only be expanded minimally by these technologies. And that instead, we should be identifying shared societal needs with some urgency.

In her conceptual approach, Baylis crafts an exploration of possible roles for scientists and science adapted from Roger Pielke, Jr.'s text *The Knowledge Broker* (2007), including 'pure scientists', 'science analysts', 'issues advocates' and 'science'. Baylis states that most scientists who participate in the international hGGE debate are 'issues advocates' (2019, p. 161), meaning that they are individual scientists or members of scientific panels who are overtly aligned with a particular set of interests (2019, p. 157). Baylis' hope is for more scientists in the debate to take on the role of 'science diplomats' — experts who provide a range of actors (from policymakers to publics) with a range

[22] Slow science, inspired by the slow food movement, contends that the highest aim for science is to make socially relevant contributions.

of policy options to assist with collective decision-making — to work alongside 'ethics architects' — whose goal is to create inclusive deliberate spaces — to explore policy options that prioritise societal good.

Although the archetypes Baylis outlines are useful for deconstructing the role of ethical and scientific actors in debate, there is little practical explanation for how science diplomats and ethics architects might come together to discuss policy options and what challenges might face these types of discussion. For example, Baylis highlights the contempt some scientists have for the field of impact ethics (2019, p. 187) in the context of its perceived hindrance to scientific progress. However, she does not appear to account for this type of hostility in science diplomats and ethics architects' dialogues. In this sense, Baylis presents an idealised account of how the hGGE policy debate should be, rather than a reflection on how it is being conducted.

What Baylis achieves particularly well in her book is an exploration of the normative aspects of human genome-editing, and an account of how the science and ethics of hGGE should inform professional and public debate on research and possible uses of the technology. However, the book covers a vast range of traditional ethical arguments in the hGGE debate, and they are explained, rather than critically appraised. Moreover, Baylis is a key critical figure in the international discussion of hGGE, but her book does not capitalise on her unique position and the in critical conviction when compared to some of her other work (Lander et al., 2019). However, in her goal of broader public engagement to prevent the perpetuation of inequities through biological intervention, her call to action is in my view successful. As Baylis explains, "I don't want to live in a world where a select, privileged few are able to inscribe their privilege in their DNA and thereby exacerbate unfair class divisions and other social injustices" (2019).

Another book that addresses the hGGE debate on an international scale is Evans' (2020) *The Human Gene-editing Debate*. The book builds on Evans' earlier work *Playing God* to produce a sociological analysis of the public bioethical debate around HGE, focusing on the technology in general, rather than embryo editing in particular. The debate is configured as a slope with barriers positioned up and down the slope. Evans describes that the top of the slope is what society finds morally acceptable, and the bottom of the slope as what society finds morally unacceptable with regards to hGGE. Evans' describes each of these barriers in turn, including potential future barriers, and sets out their strengths and weaknesses. For example, Evans sets out the 'liberal eugenics barrier'[23], where an 'upslope' would be any autonomously chosen selection or modification that does not harm anyone else and a 'downslope' would be coercion or a modification that would harm the individual or others (Evans, 2020: p. 127).

A key point in Evans' book is that sometimes ontological boundaries are 'made moral' *post facto*. In his book, in a section on objectivity and strong barriers, Evans notes that "the distinction between somatic HGE and germline HGE is based in biological reality. (That such a divide is morally relevant is obviously a human construction.)" (2020, p. 149—150). I discuss Evans' (2020) writing further in Section 4.5, where I delve further into how he uses boundaries as a lens for hGGE debates.

A final paper that discusses a comparative approach between the US and the UK is "Thinking the unthinkable: how did human germline genome-editing become ethically acceptable?" (2021) by British STS scholar Paul Martin and interdisciplinary researcher Ilke Turkmendag. The paper uses a comparative approach to analyse key documents to better understand 'regimes of normativity'

[23] The liberal eugenics barrier "[...] holds that prospective parents have the autonomy to engage in any HGE they desire, short of harming others." (Evans, 2020).

in the debate. Martin and Turkmendag describe a number of ways the constitution of these regimes has involved distinct and dynamic socio-technical processes including the "Construction of powerful moral-technical imaginaries and patient narratives", the "Creation of "demand" for the use of HGE" and the "Building of different communities of promise" (2021, p. 401).

Future embryo debates

In this section, I have reviewed literature that captures different approaches to embryo debates. Moving from the pre-embryo to the embryo proper I discuss how embryos are represented, constructed and configured in moral debate, contrasting literature on embryo debates from the US and UK literature, before focussing on hGGE debates specifically. In this chapter, I review literature that captures different approaches to the character of embryo debates. This literature shows both that there is a great deal to unpack when it comes to debating the embryo and that there are many ways to approach academic analysis of these types of discussion.

I used a breadth of literature to emphasise that debates about embryos are difficult, and that the difficulties associated with debating the embryo has led to problems in embryo debates. I described how embryo debates are (ideally) examples of public reason Evans (2002) that, therefore these debates should be challenging, and include a diverse range of perspectives. However, many of the debates I discuss are arguably not high-quality examples of public reason, and many of the patterns I and other authors observe in the embryo debates are repeated. The aim of my thesis is to understand why these patterns are repeated and if the repetition of these patterns could stop, if it would improve the quality of hGGE debates in the UK.

What all this literature has in common is that they discuss an embryo debate or a series of embryo debates without contending that their debate is the last embryo debate. While hGGE is slightly

distinct from other embryo debates — such as PGD — because hGGE need not involve embryos *per se*, if germ cells were altered. However, in the UK context, the regulation of hGGE would still fall under the HFEA, regardless of whether the subject of alteration was an embryo or a germ cell. This is quite different from other contexts, such as the US, where the term 'embryo' is excluded from discussions of hGGE due to cultural sensitivities around the use of embryos in research and reproductive technologies. It seems inevitable to all of the authors that more debates are to come, with some authors even going so far as to chart out the next potential area for discussion (for example Evans, 2020). While there are different approaches to how to conceptualise the debate — I prefer to think of hGGE as an embryo debate due to the regulatory structures in the UK — what is also clear from my review of the literature is that there is not yet an empirical account of the hGGE debate solely from the UK perspective. It is, therefore, my aim that this study addresses this gap in the literature whilst building on the research I have outlined in this section to capture the next embryo debate.

As I mentioned at the start of this chapter, my literature review is split into two halves that examine the existing research and theory that have informed my study. While the first half explored embryo debates, I will now move on to the second half that explores the conceptual literature that I build on to create my approach to studying the UK hGGE debates.

CHAPTER THREE — LITERATURE REVIEW PART TWO: CONCEPTUAL APPROACHES TO BIOTECHNOLOGY DEBATES

This second part of my literature review explores the concepts and theories around the dynamics of argument and disagreement about emerging technologies more generally. Here, I move away from the contextualised debates that address embryos and future humans to discuss literature that explores *how* new and emerging science and technology is debated. I will, however, draw on examples from the embryo debates to accentuate the conceptual topics the part of my thesis addresses.

A key conceptual idea that underpins this thesis is social constructivism. Social constructivism states that knowledge develops as a result of social interaction. Social constructivism is a central interpretive scheme for STS (Hacking and Hacking, 1999), after STS adopted the phrase "social construction" from Peter Berger and Thomas Luckmann's *The Social Construction of Reality* (1966), an essay on the sociology of knowledge. Key authors from within STS have used social constructivism to argue how human action shapes technology (Bijker, 2012), or to deconstruct the distinction between nature and society (Haraway, 1991; Keller, 1995).

Social constructivism also informs a number of authors' approaches that I have discussed in Part One of this literature review, for example Dimond and Stephens draw on social worlds framework in their discussion of the UK MRTs debate (2018), and Hurlbut (2018) used constructivism and co-production in his work on US embryo debates. As such it is sensible that my research also draws on a constructivist frame as it explores how scientific knowledge claims around various

boundaries, lines and demarcations in debates concerning embryos, genes and the germline are constructed and communicated.

In this section, I explore literature on concepts to understand the dynamics of the debate (such as metaphors and boundaries), for example, by using boundary-work (Gieryn, 1983) and ethical-boundary-work (Ehrich et al., 2006; Wainwright et al., 2006). I then delve into theories that help understand the patterns of debate (NEST-ethics) and how argumentative patterns can limit debate, using blackboxing (Latour, 1987) as an example. I then examine concepts that help understand where the debate takes place (arena, agora, observatory). I conclude with a brief explanation of how I see these spaces fitting together, given my reflections of the literature.

3.6 Concepts, theories, and methods for analysing debates

This section discusses metaphors, boundaries, and argumentative patterns (including blackboxing in debate) exploring how these concepts are used as tools in the debates. As with Part One of the literature review, Part two will open by examining the role of metaphors in the debate. However, rather than focusing on how metaphors are used to represent embryos, genes and hGGE, this section will focus on how metaphors are used as tools to analyse biotechnology discussion. I then go on to describe how literary allusion is to expound utopia and dystopia in discussion before exploring how boundaries are used in debate.

What these concepts have in common is that they all help authors understand the dynamics of debates. Moreover, by unpacking how metaphors, literary allusions and boundaries are used in discussion, authors can elucidate why actors use the language they do. This literature will be important to keep in mind as I present my own analysis of the metaphors and boundaries in the UK hGGE debates.

Metaphors in debates

George Lakatoff and Mark Johnson describe how, rather than being innocuous, metaphors are "persuasive in everyday life, not just in language, but in our thought and action." (1980). Lakatoff and Johnson go on to describe the importance of metaphor analysis for debate, particularly in areas that involve politics, law, or social issues (1980, p. 268). Moreover, discourse-analytical research into metaphor use has raised awareness of the functions that metaphors may fulfil in debates (for examples see Cameron (2007) and Semino (2008). So while identifying metaphors in debate may uncover to us what they are trying to represent, metaphor analysis can lead us to understand what they are trying to *do*.

Swierstra and Rip — whose work I will draw upon throughout the remainder of this chapter — analyse argumentative patterns and tropes in their work (metaphors being one of these tropes). They describe how metaphors are used in debate to achieve outcomes, for example: "When addressing external audiences, promoters of new technology use the deterministic metaphor of a train that cannot be stopped so as to enrol funders and publics." (Swierstra and Rip, 2007, p. 8), noting ironically, that: "When using the metaphor, the promoters conveniently forget that a train requires railway tracks which have been laid out before by human hands" (Swierstra and Rip, 2007, p. 8, footnote:4) *(sic)*. What Swierstra and Rip describe here is how the metaphor of a train is being used strategically to imply determinism, and as a result persuade others in the debate to agree with their position, or argument.

In the hGGE debates, metaphors have also been employed to assist in the public understanding of genome-editing, with reductionist effects, reducing complex lab procedures to neat cuts[24]. For

[24] This reductionist point will be important in Chapter 5, where I discuss the role of metaphors in debate.

example, Meaghan O'Keefe's work normative communication ethics highlights the importance of using appropriate metaphors when discussing promissory technology, such as CRISPR-Cas9. In 2015 O'Keefe and colleagues published a paper titled *"Editing" Genes: A Case Study About How Language Matters in Bioethics* which analysed a dataset of forty-five newspaper articles to uncover some of the metaphors used to describe genomes. O'Keefe and colleagues found that a range of metaphors were used, including 'blueprint', 'code', 'map', 'medicine' and 'weaponry' (O'Keefe et al., 2015, fig. 1), however it is likely that there may be more, as the sample size used in this paper was relatively small. Nelson and colleagues build on the work of O'Keeffe and colleagues in their paper *How metaphors about the genome constrain CRISPR metaphors: separating the "text" from its "editor"* by differentiating between metaphors for what CRISPR is, as a technology, versus what CRISPR does, in applications. In terms of the applications of CRISPR, Nelson and colleagues identified the technology was being described as a word processor (used for editing) and high-tech weaponry (used for targeting) (Nelson et al., 2015, p. 2).

Another metaphor that is common in bioethical debate is the 'slippery slope'. Mulkay discusses the slippery slope in *The Great Embryo Research Debates*, arguing the HFEA's procedures could contribute to towards social change as "the moral boundaries that define the limits of research will gradually be revised, in a piecemeal fashion, as scientists repeatedly press for permission to explore newly discovered therapeutic possibilities" (1997, p. 154). Swierstra and Rip (2007) use the slippery slope to explain how it is used strategically:

> As a strategy, it comes into play when (parts of) public opinion seems to favour the emerging technology and no convincing moral arguments against the emerging technology itself have turned up. In such a situation opponents can argue that the new technology,

> although seemingly innocuous or even beneficial now, will inevitably invoke further technological steps that will later result in applications that are blatantly immoral"

Evans, on the other hand, uses the 'slippery slope' metaphor as a conceptual lens for analysing hGGE debates. I will draw on and discuss this approach at length in the boundaries *in* debates section below.

Boundaries in debates

In Part One of the literature review, I set out a number of the key boundaries that actors draw upon in embryo debates. These demarcations include the temporal distinction between pre-embryo and the embryo, the somatic-germline distinction, and the therapy enhancement line. While these differentiations may seem banal, the process of — and motivation for — drawing lines has long been used as a tool for studying debates.

The most prominent example of analysing discursive ways of creating and enacting boundaries is Thomas Gieryn concept of boundary-work (1983). Boundary-work was originally proposed by Gieryn to differentiate between scientific and pseudo-scientific knowledge (1983, p. 781). Building on Gieryn's work, STS scholars have gone on to use boundary-work as a way of analysing how scientific disciplines are created. Boundary-work was used as a conceptual frame by a number of authors who analysed embryo debates, including Hurlbut (2018), Jasanoff (2012) and Dimond and Stephens (2018).

While the traditional roots of Gieryn's boundary-work is central to my interest in the hGGE debates (i.e. the separating of the scientific from the non-scientific), I have chosen to use ethical boundary-work as the key way I will analyse boundaries in the UK hGGE debates. Ethical boundary-work refers to Wainwright and colleagues' description of ethical boundary-work to

define how researchers in ethically contentious areas of scientific research — for example embryo research — would defer any moral judgments about their work onto the regulator (Ehrich et al., 2006; Wainwright et al., 2006). Ethical boundary-work was used by Dimond and Stephens, in their discussions of the MRTs debates, most notably to "[...] describe the ways in which scientists draw the boundaries of ethical and non-ethical scientific activity" (2018, p17).

Boundaries and how they operate as part of slippery slopes in the genome-editing debate are the primary subject of study of Evans' *The Human Gene-editing Debate*. Evans describes the slippery slope as the central micro-structure of public bioethics debate on HGE (2020, p. 9), but he also argues that many public bioethics debates are set up as slopes, with more morally acceptable applications at the top and less morally acceptable at the bottom (p. 12). Evans is quick to point out that the slippery slopes that he discusses in his book (and the same is true for the slippery slopes described by Swierstra and Rip) are not 'logical', and that formal logic derived interpretations of the slippery slope, deserve the facile status attributed to them (p. 10). Instead, what Evans is referring to when he talks about slippery slopes is 'empirical' slippery slopes, this is different to Swierstra and Rip who analyse the metaphorical force of the slippery slope as an argument of moral corruption (2007, p. 10). For Evans, rather than a slippery slope in a formal logic sense, where if A then B; if B then C; if C then… Z, therefore A implies Z, the empirical slope is based on probabilistic predictions of the future (p. 10). Evans describes legitimate empirical slippery slope arguments as able to "[…] identify the social mechanisms that will, in the future, result in an increased likelihood selecting B" (p. 10).

The slippery slopes that Evans describes build upon the work of Eugene Volokh, a Ukrainian-American legal scholar, who describes 'attitude altering slippery slopes' (Volokh, 2003, p. 1077—1104) in his work on the mechanisms of slippery slopes. Volokh's attitude altering slope is

premised by the is-ought[25] heuristic described by Swierstra and Rip where publics feel they lack enough information to feel strongly about the topic. Furthermore, Volokh stipulated that we should expect attitude-altering slippery slopes where voters are pragmatists rather than ideologues, in a trusted legal system and where the topic of the slope is viewed as complex and therefore might require expert judgement (p. 26). The mechanisms described by Evans that may cause society to slip further down the slope may be legislative change, societal change, or a change in technical knowledge (2020, p. 11).

In *The Human Gene-editing Debate* Evans describes in depth a number of slopes and barriers. For example, when discussing the therapy-enhancement line (visualised as a slope with the most acceptable therapy upslope and the most unacceptable enhancements downslope) he describes the boundary of the therapy-enhancement line to be rooted in grey areas, where actors were able to equate therapy and enhancement by stating that one type of intervention was "just like" another (2020, p. 65). The weakening of the therapy-enhancement line (described as the disease enhancement barrier) was rooted, as Evans explains, in the erroneous nature of the term disease. Evan s' conceptual analysis of the weakening of the therapy-enhancement line, has similar themes to Baylis and Scully in describing the susceptibility of barriers grounded in normative values (Evans, 2020, p. 62).

The conclusion of Evans' book explains the inevitability of why HGE debates are organised as slopes:

[25] The is-ought problem (also known as Hume's Guillotine after David Hume, the philosopher who originated the problem) is the question whether normative conclusions can be validly inferred from descriptive premises (Spielthenner, 2017).

> Participants in this debate can in theory say anything, but they have incentives to adhere to the established norms in the debate. One norm is that debates about technology and the human body are framed in terms of limits - "up until this act is ethical, beyond that act is unethical". Another is that these arguments have a "moral other" (like Nazis, Gattaca, or the Brave New World) with which to contrast your position. When combined with the discursive logic used by academics, such as rational consistency, these norms combine to produce a debate organised like a slope with the "moral other" at the bottom and barriers on it that stop us from ever reaching bottom (2020, p. 133)

Evans' explanation mirrors what Swierstra and Rip describe as the immutable grammar of NEST ethics debates. Although Swierstra and Rip do not organise their debates as slopes, they do cite the slippery slope metaphor and recognise it as a subsection of arguments of moral corruption, which are a key feature of NEST-debate. In the UK context there is a specific anti-slippery slope rhetoric, for example that of the British bioethicist John Harris who would ask if the slippery slope required skis or crampons (Nerlich et al., 2003, p. 471).

Science fiction imageries in debates

Utopias and dystopias are another for steering discussion and can be used as a method for analysing debate. They are often cited when actors debate new technologies or novel scientific techniques (academic accounts of utopia and dystopia in technoscientific debate include (Jasanoff and Kim, 2015; Kendal, 2015; Winner, 1997)). In addition, the field of bioethics relies heavily on allusion to the language and images of science fiction literature and film to debate issues such as the ethical concerns surrounding technological advances (Kendal, 2015, p. 90). Allusions draw on the intertextual capacity of language to make specific connections to unique or noteworthy texts (Irwin, 2001; Marquis, 2011; Tsakona, 2018). The cultural touchstones associated with literary

allusion are often linked to techno-normative ideals (Jasanoff and Kim, 2015, p. 123), so, it follows that debates concerning these same bioethical issues often draw upon these same touchstones.

In *The Great Embryo Research Debate* Mulkay includes a chapter titled "The Myth of Frankenstein" (1997, chap. 8) which explores the science fiction imageries in the UK embryo research debates, with a specific focus on *Brave New World* [26] and Mary Shelly's *Frankenstein* [27]. Mulkay explains that the figure of Frankenstein represented the dangers of unfettered pursuit of scientific knowledge commenting:

> The tale of Frankenstein spoke, not of a world made better by science, but of the monstrous changes that would inevitably follow if scientists were allowed to step beyond the boundary of legitimate conduct and to use living human individuals as experimental subjects (1997, p. 117)

Mulkay is quick to acknowledge the peculiarity of the inclusion of allusions to dystopian fictions like *Frankenstein* and *Brave New World* in his academic analysis of the debate, however, he argues that his work sits within an analytical tradition of literature (See for example (Turney, 2000; Van Dyck, 1994; Winner, 1978; Jasanoff, 2007, p. 43-44) that explore how allusions to fiction contributes to public ambivalence about scientists and scientific practice in the context of embryo research (p. 117).

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[26] Published in 1932 and set in a in a futuristic World State *Brave New World* depicts huge scientific advancements in reproductive technologies and describes a dystopian society where humans are conceived asexually and born in hatcheries. The book generates two key narratives: (1) commodification of life (or designer babies); and (2) a two-tiered society of the genetic 'haves' (Alphas) and 'have-nots' (Epsilons).

[27] *The Modern Prometheus: Frankenstein* depicts scientist Victor Frankenstein who successfully animates a being of his own creation. However, the life he creates is not the perfect specimen he envisages, but rather a hideous creature who is spurned by Frankenstein. Rejected, the Monster seeks its revenge through murder and terror. Thematically, Frankenstein depicts the dangers of knowledge and ambition, and the perils of 'going against nature'. Shelly's novel conjures narratives of: (1) the 'unscrupulous operator', an individual scientist who misuses science for their own ambition; (2) to imply an unethical 'unnaturalness' (e.g., 'Frankenstein science'); and. (3) 'playing God'.

Mulkay's chapter tracks the evolution of science fiction imagery and how these rhetoric travelled from the UK press to figure heavily in the parliamentary debates on embryo research. Mulkay concludes by presenting competing visions of the future that arose from the parliamentary debates, stating that the anti-embryo-research lobby combined science fiction imageries with a temporal perspective to construct an interpretive space where they could "[…] postulate dramatic technical changes and (to) envisage radically new forms of science-based activity which were clearly incompatible with present-day morality." (1997, p. 129). The pro-embryo-research lobby, on the other hand, regularly attacked this temporal perspective[28], but did not dismiss the utility of discussing embryo research through the science fiction frames. They instead employed prophetic rhetoric speculating on perspective cures that new technologies could provide. The key difference, Mulkay argues, between the two approaches, was that the anti-embryo lobby were only able to link their arguments to speculative fiction, the pro-embryo research lobby were able to argue that their claims were supported by the authority of science (p. 130).

In his book, *The Human Gene-editing Debate* Evans also discusses allusions to *Brave New World* as well as to the film *Gattaca* [29]. Evans argues that the narratives of dystopian futures such as *Brave New World* and *Gattaca* offer a "moral other" to hold up as a contrast to normative assumptions about technologies and the human body (2020, p. 133). Evans shows how actors in a debate can depict arguments around new reproductive technologies as a slippery slope, using the moral other

[28] The temporal perspective describes how morality today might be seen in the future (see Swierstra and Rip (2007) page 10 for an example of how the temporal dimension is used in debate).

[29] *Gattaca* is a 1997 American science fiction film written and directed by Andrew Niccol that depicts a society governed by a strict genetic hierarchy with no class mobility, and where children's characteristics are selected by their parents to make the best possible child. Thematically, the film explores genetic determinism and free will. In a society where genetic discrimination is legal; and reproductive technologies facilitate eugenic practices that classifies humans as 'valids' or 'in-valids', the film depicts the protagonists struggle to live lives they choose. *Gattaca* conjures narratives of (1) genetic discrimination; (2) a two-tiered society of the genetic 'haves' (valids) and 'have-nots' (in-valids); and (3) the consequences of unfettered genetic selection.

(dystopian futures) as the bottom of the slope, and constructing barriers on the slope to prevent this moral other from manifesting.

In *Altered Inheritance* Baylis discusses dystopian allusion in the context of particular scientists, for example Steven Pinker, who are encouraging bioethicists to 'get out of the way' of science. Pinker published an opinion piece in the *Boston Globe* that Baylis cites stating that bioethicists are attempting to 'thwart' science by propagating narratives concerning speculative harms. Baylis quotes Pinker thus:

> These include perverse analogies with nuclear weapons and Nazi atrocities, science-fiction dystopias like "Brave New World" and "Gattaca," and freak-show scenarios like armies of cloned Hitlers, people selling their eyeballs on eBay, or warehouses of zombies to supply people with spare organs." (Pinker, 2015, cited in Baylis, 2019, p. 171)

Baylis uses examples from Pinker and a *Lancet* editorial[30] to show how the category of bio-Luddite was constructed to refer to bioethicists who stood in the way of scientific progress. The status of bio-Luddite is contrasted with the derisive categorisation of bioethicists as the handmaidens of science (Baylis, 2019, p. 172) a fear also raised by Hurlbut in *Experiments in Democracy* (2018).

In his article "The Use and Misuse of Brave New World in the CRISPR Debate" Derek So breaks down allusions to Huxley's text (1991) in academic articles, stating that at the time of writing "allusions to Huxley's novel have appeared in more than 500 academic articles about CRISPR" (So, 2019), cites, for example MIT geneticist Eric S Lander's paper *Brave New Genome* (2015). So is largely critical about the use of Huxley in these cases, pointing out that "one of the strangest

[30] See (Lancet, 1997)

aspects of Brave New World's use in bioethics is that many authors use the novel as shorthand for ethical issues that never appear in the novel at all, and even some issues that contradict those portrayed in the novel" (So, 2019). John A. Lynch noted a similar idea in his research into the 1998 to 2003 debates on embryonic stem cell research and cloning, where he found that Huxley's *Brave New World* was a unique allusion in that both proponents and opponents of research treated references to the novel as a legitimate rhetorical strategy to cultivate a common understanding (Lynch, 2019).

Argumentative patterns in debates

This section will look at the methods for analysing argumentative patterns in debates. I will begin by drawing on Tsjalling Swierstra and Arie Rip's method of analysing the dynamics of debates in the area of nanoethics. Swierstra and Rip (2007), Swierstra and colleagues (2009), and Swierstra (2016) maintain that tropes and 'storylines' are integral components of debates concerning the ethics of new and emerging science and technology (NEST-ethics).

In their paper "Nano-ethics as NEST-ethics: Patterns of Moral Argumentation About New and Emerging Science and Technology" Swierstra and Rip offer an inventory of the arguments and show how these patterns evolve over time. Swierstra and Rip point out that the NEST patterns in a debate are played out in *arenas* with opponents and proponents of the technology taking opposite sides. Dimond and Stephens pick up this theme in their analysis of the MRTs debate, when they describe how they envisage the 'arena' as a lens for the adversarial debate (Dimond and Stephens, 2018).

Although Swierstra and Rip's paper focuses on nano-ethics (ethical issues arising from the use of nanotechnology) they emphasise the transferability of the NEST-ethics tropes, which they argue

constitute the grammar of debates concerning controversial new technologies. NEST-ethics argues that the co-evolution of ethics and new technologies constitutes patterns of moral argumentation, and that there are shifts in the repertoires of arguments and tropes drawn upon as new issues are raised. Tropes are referred to in Swierstra and Rip's work as a "[…] recurring motif or argument that is supposed to have particular force." (2007, p. 4). These tropes are used as "a repertoire that is available in late-modern societies, both in terms of framing of how actors view issues and expect others to view them, and as a kind of toolkit that can be drawn upon in concrete debates." (2007, p. 4).

As well as identifying prominent metaphors and tropes and arguments concerning new technologies, NEST-ethics also accounts for argumentative patterns in NEST debates. For example, Swierstra and Rip explain that NEST debates start with consequentialist patterns of argumentation (p. 11) as actors decide if the consequences of the NEST are desirable. During this phase of discussion, proponents of the NEST will engage in promissory narratives (see (Borup et al., 2006; Brown and Beynon-Jones, 2012) for an overview of promissory science and the sociology of expectations in NEST). Similarly to the utopias in the science fiction narratives, these promises enrol other actors as proponents the claims will be countered by critics who will identify alternative narratives that seek to undo the promises.

While Swierstra and Rip argue that the critics' responses to consequentialist claims about NEST are argued along three lines. Firstly, the plausibility of the promises, secondly whether the benefits of the promise outweigh the costs, and thirdly, whether the benefits promised by the technology are worth having in the first place (p. 12). These ways of countering promissory claims have corresponding rhetorical tropes that actors employ when mobilising these arguments, for example when weighing the benefits of the NEST an actor might remark that the NEST is a technological

solution to a social problem and therefore does not provide the benefit promised (p. 13). This example is particularly important in technologies that blur the therapy/enhancement line, given that disease and disability are lived out in social scenarios.

Swierstra and Rip argue that three-pronged response to promissory claims about NESTs cannot address all concerns (p. 14) and that eventually these consequentialist patterns of debate give way to deontological (rule-based) arguments. This is because technologies that have desirable consequences can still be rejected because of moral objections. Whereas deontological responses to consequentialist arguments are often countered with another principle that takes higher priority, for example non-maleficence (Swierstra and Rip, 2007, p. 14). Alternatively, actors might argue that the deontological principle cited does not apply to the NEST in question or by emphasising how the NEST can promote choice. For example, hGGE could allow parents to choose to have a genetically related healthy child, in which case the NEST (hGGE) could enhance (parental) autonomy.

Swierstra and Rip state that arguments around justice and the 'good life' ethics also feature in NEST-debates, for example arguments around distributive justice in relation to access to technologies or questions around what sort of 'good life' can the NEST help us achieve. Again, these arguments have corresponding rhetoric for example the technological 'have-nots' (in the case of justice derived arguments) and Promethean imageries[31] (for arguments derived from the 'good life' ethics) (p. 15).

While the NEST-ethics tradition describes the NEST-ethics toolkit as an inventory of tropes and arguments, they suggest that an arena model is the best way of understanding NEST-ethics

[31] Swierstra and Rip (2007) describes how Promethean imageries encourage trust and bravery to use science to "Boldly go where no man went before" (2007, p. 15).

debates. Swierstra and Rip argue that many stakeholders are not as interested in arguing the ethics of a technology as they are invested in the outputs of the NEST debate. This idea is highlighted by the use of institutional script on both sides of the debate by actors (Swierstra and Rip, 2007) who are invested in a policy outcome, be this for the sake of politics, future career prospects or research funding. By arguing that the NEST-ethics debates are played out in an arena model with proponents and opponents, Swierstra and Rip highlight how argumentative patterns are inevitable in NEST-ethics debates. Moreover, Swierstra and Rip's adversarial conceptualisation of NEST-ethics debates rejects the consensus-seeking agora model (p. 18) and as a result, it is hard to see how debates around new technologies can be productive. This point around the conceptual spaces where the debates take place will be important to remember later when I discuss the conceptual spaces of the arena, agorae and observatory and how I envisage these spaces interacting.

In their conclusion, Swierstra and Rip argue that a pragmatist ethics might be a solution to NEST-ethics decision-making "[…] by helping develop different tools for 'conflict' and 'dilemma' management to enhance mutual respect" (p. 19). However, the authors do not question how this pragmatist approach would be implemented in debate and if this would disrupt the NEST-ethical argumentative patterns observed in NEST debates.

An example of a NEST-ethics trope I have seen in the literature is that in the MRTs debate the NEST (MRTs) was intrinsically tied to discussions of the nuclear family. As I discussed earlier in the background chapter (Chapter Two) Haimes and Taylor argued that labels, such as 'just tissue' (2015, p. 373), 'only 13 genes' (p. 373) and 'batteries' (p. 375)) were used to diminish the contributions of egg providers. Building on the work of legal scholar Danielle Griffiths who argued that UK regulations on MRTs confined the technique to the production of heteronormative genetically related families (2016), Giulia Cavaliere and César Palacios-González argued UK

regulation should be extended to allow lesbian couples to access MRTs. However, Herbrand (2017) argues that it is likely that the egg donors were written out the narrative on MRTs for purposes related to maintaining a conservative image that these technologies will produce children in as close to a 'normal' way as possible for 'normal' (genetically related and heteronormative) families.

Blackboxing in debates

Blackboxing is what happens when scientific and technical work is made invisible by its own success (Latour, 1987) and therefore eliminates discussion and debate. Ian Siebörger and Ralph Adendorff describe how blackboxing is used to present knowledge in a way where there is little room to contest it (2015). Whereas Sturman describes this process as the "[...] closing off of this dynamic formation and contestation of scientific knowledge into the opaque object of fact, has become part of a larger social science imaginary" (2006, p. 182).

Blackboxing is not described by any of the authors I have discussed up to this point, however, I think some of the heuristics set, particularly in the MRTs debate, are examples of blackboxing. For example, the DOH changing the definition of germline genome-editing to exclude MtDNA, presented this new knowledge (the changed definition) as a fact. Latour uses blackboxing to describe how scientific facts are created, and thus uncontested (Latour, 1987). Whereas, in my analysis, I show how blackboxing is used in preparatory debate to compress normative discussions in regulatory debates.

When debates fail

This section has discussed metaphors, boundaries, argumentative patterns and blackboxing to better understand how these concepts are used as tools in debates. In using these tools to analyse

and evaluate discussion, authors have often identified shortcomings in the debates they have been investigating, suggesting ways to improve the quality of debate.

Swierstra and Rip describe the problem of "ambivalence" in NEST-ethics debates, suggesting that argumentative patterns that contribute to ambivalence in debates should be addressed by adopting a pragmatist ethics (2007, p. 18). Mulkay was critical of the *quality* of the embryo debates in the UK in the 1980s, stating that politicians were concerned about the impacts of embryo research but were "[...] unwilling to give up the major benefits promised by the research community." (1997, p. 153). Haimes and Taylor outline instances in the MRTs debate in the UK where greater clarity, depth and nuance would have allowed for better understanding of MRTs and their impact.

Herbrand's paper *Silences, omissions and oversimplification? The UK debate on mitochondrial donation* leaves little ambiguity on her thoughts about the quality of the debate. Herbrand argues that while the risks of MRTs were acknowledged in parliamentary debates "[...] key information regarding the targets of the techniques, their impacts, their alternatives and their costs were dismissed, and this contributed to make them appear unique, desirable and necessary." (2022, p. 53). Finally, the call to action in the conclusion of Evan s' *The Human Gene-editing Debate* is that he hopes his book produces an "improved debate" (2020, p. 133)

3.6 The role of space in debate

Spaces in debate are both conceptual and physical but for my thesis, I will not only focus on the debate's discourses, but also on the social spaces where actors from many different disciplines meet together to exchange ideas, co-create consensuses, draw boundaries, perform community norms and generate dominant epistemic narratives. I will give an overview of how these types of conceptual spaces are used in literature on bioethical debates before highlighting the arena, agora

and observatory as key conceptual spaces in the debate I will draw upon in my understanding of how stakeholders use particular language and discourse in hGGE discussions.

Previous examinations of the bioethical debates include Evans' concept of public bioethical debate (2002; 2020). Evans defines public bioethical debate as the process by which individuals and groups engage in discussions about the ethical and social implications of new biotechnologies. According to Evans, these discussions involve a wide range of actors, including scientists, policymakers, ethicists, and members of the public. One of the key features of public bioethical debate, as defined by Evans, is that it is a democratic and inclusive process. He suggests that it is important to engage with a range of perspectives and values, and that there should be a focus on understanding the beliefs and concerns of different groups. This approach, he argues, can help to promote a more informed and nuanced discussion of the ethical and social implications of new biotechnologies.

While Evans describes public bioethical debate as involving a wide range of professionals, he also emphasises the importance of public engagement in bioethical debate. He argues that members of the public should have the opportunity to participate in discussions about the ethical and social implications of new biotechnologies, and that their views and concerns should be taken seriously. Evans' approach is similar to another conceptual approach — the agora — that I will argue is an important space in hGGE debates.

Helga Nowotny and colleagues' concept of the agora (2001) is also related to the idea of public engagement in science and technology debates. The agora is a space or forum for democratic deliberation and dialogue among diverse stakeholders, including scientists, policymakers, citizens, and civil society groups. Like Evans' approach to public bioethical debate, the agora approach

emphasises the importance of democratic and inclusive dialogue that incorporates a range of perspectives and values.

There are, however, some key differences between the public bioethical debate and the agora. For example, the agora is a more general concept that can be applied to a wide range of science and technology debates, not just those related to bioethics. While Evans' concept of public bioethical debate focuses specifically on ethical and social implications of new biotechnologies. Secondly, the agora approach places a greater emphasis on the role of citizens and civil society groups in shaping scientific and technological policies. Nowotny and colleagues argue that the agora is a space for citizens to voice their concerns and values, and for scientists and policymakers to take these into account when making decisions about science and technology. Public bioethical debate, on the other hand, emphasises the importance of public engagement, placing greater weight on the role of technical experts and policymakers in shaping bioethical policies.

Both public bioethical debate and the concept of the agora share a commitment to democratic and inclusive dialogue among diverse stakeholders. There is also a wealth of literature concerning participatory practices within scientific debates that covers practical approaches to engaging members of the public, stakeholders, and experts in discussions and decision-making processes related to scientific topics. Key concepts from participatory practices include: citizen science (Bonney et al., 2009), public consultation (Rowe et al., 2000), participatory research (Cornwall and Jewkes, 1995), and deliberative processes (Parkinson and Mansbridge, 2012).

While the literature on participatory processes is essential to understanding practical approaches to engaging the public, there was no evidence to suggest that these practical techniques were being used to co-create discourses in the debate alongside the public. As such, I intend to use a descriptive approach to space as a way of understanding how elite stakeholders use particular

language and discourse in hGGE discussions — focusing on the spaces of the arena, agora and observatory, which I outline below.

Moreover, while my approach is similar to Evans' public bioethical discourse there are a number of key differences, the first being that my research takes place in the UK as opposed to the US. One of the key arguments that I make is that the UK has a unique regulatory structure which in turn shapes the spaces of the UK debate. As such, I felt it was important to map the spaces of the debate as part of this research, rather than building upon Evans' conceptions that best fit US bioethical discourses. Secondly, Evans' public bioethical debate is rooted in political theory drawing on both Habermas' concept of communicative action (1987) and Rawls' theory of justice as fairness (1958). The theoretical framework for my research is more strongly rooted in STS, therefore using a political theory approach grounded in normativity would not be a good fit, given my descriptive approach.

Arena

The arena is a conceptual space where proponents and opponents come together to debate, where some win and others lose, and consensus is never reached (Swierstra and Rip, 2007, p. 18). Dimond and Stephens also use the arena concept in their work on MRTs, derived from Adele Clarke and Susan Leigh Star on social worlds frameworks (2008). The arena in this context is a device that explores "[…] how this group of implicated actors were 'conceived, represented, and perhaps targeted by the work of arena participants' (Clarke and Star, 2008: 119)." (Stephens and Dimond, 2017).

An example arena is the House of Commons of the UK Parliament in the Palace of Westminster. Although the Commons is a physical space, restrictions imposed by the COVID-19 pandemic

have shown that the Commons can also be a virtual space, with MPs joining debates online. The Commons can be thought of as an arena because it is a space where actors come together to debate, and some actors win, and others lose. In the context of debating legal reform, this win/loss takes the form of a vote that will regularly follow such a debate. Dimond and Stephens also defined the Commons as an arena in their work on the UK MRTs debates. They demonstrated how new rhetoric (for example, conceptual categories such as 'mitochondrial mothers') was constructed and communicated by actors in the arena (2018, p. 244).

The House of Commons is also an excellent example of an arena because it represents a challenging space to access and has complex rules about what can and cannot be said. The exclusivity of the space means that it is tough for both actors and arguments to penetrate the arena. Genome-editing has not yet been debated in the House of Commons. However, the literature that I have reviewed has consistently highlighted this arena as an essential source of debate (see Dimond and Stephens (2018), Wilson (2015) and Mulkay (1997) for examples).

Another arena highlighted as crucial in UK embryology debates is the House of Lords (see Mulkay (1997), Jasanoff (2007), Dimond and Stephens (2018), and Wilson (2015)). Under the 'two house system' in the UK, the House of Lords is independent of and complements the work of the elected House of Commons. The Lords make and shape laws and provide oversight to the work of the government. On the 30th of January 2020, Genome-editing was debated in the House of Lords. Baroness Bakewell motioned the debate to note recent developments in gene-editing and its status in scientific research worldwide.

Similar to the House of Commons, the House of Lords is not freely accessible to those who wish to participate in the debate; instead, membership to the Lords is by appointment, heredity or official function. However, while the elite stakeholders — whose debate is the focus of this thesis

— did not feature in this debate due to the exclusivity of the space, the arguments seen in the elite stakeholder debates did subsequently feature in this arena. These arguments included some of the key themes I will discuss in my empirical chapters, such as allusions to science fiction (Hansard, 2020, C. 1522), attempts to secure the nomenclature of the debate (Hansard, 2020, C. 1529) and concerns raised that genetic enhancements performed using hGGE could contribute to two-tiered societies (Hansard, 2020, C. 1534). As such, it indicates a connection between the debates in different spaces.

Since the HoL debate in 2020, genome-editing has not featured in debates in these arenas. There have also been no arena debates that specifically concern hGGE. For this type of debate to occur, proposed reform to the HFE Act 2008, which included hGGE (beyond the MRT's debates in 2015), would have to be debated in either House. Given that this type of debate was not proposed during the timeline of my PhD, I have chosen not to focus on the arena as it would not have yielded sufficient data. However, genome-editing for farming and food production was included in the 2022 Queen Speech. Therefore, an arena analysis of genome-editing debates may be a potentially fruitful avenue for future work.

While these arenas will not be the focus of my research, my empirical chapters will focus on how elite stakeholders produce and mobilise key argumentative patterns in hGGE debates. I argue that while elite stakeholders never genuinely engage in the arena — because they cannot access these spaces — what they do engage in is preparatory debate. This preparatory debate occurs in the agora and is a way of practising crucial arguments that will form the basis for lobbying and influencing activities when debate in the arena occurs. Therefore, it is important to remember that these spaces, while separate, are connected in important ways. As a result, discussion in one space can shape debate in another.

Agora

The agora is an important tool that I have employed throughout my research to illuminate how different social spaces can accommodate different types of debate. The agora is defined as a metaphorical interpretation of the central public space in Hellenic society. Therefore, it is conceptualised as an open space and a democratic platform where different perspectives are brought together and are "ultimately creating different visions, values and options" (Barr, 2001; Frederiksen et al., 2003). The agora concept is introduced by Nowotny et al. (2001) to describe how society can produce socially robust knowledge in a situation where traditional methods of constructing scientific reliability are insufficient. Although the concept of the agora originates from classical Greek history describing the town square where people met to exchange points of view, the use of the agora metaphor in STS is centred on forms of scientific knowledge production referred to as 'Mode 2'. 'Mode 1' refers to academic, investigator-initiated and discipline-based research within the university and other dedicated research institutes (Limoges et al., 1994). However, Nowotny and colleagues state that in contemporary society Mode 1 forms of knowledge production are insufficient, and context-driven, problem-focused and interdisciplinary research processes are required instead. Knowledge should therefore be "[...] shaped by the interaction of its actors/agents" (Nowotny et al., 2001: 209) in the agora, whereby actors scientific and other stakeholders co-mingle to shape research agendas and make use of research results (Ibid: 202). Finally, the agora is an open space, democratic platform where different perspectives are brought together and are "ultimately creating different visions, values and options" (Barré, 2001; Fredderiksen et al., 2003).

There is a gap in the STS literature relating to how ideas exchanged in the agora are translated into documents, which would be benefitted by further research in the area. One of the classical agora

elements was the records of what happened in the space in the form of stone tablets (Grandjouan et al., 1989). Therefore, in the definition of the agora for use in this project, documents produced from the agora are of central importance. While stone tablets, and nowadays other documents, represent records of the agora, it is vital to think about the authenticity, readability, representativeness and meaning of the documents (Denscombe, 2014. p, 167). Documents are constructed artefacts with politics and as such because what is recorded may likely be shaped by *who* is recording it.

The concept of agora is contested in the literature on biotechnology debates and in the discussion of NEST-ethics. Swierstra and Rip argue that the agora approach is an idealised paradigm (2007, p. 18). Instead, the space where actors come together should be conceptualised as an arena where some win and others lose, and a consensus is never reached. However, while literature discussing arenas of debate focuses on battles, literature that discusses agorae focuses more on collaboration and democracy.

When addressing legitimacy in the arena, Swierstra and Rip describe how the authority of one's standpoints can only be acquired by participating in debate. Therefore, to have legitimate arguments (or to win in the arena), in Swierstra and Rip's view, actors must operate as though they are in an agora, seeking consensus for the legitimacy of their arguments. Even though Swierstra and Rip point out that the agora has an illusory function in NEST-ethics debates, they argue for the utility of the illusion (p. 19). For Swierstra and Rip, actors engaging in the arena as though it were an agora are creating 'reflective awareness' in NEST discussions (p. 19). They argue that pragmatist ethics can assist in providing tools for actors to assist in managing the conflict that arises from discussion.

Observatory

Finally, the observatory was described as an international space comprised of scholars, academic institutions and non-government organisation (NGOs) dedicated to gathering information and articulating often overlooked arguments (Jasanoff et al., 2019). Observatories in this context refer to actors who observe how debates unfold to provide analysis and oversight of developments. A vital example of an observatory in the global debate on hGGE is the global observatory on genome-editing (GOGE). In March 2018, Hurlbut and Jasanoff called for a global observatory for genome-editing in Nature, stating the need for "[...] a forum to promote sustained international, interdisciplinary and cosmopolitan reflection on several key considerations: what questions should be asked, whose views must be heard, what imbalances of power should be made visible, and what diversity of views exist globally." (2019).

Rather than using arena or agora as a concept in their work, Jasanoff and Hurlbut advocate a policy position of a global observatory model for genome-editing for "[…] determining how the potential of science can be better steered by the values and priorities of society." (2018). The observatory envisaged by Jasanoff and Hurlbut would be international and comprised of academics, their institutions and NGOs dedicated to gathering information and articulating often overlooked arguments. Alongside colleagues Hurlbut and Krishanu Saha, Jasanoff argues that democratic governance on a global level would require a process for active and sustained reflection by scientists on scientific practices around genome-editing in partnership with scholars and public representatives from varied social, political, and religious backgrounds (Jasanoff et al., 2019; Baylis, 2020).

The GOGE was established in 2020 to bring together representatives from a diverse range of intellectual, cultural, and spiritual traditions to discuss the ethics of hGGE. The GOGE aims to

collect diverse evidence on "[...] the range of issues brought into view through biotechnologies that touch upon fundamental dimensions of human life." (GOGE, 2022), and to analyse the "[...] foundations of thought on human purposes and meanings, attending to key issues, concepts, convergences, and variations in law, policy and public debate across jurisdictions." (GOGE, 2022).

While the GOGE is an excellent example of how to move away from pitfalls that have dominated bioethical debates, for example, by introducing more voices into debates on biotechnologies, the observatory does not necessarily achieve these aims with its membership. The people who comprise the leadership of the Global Observatory for Genome-editing are all US academics. So while the observatory is 'global' in the sense that it gathers data globally, the lens of the analysis is very western, elite and academic. The GOGE is one type of observatory where actors can distance themselves from the debates of the agora and arena and serve to provide oversight and commentary.

Conceptualising the spaces

When I conceptualise how the arena, agora and observatory interact, I consider two primary foci. The first is how exclusive the spaces are — the arena is the most exclusive, and the observatory is the least exclusive (with the agora in the middle) — and the second is the geographical locus of the spaces — again, the arena is the most local. In contrast, the observatory is the most global (with the agora in the middle). I have produced the following visual representation of the conceptual spaces (see figure 1) based on my work in the area. The framework is speculative; to collect evidence to support the framework would have been beyond the scope of my thesis (which focuses on the agora in the UK context). However, I think the framework is a helpful way to organise the conceptual spaces I have outlined in the preceding sections. Moreover, the validity of this framework could be explored by future work.

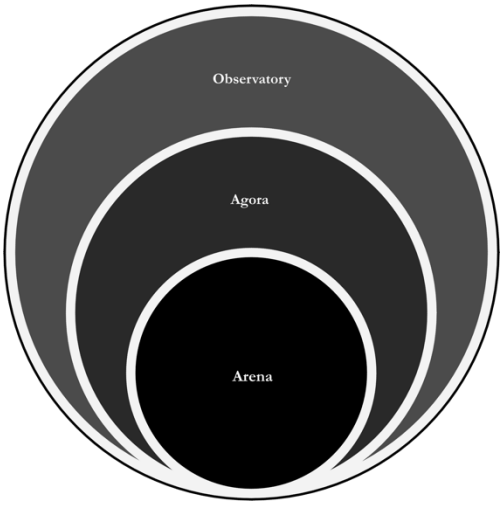

FIGURE 1: CONCEPTUAL MODEL OF THE ARENA, AGORA AND OBSERVATORY

While the exclusivity of the spaces and their geographical loci is relatively simple to conceptualise, one of the primary interests of my thesis is how elements of the debate (such as argumentative patterns) permeate these spaces. As I have previously mentioned, there has been scant arena debate on hGGEs up to this point. However, future research might map how arguments from the observatory and agora permeate future arena debates.

For the purposes of my research, I will examine the discourses of the hGGE, as they occur in the various agorae of the debate. While the arena and the observatory are important spaces in the debate, there have not yet been many examples of arena debates to draw upon, and examples of observatories of the hGGE debate are generally international enterprises, are beyond the remit of the UK debate.

3.7 Discussion

In this second half of my literature review, I explored how metaphors and boundaries can be considered as tools for analysis, through boundary-work (Gieryn, 1983) and ethical boundary-work (Ehrich et al., 2006; Wainwright et al., 2006). I discussed how NEST-ethics tropes create argumentative patterns that can limit debate and how concepts can be blackboxed (Latour, 1987) as an example. I then situated these debates by giving an overview of agora, the arena, and the observatory, before explaining how I see these spaces fitting together, given my reflections on the literature.

Argumentative patterns in biotechnology debates were a prominent theme in the literature I examined. In the literature review, I drew upon several authors who charted the mechanics and grammar of debates (Swierstra and Rip, 2007, p. 3) or the thinning of debate through the rationalisation of discussion as substantive arguments in the discussion were diminished (Evans, 2002). Other authors outlined how debates in embryology have become less heterogeneous due to the formalisation of institutional practices in bioethics (Evans, 2002; Hurlbut, 2017).

A further essential claim I synthesised from the literature review was that discussions of emerging biotechnologies are in some way limited. Authors pointed out that debates on emerging biotechnologies in the UK context have lacked nuance (Haimes and Taylor, 2017; Baylis, 2017), have been of poor quality (Mulkay 1997), or have omitted important details (Herbrand, 2022). It is clear that there is space for hGGE debates to "improve" (Evans, 2020, p. 133), and although I remain neutral on whether I consider hGGE to be ethically permissible, I do think it is vitally important that there is high-quality debate on the ethics of hGGE.

CHAPTER FOUR: METHODOLOGY

This chapter represents a reflection on the process of data collection and analysis, from my initial aims and questions to the research results. In this chapter I describe the methods through which I generated my empirical data and justify the decision to use elite semi-structured interviews and non-participant observation as my methods of data collection and how this data collection was scaffolded by analysis of key documents that have shaped the debate. I explain how I defined and recruited a sample of 'hybrid elites' (Desmond, 2004) for the study, selected conferences as data collection sites, and identified relevant documents to support my research.

I have chosen to focus my research on hGGE for three reasons. Firstly, it would not be feasible, either in terms of timing or with the funds available to examine the UK genome-editing debate in its entirety, mostly because different statutory bodies oversee different applications of genome-editing. Secondly, my research interest lies in the ethical questions, social processes and rhetoric raised by human applications of germline editing. Thirdly, a change in the law would be required for clinical applications of hGGE to be permitted and given the previous liberalisation of embryo policy in the UK, I was interested in studying the UK hGGE debates to see if they would follow similar patterns to previous debates, such as the UK debate on MRTs.

I focused on the UK as my site of research due to its unique legislative context that is both highly permissive but also highly regulated. The research took place between 2015 and 2022 and I interviewed 18 informants and attended six events. The majority of these events I attended for non-participant observation were run by the Progress Educational Trust, an influential pro-science organisation in the debate, but I also attended events by the Nuffield Council on Bioethics and the Royal Society. For my interviews, I sampled hybrid elites, focusing on people who had been

speakers at the conferences I attended. I also sampled a range of documents that were analysed and used, where relevant, to supplement interview and non-participant observation data.

The chapter addresses how interview transcripts were produced and analysed as well as clarifying that although the topic of the research is on the UK hGGE debate, while I do not take a normative stance on whether the use of hGGE would be ethical, I do take a normative stance that up to this point the ethical discussion has not been robust enough to determine whether or not the clinical application of hGGE would be ethical. I conclude by discussing research ethics and present a section on reflexivity where I consider how my positionality as a researcher has impacted the study.

4.1 Aims, objectives, and research questions

At the start of my research project, I set out a specific aim for the research to better understand the debates on hGGE in the UK context. Although my research objectives and questions have changed and evolved, the aim of my research has remained the same. The initial objective of my study was to analyse experts' views of hGGE within the broader context of messages they draw from, conveyed through their political, regulatory, and academic discourse. This project also aimed to raise some reflexive questions about the social scientist's role in debates concerning NEST, following on from work that Haimes has produced in this area (2002).

I began my research project intending to address three research questions, from which I have identified several sub-questions. The research questions that guided the study were:

1. Who are the key actors and organisations that have participated in these debates (bioethicists, scientists, policy experts, etc.)?

    a. How do they describe the hGGE debate in the UK?

2. What are the spaces in which these debates are conducted (labs, conferences, advisory councils, etc.)?

    a. Who can access these spaces?

    b. Who can speak in these spaces?

    c. Does anyone control who can access and who can speak in these spaces?

    d. Are there written documents that arise from these spaces, and how do they impact the hGGE debate?

3. How do key stakeholders understand and use language and discourse in UK hGGE debates?

    a. What are the similarities and differences between the hGGE debate and other UK debates on emerging biotechnologies?

These research questions guided and shaped my research. I was able to gain insight into some more than others, for example, although I could ask interviewees about access, I could not identify those excluded from the debate by virtue of their exclusion. As a result, I became interested in additional and related questions as my interviews, and non-participant observations progressed. For example, my research questions do not contain any questions about what types of ethical reasoning actors employ during debates; however, a substantial section of my findings explores the role of consequentialist narratives in the UK hGGE debate. As such, my research questions promoted my data, but my data prompted my findings, on occasion producing unexpected results.

4.2 Rationale for research

My interest in how elite stakeholders understand and use particular language and discourse in the UK debate on hGGE, and why, prompted a qualitative approach to data collection. I sought to capture the complexity of the influencing landscape and analyse the discourses stakeholders drew upon in the debate. Additionally, I was interested to see if the discourses I observed at conferences and during interviews were translated into policy documents on hGGE. For this reason, I chose to combine hybrid elite interviews, and non-participant observations at conferences as my data collection methods. These methods of data collected were then scaffolded by quotes and insights from key documents that have shaped the debate. I decided that the study's temporal scope needed to commence after the ratification of the HFE (Mitochondrial Donation) Regulations 2015 (March 2015) but before the announcement of Kathy Niakan's HFEA licence in February 2016. The period in between these two events represents a transition period between the MRTs and hGGE debates in the UK (as noted by (Stephens and Dimond, 2016)). I therefore chose December 2015 as the start point for the research because it falls within this transition period. Another factor in this decision was that the 1st- 3rd of December 2015 marked the inaugural meeting of the International Summit on Human Gene-editing (Olson et al., 2016) and on the 9th of December 2015 the Progress Educational Trust held their annual conference, which focused on human germline modification (which I attended). Most hybrid elite interviews were completed in 2019, and all data collection concluded in 2021 after all avenues for interviews were exhausted, and there were no imminent events or publication of new documents on the horizon.

Why focus on the UK context?

I chose the UK as a site of exploration due to the jurisdiction's unique legal and regulatory framework. As I discussed in my background chapter (Chapter Two), the UK has been the first

country to regulate MRTs for clinical application, and the first country to regulate the use of genome-editing in human embryos. The UK has a unique legislative context that is permissive but highly regulated. The HFEA is integral to this unusual regulatory context, in their regulation of ARTs and embryology specifically, but also in the historical examples of where the HFEA has licenced activities beyond the legal letter of the law. As well as the regulatory context in the UK, the jurisdiction also has a reputation as a 'world leader' in the regulation of ARTs and embryo research. Furthermore, my literature review (Chapter Three) has yielded insight into how the UK's unique biomedical culture (Felt and Müller, 2011; Stephens and Dimond, 2016) is bound up in the UK's dominance in the field of ARTs.

For the purposes of my research, the UK was the ideal site for research into the hGGE debate, previous research has highlighted the centrality of UK approaches in previous biotechnology debates (see (Dimond and Stephens, 2018; Mulkay, 1997)), and key stakeholders from the UK hGGE debate have been influential in shaping global debates on genome-editing. For example, Professor Robin Lovell-Badge (of the Francis Crick Institute and the Royal Society) has chaired a number of sessions at the International Summits on Human Gene-editing. Moreover, based on previous examples, where the UK was the first to perform IVF and PGD, to regulate MRTs, and licence genome-editing in human embryos and therefore, the UK has the potential to be the first country to regulate hGGE also.

Why focus on hybrid elites?

All research will have a different set of stakeholders whose interests, experiences, and expertise make them a vital source of information. My research draws upon various outputs, such as documents and conference presentations from a critical group of stakeholders whose interest and influence shapes the UK debate on hGGE. I will explain briefly here why I have decided to focus

on the 'perspectives of the powerful' (Beynon-Jones, 2009). Other perspectives on this debate might be members of the public or those who suffer from genetic diseases that have the potential to be cured by hGGE. The lack of robust public debate opportunities raises challenges for a research project aiming to better understand the UK hGGE debate.

Although I understand the importance of public representation and patient advocacy in debates regarding new technologies, there were two reasons I decided to focus on understanding the UK hGGE debate through the lens of the influence that hybrid elites have on the debate. Firstly, the early stage of the public genome-editing debate in the UK means that there is very little data on how publics have been involved in the debate. Secondly, the interest of this research is how the UK conducts debates around new and emerging biotechnologies more generally, and it builds upon a tradition of academic work that charts the development of these debates. For better or worse, this literature shows that hybrid elites in the agora have traditionally conducted and contributed to these debates, to the exclusion of non-elites. Where the patients and publics have been consulted, patients have been used as 'political capital' (Dimond and Stephens, 2018, p. 96), and publics have been consulted out of a perceived need to convince them that certain research practices should not be banned (Williams and Gajevic, 2013, p. 511). As a result, I chose to focus on the perspectives of the hybrid elite stakeholders in debate.

Where the ethics of a new reproductive or genetic technology are debated, patient voices are generally introduced into debates at a late stage, for example, before a parliamentary debate. The time to 'bring the public into a debate' is a great source of concern for some institutions, by "[…] engaging the public too soon may pander to hype and entrench negative attitudes; equally there is a concern that failing to engage early will leave the field open to misinformed speculation" (Nuffield Council on Bioethics and Sciencewise, 2016, p. 3). Moreover, Joan Haran's critical

perspective of the Science Media Centre's (SMC) role in the UK's animal-human hybrid embryos debate captures how elite institutions are integral to enrolling publics. Haran criticises the structural role of the SMC in the animal-human hybrid debate, arguing that the SMC's "[…] unashamedly pro-science advocacy" (2012, p. 254) prohibited two-way public orientated approaches to science communication (2012, p. 241). Therefore, it is essential that there is research that focuses on elites and elite institutions and that can show the impact of having *only* these voices in debate.

The most comprehensive public engagement exercise has been conducted by Genetic Alliance UK and the Progress Educational Trust (PET), where the primary focus of this activity was to gather evidence on how to communicate genome-editing to the general public in the future (2017). I would argue, therefore, that another reason for why I have chosen to focus on hybrid elites, and institutions, is because they are currently priming the UK hGGE debate ahead of communicating it to the public. As a result, it is vital to collect data from elites and elite institutions, not only because they are currently the primary actors participating in the debate, but also to better understand strategies for how the debate is to be communicated to publics when the 'policy moment' arrives.

4.3 Research design

My research employs a multi-method approach to address the study's aims. This section outlines my various theoretical and practical approaches for addressing my research questions, aims and objectives. I will detail the ontological and epistemological considerations of my approach and indicate how my research questions fit my research design. I will also give an overview of how research methods were selected to best address my research questions and give an overview of the sampling strategies I employed during my research.

Central to the interpretive framework is the inseparability of understanding from interpretation (Given, 2008), and therefore 'understanding' generated from interpretive research is based on the ontological, epistemological, and methodological beliefs of the researcher. As a result, it is imperative that the researcher disclose these beliefs, both to situate the researcher within the research, but also to help uncover the underlying assumptions that have contributed to the researcher's interpretation of the data. One of the ways I have been sure to disclose my beliefs is around my own normative views around my work. I have outlined in this thesis that my position is that while I do not take a normative stance on whether the use of hGGE would be ethical, I take a normative stance that up to this point the ethical discussion has not been robust enough to determine whether the clinical application of hGGE would be ethical.

Social science research methods generally fall into one of two categories, these are the empirical-analytical and the interpretive group (Wellington and Szczerbinski, 2007, p. 18), my research falls into the latter. Where empirical-analytical approaches emphasise the creation of objective knowledge, the focus of interpretive methods position the meaning-making practices of human actors at the centre of scientific explanation (Yanow and Schwartz-Shea, 2006, p. 12). Moreover, interpretive research focuses on understanding phenomena in a holistic way, by showing how the meaning-making practices amongst actors can be used to generate observable outcomes. Interpretive research aims to generate subjective knowledge claims, expressing social reality as the "[…] product of its inhabitants" (Blaikie, 2009, p. 99). This approach to social reality is integral to my exploration of how different hybrid elites in the debate employ different discourses of social reality surrounding these technologies and will help uncover themes around the mutual shaping of technology and the social world (Bijker, 2012), and how meaning surrounding new technologies is interpreted by actors within the context of the society in which they live.

The interpretive approach underpins my establishing of how different actors in the hGGE debates employ various discourses, and therefore different social realities, with respect to genome-editing. This enterprise is broadly constructivist (as I discuss below) and therefore an interpretive method will help uncover themes around the mutual shaping of technology and the social world (Bijker, 2012). A criticism of the interpretivist research method is that its relativistic nature means that it can never determine the legitimacy of one knowledge claim over another (Hughes and Sharrock, 1997). However, my research is not interested in any kind of *objective* legitimacy in actor's viewpoints, rather, my focus lies in what arguments different actors in debate find compelling and legitimate, and why I discard the empirical-analytical approach.

I take an idealist approach to my research ontology. In the context of interpretive research idealist ontologies maintain that social reality is comprised of shared interpretations, produced, and reproduced by actors going about daily life (Blaikie, 2009, p. 93). The idealist research ontology deals with the way in which human's shape society (Macionis and Plummer, 2005) and new technologies. Idealist ontologies are often utilised in STS research, (see (Barnes, 1983) for example) and represent an important distinction in my research, specifically, that my study examines normative claims without taking a normative stance on the technologies themselves. Given that idealist approaches emphasise that there is no single reality, but rather there are multiple realities based on one's interpretation (Smith, 1983) idealist research resists normative conclusions, preferring to expose complexity. An interpretivist research paradigm fits with an idealist research ontology because they both seek to understand the way in which actors shape, construct and produce their social worlds.

As I have previously stated, my research examines how normativity and new and emerging technologies are created and mobilised by hybrid elites in the debate. As such, my epistemological

approach that forms the foundation of the research is constructivist. Constructivist epistemologies assert a view of human beings as actively constructing knowledge, in their own subjective realities and in contextually specific ways (Coghlan and Brydon-Miller, 2014), and seek to understand how actors participate in the construction of a perceived social reality (Gergen, 1985). Constructivist approaches in research encourage researchers to reflect on the assumptions that underpin their research, and to consider other ways of interpreting any results. Consequently, the results of my study are not only influenced by my own theory-laden observations as a researcher, but they are also to be seen as negotiable constructs rather than an objective reflection of the social reality studied.

Both idealist ontologies and constructivist epistemologies sit within a post-positivist way of understanding social realities and therefore effectively contribute to interpretative research paradigms. Moreover, my ontological and epistemological approaches emphasise the role of the researcher in the research, and the role interpretations on the part of the researcher play in shaping the findings of the research. The subjectivity of the interpretive paradigm compliments the qualitative methodology selected for the research. Qualitative methodologies do not seek to test hypotheses to generate reproducible and objective knowledge claims, rather they collect and analyse non-numerical data. Therefore, interpretivist rejections of objectivity further justify the qualitative approach to data collection and analysis of my study, rendering criticisms of qualitative approaches, for example smaller sample sizes, less powerful in the context of my interpretive approach.

Interdisciplinarity in research ties together ideas from different academic traditions and transcends established disciplinary boundaries. It is important to identify the research I am doing as interdisciplinary, because the focus of the research is on the hGGE debate, with specific emphasis

on the rhetorical features of the debate. My work combines disciplinary approaches from science studies, sociology, sociolinguistics, and philosophy. Interdisciplinary research has been described as 'problem centred' (Palmer, 2001, p. 64) and is frequently used by academics to address controversial, emerging areas of research (Kincheloe, 2001), such as new technologies. This approach is particularly beneficial when examining new epochs of knowledge, making it an appropriate choice for my research design.

4.4 Research methods

I chose to use a multi-method approach, combining hybrid elite interviews and non-participant observations at conferences for my research methods. These research methods were supplemented by quotes from key documents that were relevant to the debate. In the context of qualitative research, triangulation refers to the use of multiple methods or data sources to develop a comprehensive understanding of phenomena (Heale and Forbes, 2013). Triangulation is a practical approach to data collection because some methods, such as document analysis, are cost-effective and have strong data permanence, whereas other methods, such as interviews, allow the researcher to collect rich, qualitative data (Flick et al., 2004).

A version of combining methods that involves as the need for them arises from them is referred to as 'bricolage' (Kincheloe, 2011, 2001). The purpose of bricolage in research is to reflect the complexity of the lived world. Kinchloe describes how bricoleurs reject realism in research and instead focus on "[…] the clarification of his or her position in the web of reality and the social locations of other researchers and the ways they shape the production and interpretation of knowledge." (2011, p. 324). As a result, bricoleurs tend to eschew disciplinarity in favour of more holistic, inclusive, and eclectic models (Kincheloe, 2011, p. 347) see **Table 1** for an overview of methods and data collected.

My decision to collect my data using a bricolage approach was prompted by an understanding that each data collection method would support and enhance the other methods of collection (Flick et al., 2004, sec. 4.6). At the beginning of my PhD research, I considered other data collection methods, including more traditional STS approaches to understanding how scientific work is conducted, for example, a lab ethnography (Latour and Woolgar, 1986). However, after establishing that my research questions were more firmly rooted in how stakeholders (including scientists) *influence* policy debates — and after completing a short scoping study in a lab environment — I chose to discard lab ethnography as an avenue for data collection. I discuss my reasons for this in Section 4.4.1.

TABLE 1: OVERVIEW OF RESEARCH METHODS AND DATA COLLECTED

Research Method	Data Collected
(1) Hybrid elite **interviews**	**18 transcripts from semi-structured in-depth interviews**, lasting between 30 and 90 minutes each
(2) Non-participant observation at conferences	**20 hours of non-participant observation** (observational notes), five hours of digital recordings and 'material sources' derived from attendance at 6 national conferences
(3) Supplementary information from key **documents**	**50 documents** including policy documents, reports, consultation responses, statements, press releases, blog posts, articles, and transcripts from parliamentary debates

By using the methods outlined in **Table 1**, I was able to ask in-depth questions, and to probe and clarify the answers. At the start of the interview recruitment, I intended for the documentary analysis I had already completed to inform and bolster the interviews, both by guiding my interview schedules, honing my questions, and informing the sampling. It was my expectation that I would

be able to better understand the finer nuances of the debate from the elite stakeholders' perspectives given my background documentary analysis. However, what I did not expect was that after I had conducted the interviews, I became interested to see if the narratives I found in the interviews were also in the documents that I had analysed, prompting another phase of documentary analysis. For example, after I had conducted a couple of hybrid elite interviews, I found that informants regularly cited 'molecular scissors' as a metaphor that featured heavily in the debate. I then scanned for this metaphor in the grey literature of the policy documents. I found that the metaphor featured in a number of these documents (see NCoB (2016), NCoB (2018) and The Parliamentary Office of Science and Technology (2016)[32]. As a result, the claim of my informants (that the 'molecular scissors' metaphor was a central metaphor in the debate) was supported by the documents.

As well as collecting documents and conducting interviews I also conducted non-participant observation at conferences and other spaces — that I came to understand as agorae — where hybrid stakeholders convened to share and exchange ideas. This method of data collection had some drawbacks, attending conferences was less cost-effective when compared to documentary analysis and I was tasked with identifying conferences for data collection that might yield important insight and that were accessible. Where possible, I was able to observe emerging debates on hGGE in workshops and conferences, where attendance was not possible, due to the space being closed, I included the records of these events into the documentary analysis. One of the benefits of conference attendance was that it allowed me to keep up to date with new advances in genome-editing; they also provided an opportunity to observe hybrid elites and their interactions in the agora. Combined with interviews and documentary analysis, non-participant observation also

[32] The 2016 POST Note even included an image of scissors cutting a drawing of DNA on paper.

allowed me to better understand the social networks between stakeholders and gave me insight into potential hybrid elites I might sample for interviews.

4.4.1 Participant and non-participant observation

Scoping study: participant observation in the lab setting

I have chosen this point to take a break from outlining my methods and discuss how I explored an alternative approach to my research that I decided not to pursue. I had initially considered that the lab might be a good site for data collection. This intermission describes my experiences of taking a two-week genetic engineering course to scope out how I might better understand policy discussion in the UK hGGE debate by understanding scientific discourses and practices around genome-editing technologies.

The purpose of taking this course was to better understand the materiality of genome-editing, how scientists visualise and discuss genome-editing, and what type of data a lab-based ethnography might yield. Although after this short scoping study, I concluded that pursuing the lab as a site of empirical research would not be the best way to better understand policy discussions around hGGE. I did find that my time spent using genome-editing inside the lab shaped my thinking around how genome-editing technologies are constructed and communicated by elite stakeholders outside of the lab.

STS perspectives on lab-based research

The laboratory environment has special significance to STS research, as lab ethnography has helped shape the field, particularly in the constructivist tradition (Latour and Woolgar, 2013). The focus of STS has since centred on the lab, and rich empirical research has followed. Finally, the aim of the scoping study was not to go from a position of 'no expertise' to gain 'interactional' or

'contributory' expertise as described by Harry Collins and Robert Evans (2002), but rather to gain insight into scientific practice and discourses around genome-editing in the lab.

During my time in the lab, I gained valuable skills and insights, for example how to actually *do* genome-editing, and how to test to understand whether my experiments had been successful. I learned a great deal about how the scientists I met communicated in the lab space. Finally, I grew to understand that disciplinary boundaries played more important to the scientists I met than I had anticipated they would be, and that my presence - as a 'non-scientist'[33] in a lab - fielded a number of valuable conversations which made me reflect on my positionality in my own research.

As a way of learning more about genetic engineering and the practical approaches routinely used by scientists in the field, I attended a Practical Genetic Engineering and Genome Analysis course arranged by the School of Biological Sciences Graduate Training Programme at the University of Edinburgh. This intensive training course ran for two weeks on the King's Buildings Campus at the university, led by Professor Ian Chambers, Group Leader (Embryonic Stem Cell Biology) at the Centre for Regenerative Medicine and Professor of Pluripotent Stem Cell Biology.

This course gave me insight into scientific practice surrounding the techniques and practical insight into their application. The primary factor motivating me to participate in this training course was allowing me to conduct CRISPR first-hand in a lab setting. Other reasons I undertook the course included testing out what sort of data a lab ethnography might yield and learning more about the theory and development of genetic engineering techniques.

[33] During my scoping project I identified myself as a social scientist, however, most in the group did not consider me a 'science' student. There are many likely reasons for this, a few reasons may be: I have no scientific training (my undergraduate training is in philosophy), science students at the University of Edinburgh are broadly based on campuses outskirts or the outside of the city, whereas I was based centrally, finally, the nature of my research could not be answered through the techniques I learned during the course, which others on the course pointed to as a way in which my research was non-scientific.

My experiences throughout this scoping study prompted me to exclude lab ethnography as a method. This was because I felt it was not the best tool to answer my research questions - which are rooted in how elite stakeholders conduct policy conversations around genome-editing technologies. These policy discussions were not a feature of the lab I visited, and I concluded that conferences would serve as a better site of data collection moving forward. Although the scoping study ruled out lab ethnography as an avenue for empirical research, the two weeks I spent on the genetic engineering course have shaped my research in meaningful ways. Firstly, my experiences in the lab gave me an understanding of techniques and better insight into practice. By better understanding the techniques, I appreciated what metaphors I had identified from the policy debate were trying to represent. Moreover, by observing how scientists talk about genome-editing, I understood *why* metaphors were needed beyond the lab space, especially given the invisibility of the techniques, given its microscopic nature and the tiny amounts of reagents used.

One critical insight from the scoping study was that scientists are not using metaphors in the lab. Because, in their discourse related to their practice, they did not have to use metaphors; they knew what one another was referring to, without the need for imageries. However, I found that the scientists used metaphors when explaining the techniques to me, a social scientist with no previous lab background. This insight shaped my decisions around data collection because I surmised that if I were to explore how these technologies are constructed through discourse, it would be more fruitful to explore spaces other than the lab.

Another insight from conducting genome-editing in a lab setting was that it was very complicated to complete. Even experienced students on the course found the process complex. This observation jarred with my previous understanding of genome-editing (through policy documents) that described the techniques as simple. When I asked scientists on the course why CRISPR-Cas9

is often considered simple, they informed me that it was easier to use than previous technologies, such as ZFM or TALENs. However, this did not mean that CRISPR-Cas9 was uncomplicated to use, but rather that it was not *as* challenging to use as its predecessors.

My time working in the lab foregrounded an idea that eventually would become a key theme I saw in the hGGE debate and the basis of an empirical chapter in my thesis. Boundaries were ubiquitous in the lab. There were clear rules and boundaries for lab practice, but there were also boundaries around interpreting the success of experiments. Finally, there were disciplinary boundaries considered highly relevant by other students on the course. This idea highlighted that boundaries - and their construction - would be important to this study, whether they be the hard-line academic tradition boundaries I saw in the lab group or the socially constructed, flexible boundaries observed from the STS perspective.

It is logical to assume that laboratory work brings about policy discussion. For example, genome-editing was not being used in laboratories. There would be little point in having an applied policy discussion about hGGE. So, it was worth my time in the lab to observe that these ethical and policy discussions were not present there. Finally, insights gained from my time in the lab, for example, the visualisations of techniques, have had lasting impacts on how I have conceptualised hGGE in my own research

Data collection from the agorae: non-participant observation at conferences

While I did not decide to pursue that method of participant observations in the laboratory setting, I did decide instead to conduct non-participant observation at conferences. Non-participant observation is an unobtrusive research method, where the researcher tries to understand the world by observing actors' actions, relationships, and interactions (Ciesielska et al., 2018). Whereas participant observation involves spending time with communities and working with them as they

go about their daily lives in order to understand them (Laurier, 2016) For my non-participant observation I attended a number of events between 2015 and 2022 in order to collect data using non-participant observation. These conferences are detailed below in the sampling section (see Table 1). This section will explore how I sampled conference events, collected, reduced, and analysed the data before reflection on any ethical implications associated with this work. I will close the section by outlining how my positionality as a researcher may have impacted my non-participant observation, but also my research more generally.

Traditionally, STS has recognised the laboratory and the clinic as commendable sites of knowledge production (Sismondo, 2010). However, as traditional models of STS scholarship continue to recognise and acknowledge the entanglement of science with other spheres of knowledge and indeed the hybrid forms and co-production of scientific knowledge (Hackett et al., 2007; Jasanoff and Jasanoff, 2004), new sites of knowledge have become increasingly germane for STS enquiry. Furthermore, in NEST-ethics, the study of conferences has shaped academic thought on how technologies are debated by stakeholders (Swierstra and Rip, 2007).

"Conferences are a ubiquitous part of political, commercial and academic life, but as such commonplace events, are often overlooked as objects for study" (Craggs and Mahony, 2014). The conference's status as an under researched space (Stephens and Dimond, 2016) has contributed to the enigma of what constitutes a conference. Generally, a conference is a meeting, which can either be periodic or one-off gatherings of people, most commonly experts and those in positions of power, to produce knowledge or agreement on particular topics (Craggs and Mahony, 2014). González-Santos and Dimond have also pointed out: "They (conferences) are also sites where relationships are forged, statutes and roles are distributed, reputations are fought and established, and where the history and future of disciplines are enacted, remembered and planned." (2015).

Hence, conferences are also an important space where discipline epistemologies are up for debate and where who holds power in a given discipline is established.

Non-participant observation sites were also sampled purposively, and six conferences were attended. The criterion for conference attendance was that it was based in the UK, that the conference contained a discussion on hGGE and that some of the elite stakeholders identified from the document analysis were in attendance. The data collected includes 20 hours of non-participant observation (observational notes), five hours of digital recordings and 'material sources' produced by the conference. These material sources have been described as a 'treasure trove' of data (González-Santos and Dimond, 2015) and include proceedings, abstracts, advertisements, media coverage, agendas, and lists of speakers, and I used them to supplement notes and recordings, locating these events within a broader context. For example, PET produces excellent summaries of their events, which were used to contextualise my findings from the non-participant observation conducted at these events.

Sampling

Conference attendance allowed me to collect the data while events were unfolding in real-time and informed the sampling criteria of the documents and elite stakeholder interviews. I attended a number of events between 2015 and 2022 in order to collect data using non-participant observation (please see Table 1 below for details of these events). Conferences were selected according to the sampling criteria which dictated that conferences must take place in the UK; they must have an element that covers hGGE and they should have hybrid elites included in their roster of speakers.

Sampling will invariably impact data collection, and as a result it is my role as a researcher to be transparent about the strengths and limitations of my findings. An important way my sampling has

shaped my findings is that most of the events I attended were organised by pro-science organisations (PET and the Royal Society), the NCoB event is the exception. As a result, my sampling will have impacted my data. In my case, the data will be skewed towards pro-science voices and hGGE proponents in the debate. However, I had to sample conferences from the events that were available, and there were no equivalent events run by other organisations that were not pro-science (other than the NCoB event). As a result of this limitation of my sampling, I will ensure that I am transparent about the pro-science skew of the data in my discussion chapters.

TABLE 2: EVENTS ATTENDED FOR NON-PARTICIPANT OBSERVATION (2015 - 2022)

Event title	Event organiser	Location	Example speakers
(1) Three-Person IVF to Genome-editing The Science and Ethics of Genome-Editing (2015)	**Progress Educational Trust**	**London**	Mark Walport, John Harris, Calum Mackellar
(2) *Genome-editing: An Ethical Review*: Launch Event (2016)	**The Nuffield Council on Bioethics**	**London**	Hugh Whittall, Richard Ashcroft
(3) Crossing Frontiers: Moving the Boundaries of Human Reproduction (2017)	**Progress Educational Trust**	**London**	Sally Cheshire, Sarah Rappaport, César Palacios-González, Andy Greenfield, Sandy Starr
(4) The future of your genetic health (2018)	**The Royal Society**	**London**	Sarah Chan, Robin Lovell-Badge, Andrea Nemeth
(5) Make do or amend: Should we update UK Fertility and embryo law? (2018)	**Progress Educational Trust**	**London**	Sally Cheshire, John Harris, Fiona Fox, Calum MacKellar, Kathy Niakan
(6) Germline in the sand: where should we draw the boundaries for	**Progress Educational Trust**		

genome-editing? (2019)	**and the Scottish Government**	**Edinburgh**	Sandy Starr, Bruce Whitelaw, Gillan Wright, Nevia Haites, Calum Mackellar, Sarah Chan
(7) Changing the Human Genome: What Next for Germline Genome-editing? (2021)	**Progress Educational Trust**	**Virtual**	Robin Lovell-Badge, Norah Fogarty, Peter Mills
(8) Editing the Human Genome: Where Are We Now? What Happens Next? (2022)	**Progress Educational Trust**	**Virtual**	Robin Lovell-Badge, Kathy Niakan, Hank Greely, Nick Meade

I have chosen the PET annual conference as an essential example of the agora. The annual PET conference takes place in early December, dating back to 2003. These conferences were held at the University College London Institute for Child Health at Great Ormond Street Hospital in Bloomsbury, London. Exceptions to this are the 2007 and 2008 conferences held at Clifford Chance law firm in London (one of the primary funders of this conference from 2007 to 2009). The 2017 edition of the conference was held at the Amnesty International building in Shoreditch, London, supported by the Anne McLaren Memorial Trust Fund and the Edwards and Steptoe Research Trust Fund, and by the ART Institute of Washington, Ferring Pharmaceuticals, the London Women's Clinic and Vitrolife.

Dimond and Stephens identified PET as a crucial site for transitional space, and community performance (2016) and interviewees from my research consistently cited the annual conference as a space for exchanging ideas on new and emerging biotechnologies. As well as the conferences themselves, PET produces a number of material sources, such as conference texts and outputs.

These material sources make PET an effective exemplification of the agora as they represent the stone tablets produced by the original Hellenic society.

While the annual PET conference captures the ideal of the agora (interviewees consistently cited it as an opportunity for elite stakeholders in the UK biotechnology sphere to come together and exchange ideas), the conference also illustrates the inequality of the agora as a conceptual space. Although the annual PET conference is open to all (including members of the public), the event is very selective in the speakers it invites to present. These speakers are generally high-profile, and the majority of the speakers stem from a biomedical science background. Moreover, while the topics of the annual conference can change year-to-year conference attendees and speakers remain similar, the formulation of which speakers speak when is consistent from year to year.

PET is a pro-science organisation; therefore, its annual conference aims to promote the responsible use of emerging science and technology. Therefore, the majority of the speakers at PET conferences are scientists. Other actors such as social scientists, policymakers, politicians, philosophers, or clergy generally appear on panels, rather than as speakers, to stimulate debate around the conference's topic. Organisers generally cite these non-scientific speakers as 'widening debate' (Stephens and Dimond, 2016).

Another way in which the organisers subtly shape the topics of discussion is that a moderator gatekeeps audience questions. Stephens and Dimond describe how the conference performs a "staging open debate" (2016), reflecting on how practices such as invited speakers and questions are often ignored or treated selectively shape the event. While these practices are relatively commonplace at conferences, conferences are performative spaces (Ford and Harding, 2008). However, STS literature supports the claim that they are also significant 'places of performance' in the social production of knowledge (Henke & Gieryn, 2008; Wainwright & Williams, 2008).

While my research acknowledges the roles of the arena and the observatory, the agora will be the conceptual space I focus on in my research. To better understand this space and how it works, I use non-participant observation at conference events, such as the annual PET conference, as a research method. My empirical chapters will focus on how elite stakeholders produce and mobilise key argumentative patterns in the agorae of the hGGE debates. The type of agora I will focus on specifically is conferences because conferences have widely been acknowledged in STS research as sites where the boundaries of epistemological communities are established, erased and redrawn (Craggs and Mahony, 2014). Moreover, this agora can give rise to the establishment of narratives and boundaries — which I argue in Chapter Seven — may contribute to moral shifts.

Data collection

Where sessions were not conducive to note-taking (e.g. fast paced-discussion sections), digital recordings were made in order to support observational notes taken and conference materials, such as agendas, were retained. These recordings were later destroyed.

Data reduction and analysis

Observational notes and conference materials into a computer-assisted qualitative data analysis software (CAQDAS) program (NVivo 11) for data reduction and analysis. Coding aims to enable outcomes that "[…] "make connections, identify patterns and contribute to greater understanding" (Glesne, 2016, p. 146). I chose to use a CAQDAS programme to assist in data reduction and analysis. CAQDAs represents an important progression in fields that use qualitative data analysis to conduct empirical work. CAQDAS programs can search, organise, categorise, and annotate textual and visual data; and can be employed by researchers to help bridge the gap between qualitative and quantitative research, with researchers able to analyse more data more efficiently than ever.

Within the context of qualitative research, the computer software was characterised by Gerson as "[…] a tireless endlessly efficient clerk who never forgets" (Gerson, 1984 cited in Lee and Fielding, 1991). The computer not only provides researchers with the tools to analyse more, more accurately, it also "[…] makes it easier to find deviant cases or extract small but significant pieces of information buried within a larger mass of material" (Conrad and Reinharz, 1984). I used CAQDAS to search for themes, such as boundaries and metaphors, across my observational notes for different events. This was helpful in my thematic analysis as I could see if the metaphors or boundaries changed over time. This approach was particularly important for my identification of the 'lifecycle' of the boundary, that I discuss in Chapter Six.

In my experience, the biggest asset of CAQDAS was that the mechanistic effect of importing the data had a sanitising effect, separating the data collection from the reduction and analysis. This point is reiterated by Lee and Fielding, who stated a benefit of CAQDAS was that "The […] fieldwork should become less likely to get in the way of the analytic process" (Lee and Fielding, 1991). This was particularly helpful in the context of my research because it meant that I could return to my observational data following my interviews and recontextualise my observations in the context of my interviews and search for new themes. As such, I was able to use these two research methods to reinforce one another.

Ethics

In advance of data collection, a thorough review was conducted to reflect on the ethical implications of conducting this project, aided by the University of Edinburgh's School of Social and Political Science guidelines and the ESRC's Framework for Research Ethics. I completed the self-assessment Level One ethics form, which indicated that the project's research design was sufficient to cover any unanticipated issues that arose during the research.

One ethical issue raised by the non-participant observation was whether I should declare the conferences I attended as a research site to organisers and attendees prior or during the event. I decided where events were open to the public, my research did not need to be disclosed as I was in a 'public space'. One event (*Genome-editing: An Ethical Review*: Launch Event (2016)) was not open to the public and I had to ask permission to attend. In this case I disclosed my intentions to use the event as a research site. Given that my attendance was granted, I proceeded as if this were a public space.

Non-participant observation and researcher positionality

As with any research design, the decisions I have made in practice have allowed for and created limitations on the data I have collected. Moreover, choices made during the research design phase of the project will impact on the transferability of the knowledge produced. I have aimed to highlight my reflexive decision-making throughout this chapter, in describing how methodological choices have shaped both the collection and the interpretation of my data.

I imagine that the number of empirical research projects that truly reflect researchers' original intentions is vanishingly small, and that high quality social research requires researchers to be cognisant of, and responsive to, change. Conducting research in an interpretivist paradigm often requires social scientists to put ideals aside and to best interpret and represent the findings from the data they have, through the lens created by the researcher's own positionality. So while my research has not always gone to plan, I have found that I have been able to embody this interpretivist paradigm.

Positionality describes an individual's worldview and the position they adopt during the process of their research (Holmes, 2020). As such, it is important for researchers to set out "[...] where

they are coming from' (Holmes, 2020: p. 1) when they are conducting research. I have set out in Section 4.2 of this chapter the epistemological and ontological assumptions that have underpinned my research. This positionality within my research has been informed by my approach to reflexivity.

Reflexivity informs positionality (Holmes, 2020) as positionality requires the researcher to engage in self-reflection during the research to reflect on how their prior beliefs have shaped their research and findings. For example, before I studied STS, my academic background was in philosophy. As a result, at conferences I was more engaged in the panel discussions that discussed the ethics of hGGE. Had my background been in embryology I might have been more engaged with the presentations by scientific speakers who gave up to date reflections on their research. As a result, my notes and observations of the ethics sections of the conferences I attended are richer and appear more commonly in the thesis. Another aspect of my unconscious influence on my data is that I am interested in the 'debate'. Scientific presentations were generally single speaker, which also meant I found panel discussions more resonant in the context of my research.

Other factors that have shaped my research in a less overt way are my personal characteristics. For example, factors like my (relative) youth and inexperience as a researcher, that I am female, white and from a new affluent worker class background (Savage et al., 2013) are likely to have impacted power dynamics. This was not of concern during the non-participant observation data collection, however during the elite interview setting, for example I might have been taken less seriously than someone who was, male, older (Vähäsantanen and Saarinen, 2013) and with a received pronunciation (Levon et al., 2020). I will discuss my experiences of hybrid elite stakeholders in the next section.

4.4.2 Interviews

One of the ways I chose to focus on understanding the UK hGGE debate is through interviews. For the purposes of my study, I set out to sample 30 interviews, although a number of interviewees were either unavailable or did not reply.

Sampling

Though additional sampling e.g. through snowball sampling I ended up conducting 18 interviews. These interviews were conducted with hybrid elites I had identified through non-participant observation, or by snowball sampling. The sampling of the interviewees was determined using Desmond's conception of 'hybrid elites' described as inhabiting "[…] blurred academic, industrial and political fields" (2004). As I have previously mentioned, the primary justification for choosing to interview elites is pragmatic. I felt that I would be able to collect high-quality data from experts as they have previous experience speaking about hGGE, and because they positioned themselves as spokespersons for their subject areas by volunteering to speak at conferences.

I think those informants who chose to take part were those who were altruistic (and wanted to contribute to a PhD research project when it would likely have little benefit to them) and those who had a point that they wanted to get across. My opinion is that these interviewees would either strongly identify as a proponent or an opponent of genome-editing. As a result, I think my data will be skewed towards a more extreme view either for, or against, the legalisation of hGGE. I think those who chose not to take part may have done so for a number of reasons, for example they may have been unable to make the time commitment.

A further justification is epistemological in nature; this project seeks to understand hybrid elites' experiences, rather than assert any sort of objective truth. As such, knowledge claims will not be

evaluated on their legitimacy. The stakeholders sampled for interviews included scientists working in the area of genome-editing, academics examining the ethics of hGGE and, individuals and representatives of groups actively campaigning for and against further research and regulation of genome-editing in general and hGGE in particular. I also approached a number of individuals and organisations that did not result in an interview[34].

Beyond the sampling criteria — which shaped the composition of the informants I chose to interview (hybrid elite stakeholders) — it was also essential that the informants were knowledgeable about the UK hGGE debate, so that they may provide sufficiently high-quality data. As such I took steps to ensure that these informants were contributing to the existing hGGE debate in the UK. I took two approaches to achieve this, firstly, I attended events where the science, ethics and societal implications of hGGE were debated, such as the 2015 PET conference, and secondly, I read articles, blog posts and reports published by journals and elite institutions (such as the NCoB) to identify other voices.

The drawback of this strategy is that the sampling would skew towards those who were most prominent in the bioethical debates. I addressed this by asking interviewees to identify those who might have different opinions to them in an attempt to identify additional informants (I discuss this strategy further on page 178). By doing so, I was better able to get a cross-section of views from the debate. The final composition of my interviewees included four scientists, four people who worked in the charitable sector, four bioethicists, one philosopher, one futurist, two sociologists and two policy experts.

[34] Sampling had around a 50% success rate.

Informants were selected from elite institutions and were predominantly involved in bioethical debates — either as a function of their role as a bioethicists or sociologists, or as scientists aiming to contribute to the debate by reflecting on the techniques they used in the lab day-to-day in the context of the bioethical debate. This approach to sampling impacted the data collected in two important ways, firstly, the informants sampled had an existing understanding of the societal and ethical implications of hGGE and were actively trying to reflect on these issues as part of their work. The existing knowledge of the debate held by informants meant they were easily able to identify key ethical issues as part of the interview. A surprising finding of this approach was that all of the informants who identified as scientists spoke about their interest in translating their research for public audiences and as such had taken steps to enhance their opportunities for public engagement — for example, by attending media training. Upon reflection, perhaps this was an effect of the sampling strategy whereby those scientists who were most interested in public engagement would be the same who were most likely to contribute to the bioethical debate. However, I think that while this effect would shape the data collected, it also confirms that these scientists would fit the sampling criteria of being hybrid elites in the traditional sense as described by Desmond (2004).

After identifying a definition of the type of elites that I wanted to sample I then performed a purposive sampling of actors who have contributed to the debate that fitted Desmond's definition. Purposive sampling is a non-probability technique that involves identifying key contributors and approaching them for an interview. Purposive sampling is deemed most appropriate for elite interviewing (Tansey, 2007) because it gives the researcher control over the sample, such as the opportunity to include high profile experts.

Non-probability approaches to sampling are limited in the sense that they are subjective, and therefore cannot be representative of the population. However, as I have detailed in my research strategy, the aim of this research is the collection of subjective data and therefore a purposive sampling approach is appropriate. Purposive sampling was then combined with a snowball sampling approach, another type of non-probability sampling, where interviewees provide referrals to recruit samples required for a research study. Snowball sampling or respondent referral is a particularly effective sampling technique in studies where the samples have traits that are rare to find. In the context of the UK hGGE debate, snowball sampling was used to address methodological problems associated with the recruitment of the samples, as opposed to the identification of the sample.

In completing the purposive sampling for the interviews, I drew upon contacts made at conferences to conduct initial sampling. I then used snowball sampling to contact other key actors. It was my aim to get a diverse cross section of opinion during my sampling and therefore while snowball sampling I asked if interviewees could identify those who might have different opinions to them in an attempt to identify future interviewees. It was my intention that in doing so I would avoid sampling interviewees who all had the same opinion and, as a result, create an echo-chamber effect. However, because snowball referrals were often accompanied by an introduction, this was a more effective approach to sampling than approaching actors with a different view spontaneously. It was initially my intention to conduct interviews with around twenty-five participants, however, I found it challenging to recruit interviewees to the study and I was aware that sample saturation cannot ever be truly achieved because each respondent is able to provide different and interesting insight into their experience.

Data collection

18 hybrid elite interviews were conducted between 2019 and 2021. Interviews were conducted one-on-one between myself and the interviewee, predominantly face-to-face, with a minority conducted by telephone. Interviews generally lasted between 30 and 90 minutes, and where permission allowed, I created digital recordings of the interviews due to the high fidelity of this data when compared with interview notes alone. I chose to take a semi-structured approach to my interviews, using a list of questions as a guide (this can be found at Appendix D), but frequently asking follow-up questions that were off topic where I felt this would provide a fuller answer. I found the semi-structured approach worked well, providing both a comprehensive base for interview, while allowing for unexpected, or surprising, data.

Following the data collection, I then transcribed the interview recordings and destroyed the recordings. Interviewees were asked if they wished their quotes to be attributed or preferred their data to be anonymised. Where interviewees requested their quotes be attributed, I re-contacted interviews while this thesis was being finalised, to clarify that they still wished to be identified when quoted and whether they required any edits to be made to their quotations. Where these edits did not undermine the sentiment or content of the original quote, they have been included. Where the edits changed the quote significantly, the quote has been omitted. Finally, the inclusion of a quotation does not imply an endorsement of its content, however, I did use quotes as indicative of themes they served to demonstrate.

Data reduction

As with non-participant observation NVivo 11 was used for data reduction and analysis. During the early phases of my research where I used CAQDAS to analyse preliminary data, I found that one of the disadvantages of the program was that the ease of use incited a tendency towards over-

coding, which was not conducive to data reduction, merely sorting the data into increasingly descriptive categories, rather than reducing it. Therefore, to scale back this over-coding, a step I took was to read imported data over a few times, then begin the process of establishing the best way to conduct data reduction and coding. I did continue to use NVivo 11, but I tried to reduce the density of my coding.

Coding is the strategy that moves data from diffuse and messy texts to organised ideas (Richards and Morse, 2012) and is the primary approach for the process of data reduction in qualitative studies (Gibbs, 2002). Given my interpretivist research paradigm and my interest in the construction of controversial, novel medical technologies, I chose to use open axial coding to identify themes and then coded my data according to these themes. Open axial coding is a tool for data analysis, enabling the researcher to search for new and emerging patterns in the data, despite previous familiarisation with the literature (Timmermans and Taveroy, 2012). This approach gave a good balance because I could identify broad themes efficiently and allow the more nuanced themes to appear over time through the open coding framework using NVivo 11.

The coding of the data was a largely iterative process involving many repeated instances of reading and recoding, reflecting Bong's view that the process of coding is "[…] dissecting one's data into manageable and meaningful analytical units" (2002). During the data reduction, I used a research diary and codebook (created as an NVivo memo) to track the progress of my coding framework as it changed and progressed over time. The decision to use open axial coding to identify themes did have its drawbacks; for example, I fell into the realms of "coding fetishism" (Saldaña, 2015), whereby every section of the data was coded. As a result, my coding density was very high, and the data was not sufficiently reduced. Despite these concerns, after my initial data reduction, I

began to refine my coding framework, and I chose to abstract some of my themes and un-code some data, which aided in more effective data reduction (Nowell et al., 2017).

Data analysis

My research employs an interpretivist approach, meaning that I explore 'sense-making activities' articulated within the data to understand the perceptions and experiences of those involved. Given my interpretivist approach, and my interest in experts' rhetorical contributions to the hGGE debate, following data reduction, I analysed the coded data using Critical Discourse Analysis (CDA). CDA is a data analysis tool commonly used in interdisciplinary, inductive research, and it is used to assess what is meant by language used to describe and explain. The technique employs data analysis:

> […] to systematically explore often opaque relationships of causality and determination between (a) discursive practices, events and texts, and (b) wider social and cultural structures, relations and processes; to investigate how such practices, events and texts arise out of and are ideologically shaped by relations of power and struggles over power (Fairclough and Wodak, 1995, p. 132).

CDA is "[…] a type of discourse analytical research that primarily studies the way social power abuse, dominance, and inequality are enacted, reproduced, and resisted by text and talk in the social and political context." (Van Dijk, 2003). My decision to use CDA was motivated by my interest in deconstructing how actors mobilise dominant discourses surrounding hGGE in the expert sphere in both spoken and written word. This idea is supported by CDA scholars (Van Dijk, 2003; Woak and Meyer, 2009), who state that documents can structure episodes of social interaction. Hence, actors are '[…] recruited into alliances and […] underpin particular visions of the world and the things and events in that world" (Prior, 2003. p, 67). The CDA, therefore, aims to produce a

lexicon of rhetoric that actors draw upon in the hGGE debate, similar to the type of analysis completed by Swierstra and Rip (2007) when mapping out the rhetoric of NEST ethics tropes in nanotechnology debates.

Similar to interdisciplinary research, CDA often starts from a 'problem-centred' approach, eschewing fixed theoretical or methodological positions, and as a result, can complement varying research designs. Using CDA, I deconstruct how dominant discourses surrounding hGGE are mobilised by actors in the expert sphere. I analyse stakeholders' views within the broader context of messages they draw from, conveyed through the political, regulatory, and academic discourses, focusing on the discourses of societal and ethical issues associated with these technologies. To evaluate actors' discourses from the perspective of continuity and change, over time, in my analysis, I explore how discourses compare to previous UK debates on new and emerging biotechnologies — outlined in the literature review — and grammatical tropes of NEST ethics (Swierstra and Rip, 2007).

Ethics

The interview stage of the project posed a number of ethical considerations. During the interviews, I explained fundamental research ethics practices to my participants, such as voluntary participation, the right to refuse to be voice recorded, or the right to refuse to answer any questions they did not wish to respond to. One of the most difficult decisions was the decision to offer the participants the choice of whether they wished to be identified. This decision to allow identification was informed by examining previous research's approach to this issue, for example, Dimond and Stephens (2015) who conducted elite stakeholder interviews on the UK MRTs debate.

Leslie Brown and Susan Strenga highlight a turn in modern research ethics where informed consent became more like a hurdle to overcome, rather than a way of protecting participants, and

that the "[…] "informed consent" processes have become institutionalised for purposes of avoiding liability" (2005, p. 269). Thus, supporters of critical research have reclaimed informed consent as a collaborative and transparent document that helps empower both the researcher and the participants (2005, p. 269). I aimed to promote this idea in my research by using techniques Brown and Strenga advocate, such as transparency in the pre-contact and post-contact stages (Harvey, 2005, p. 433) to foster mutual empowerment.

Prior to the interview, I sent out a research information sheet (Appendix B) and consent form (Appendix C) for informants to read and reflect on. I sent this form out prior to the interview for three reasons. Firstly, so that informants could decide if they wanted to participate in the research prior to scheduling the interview. Secondly, that informants would not feel pressured to participate in the research by my presence. And, thirdly, so they could review the form in their own time and think about any questions they might have.

After giving informants time to read the information sheet, interviews were mainly conducted face-to-face and arranged in a location that best suited the informants. Although some research methods literature encourages mutual ground for elite interviews, I decided to prioritise — given the strict sampling criteria — ease of participation for informants. Before the interview, I would ask if the informant had any questions regarding the project information sheet or consent form and address any questions. On two occasions, the informant requested a change to the consent form[35]. In line with Brown and Strenga's approach, I decided to permit these changes to the form, welcoming them as an opportunity to practise informed consent as a collaborative and transparent

[35] One informant requested that their quotes should not be used *unless* they were identified. Another asked that they may approve a copy of the quotes to be included in the thesis.

document. This approach may raise concerns for researchers who problematise power relations in elite interviews, I will address these concerns in section 4.6.

This transparency is particularly vital for my project, given that I have offered informants the opportunity to identify their data. This move was partially informed by the methods literature from the critical research tradition (e.g., MacDowell (1998)). This literature prompted me to decide that allowing informants to choose how they wanted to be identified enhanced the informed consent by encouraging informants to collaborate in the process. One of the downsides of offering informants the opportunity to identify their data (if they wished to do so) was the impact this might have on informants who requested their data be anonymous. Given the small sample size of the project and the strict sampling criteria, it is possible that informants could be identified by their data. This risk was emphasised on the consent form, and I asked informants if they had any questions about this risk in the pre-interview chat. A couple of informants did ask follow-up questions about this point, but these questions centred on the reason I had included this information, rather than out of concern.

As well as transparency in the pre-contact phase, the critical research tradition also encourages post-contact transparency. A number of informants asked that any quotes used for the research be reviewed before publication. At first, I was reluctant to permit quotes to be reviewed in case major changes compromised the integrity of the data, and to allow censorship. However, as more informants requested to review their data prior to publication, my epistemic perspective shifted. For informants, participating in interviews was another opportunity to perform their role within the debate, and it was vital that they could get their point across in a way that was satisfactory to them. I realised over time that it would be beneficial to the project, as language is one of the ways

that elites seek to influence debates. As a result, I agreed to share quotes with informants prior to publication.

I chose to create digital recordings of interviews (where permission allowed) due to their high fidelity. No informants refused to be recorded. All digital recordings were de-identified prior to transcription to maintain the confidentiality of those who requested their data be pseudonymised, and these recordings were destroyed at the end of the fieldwork. I ensured the anonymization of informants' identities (where requested) using numbering. The key made between the transcripts and pseudonyms was held separately from the transcripts and destroyed at the end of fieldwork, ensuring the transcripts were irreversibly anonymised. Data generated throughout my PhD was imported into NVivo and held on an encrypted hard drive.

Methodological challenges associated with hybrid elite interviews

There is no standard definition of the 'elite' within social sciences, and as such, I have chosen to conceptualise my elites as hybrid elites. Power relations between researchers and elites can often result in what Keating refers to as a 'closing off' (Delaunay et al., 2021), where potential elite participants seek to set the interview agenda. In attempts to ease tensions between researcher and elites, a small amount of literature on elite interviewing in social science research has addressed strategies to bridge or reduce the gap between interviewer and interviewee. Pamela Moss describes this 'gap' as "[…] the social-political distance between the researcher and the "researched" as a result of marginalisation processes" (Moss, 1995, p. 82). Various strategies are suggested for how this 'gap' may be reduced, for example, by employing an 'elasticity of personality', when an interviewer adapts their behaviour to suit different interviewees or adopting a 'supplicant' approach (Desmond, 2004, p. 265) and presenting oneself as unknowing or unthreatening. Rather than adopting either of these approaches in the context of the elite interviews, I preferred to

consider the issue of 'positionality' (Desmond, 2004) in my research. Positionality denotes whether the researcher is seen as an insider or outsider. I chose to use my positionality as an insider to create a more collaborative interview process where the interviewer and interviewee work together to try and co-produce knowledge. As a result of this process, the researcher can position themselves as an insider. I think I was successfully able to position myself as an insider because during my PhD I also undertook a lot of work in the policy sphere, including at the Scottish Parliament and the UK Government. I think this meant I was better able to show that I had similar skills, aims and experiences to my interviewees (albeit in a different topic area of health policy, medical devices, and digital regulation).

When thinking about negotiating an elite-researcher relationship, the interview location is significant (Rice, 2010). In cases where the researcher interviews an elite in their locus of control, the power balance favours the responder rather than the researcher (Schoenberger, 1991). This concern, however, has to be balanced with practical considerations, such as gaining access. Moreover, offices tend to have fewer obstacles to high-fidelity digital recording as they are generally a more controlled environment when compared to a public space, like a café, where there is a greater likelihood of background noise. Hence, I chose to conduct the interviews in a space that best suited my informants.

It is crucial to understand elite interviews within their context: as a non-typical social interaction. Goffman saw 'all interaction as performance' (1978), designed to convey distinct impressions. This impression management in elites is an important area of study due to the varying extent an elite may seek to control the impression that others may have of them (Goffman and Morris, 2009). Many writers on elite interviewing are concerned that elite interviewees "[…] agree to being interviewed because they have something to say" (Goffman and Morris, 2009, p. 211) or that

informants may seek to 'rewrite events' or 'set the record straight'. However, as I discussed in the ontology and epistemology sections of this thesis, I am not searching for an objective perspective on the UK hGGE debate — if such a thing were to exist — rather, I am examining informants' interpretations of their own experiences. As a result, informants agreeing to be interviewed because they have 'something to say' is a strength of the project to understand better how elite stakeholders influence debates.

Practical reflections on the interview process

Beyond the academic approach taken to interviewing, there were also some key practical decisions made that I will address in this section. I will also give an overview of how interviewees responded to the questions asked and how I tackled challenging topics when they occurred.

One of the primary practical considerations was where to hold interviews. During my master's course I conducted a very small number of interviews for a data collection course. The literature recommended a neutral space for elite interviews, where possible, to help rebalance power dynamics (Blakie, 2014). However, I found that when it came to recruiting interview informants for my PhD this was not practical. Potential informants were very busy, and I found that their options for time slots were limited. As such, I did not think it would be prudent to suggest holding the interview in a neutral, public space. Moreover, on the occasions[36] where interviews were held in public neutral spaces, I found this created new challenges (such as the digital recording of the interview being of a lower quality).

The next challenge was choosing what questions to ask and where to stick to — diverge from — the interview schedule (Appendix D). Generally, the interviews would start with an opening

[36] Interviews were held in public, neutral spaces on two occasions.

question and then we would move on to the questions about the debate, for example discussing what informants considered to be the key topics, or most important metaphors in the debate. Interviewees responded well to questions and there was little need for prompting, but occasionally follow-up questions were helpful to probe an answer to get more information on why an informant had answered a question in a certain way. When closing the interview, I gave informants the opportunity to ask questions about the research, at this point I would give an overview of the project and its aims. I thought it was better to give a more thorough overview at the end — rather than at the beginning — so that informants could approach the interview questions with an open mind.

4.4.3 Supporting documents

For this project, I analysed textual documents that exist within the hybrid stakeholder sphere to help support the findings derived from my hybrid stakeholder interviews and non-participant observation. The sample of documents included policy documents, reports, consultation responses, statements, press releases, blog posts, and transcripts from parliamentary debates. Although documentary analysis has its strengths in terms of fidelity and cost-effectiveness, analysing documents in isolation was unlikely to generate rich data on how stakeholders influence UK hGGE debates. Hence, the documentary analysis is supplemented by interviews, often with the producers of the documents themselves, for example I interviewed Sandy Starr, who helped author the PET and Genetic Alliance UK document: *Basic Understanding of Genome-editing: The Report* (2017). Starr later wrote about the report's findings in the *British Medical Journal* (Starr, 2018).

<u>Sampling</u>

Documents were sampled purposely for the study, using criterion sampling, where specific inclusion criteria were set out prior to sampling. The inclusion criteria were purposefully broad to

prevent data gaps, defined as a document that was on the topic of hGGE and was written by a UK stakeholder or published by a UK institution. The exclusion criteria were more specific and included editorial newspaper articles, peer-reviewed journal articles, and other types of documents (that were not written or published by a UK actor).

Data collection

A broad range of documentary analysis informs this thesis. These documents were collected according to the sampling criteria between 2016 and 2021. All documents collected were open-source and available in the public domain. All documents were imported into the CAQDAS program for data reduction and analysis. Specific documents are referenced by title during the empirical chapters; however, I felt that including the complete list of documents would have been too extensive to provide as part of the thesis, however the sample was around 50 (details of these papers can be found in Appendix A).

Data reduction and analysis

I chose to use documents in a more supportive function, and as a result I did not code or analyse them. Instead, I used instances from documents to inform my sampling for interviews and support my arguments in the thesis. For example, I was able to identify those who have contributed to documents such as the NCoB reports as potential interviewees. The PET and Genetic Alliance UK report that analysed metaphors in the debate promoted me to ask my informants questions about metaphors in the interviews. Finally, after boundaries emerged from the interviews and non-participant observations at conferences, I checked the repository to see how boundaries were constructed and mobilised in the documents I had collected.

While my use of documents is not a traditional documentary analysis, I used the documents as the need for them arose. This is a clear example of how I used the bricolage approach in my work.

The purpose of bricolage in research is to reflect the complexity of the lived world, rejecting realism and instead focussing on production and interpretation of knowledge in the context of the research (Kincheloe, 2011).

Working with authoritative documents

For this project, I sampled authoritative textual documents that exist within the hybrid stakeholder sphere. "When analysing documents, it is important to think about the authenticity, readability, representativeness and meaning of the documents" (Denscombe, 2014, p. 167). Hence, the use of documents is supplemented by interviews, often with the producers of the documents themselves. The construction of documents means there is more than the word on the page; there is a dynamic relationship between writers (including funders) and the reader of a document. This dynamic relationship between writers and readers is mediated by the document. Documents themselves are "[…] systems of action in their own right" (Prior, 2003, p. 20), and any document can affect the thoughts and activities of the reader. Therefore, I needed to be reflexive about who authored the document and how they were made visible (or invisible) and how they positioned themselves in terms of the goals the document aimed to achieve.

Where documents appear to have no author, it was essential to think about the author's invisibility and its purpose. For example, parliamentary records of debates have no listed author and are published by *Hansard*, the official report of all UK Parliamentary debates. However, while these documents looked like a representation of events that did not require an author, the omission of hesitation markers, for example, 'umms' and 'ahhs', or the assent or dissent of the parliamentary audiences, led me to be more scrupulous when thinking about how documents might represent a sanitised version of events. This idea mirrors the point raised by Lucivero and colleagues about assessing rhetorical devices in the context of NEST-ethics: when assessing specific claims by actors

regarding new technologies, they should be aware of the rhetorical devices employed by the speaker, but also "What is the background of the person uttering an expectation? What is the audience s/he is addressing?" (Lucivero et al., 2011).

4.5 Discussion

Strengths and limitations

This methodology chapter establishes and reflexively elucidates my research design, recognising the positive and negative attributes of the decisions made. The primary strengths of the project are that it prioritises a problem-centred approach (Leavy, 2016). Furthermore, by focusing on qualitative data collection methods and an interpretative research approach, the project can produce robust and unexpected insights into how elite stakeholders shape the UK hGGE debates.

As with any research project, there are invariably limitations to this project. For example, my sample for the elite-stakeholder interview is self-selected, and there is good reason to believe it may be biased towards those who have extreme positive or negative perspectives on the debate. However, this criticism is mitigated by my decision to combine hybrid elite interviews with non-participant observation, supported by key documents in the debate. Furthermore, whilst my sample cannot be seen as straightforwardly representative of a wider population, it is my aim that my findings might prompt future research into the topic. For example, claims around how legitimacy is constructed in arguments concerning NEST. Finally, it is important to reinforce that while methodological choices will invariably shape data collection and analysis, it is transparency surrounding these choices that is integral to interpretivist research.

As I previously mentioned in Section 4.4, my sampling has shaped my findings, because I sampled mostly pro-science organisation conference events, my data will be skewed towards pro-science.

This decision was largely practical as pro-science events were the events I could choose from. I could not identify an equivalent type of event from a non-science organisation that would have been comparable (other than the NCoB event). I did find that the SCHB organises film screenings as part of the Edinburgh International Film Festival to engage publics on bioethical issues through film. I also found this event included a panel discussion on bioethics following the film. However, while these events might have featured some similarities (e.g. a panel debate) they are not conferences and they did not discuss hGGE, and therefore they were out of scope.

As a result of this limitation of my sampling, I will ensure that I am transparent about the pro-science skew of the data in my discussion chapters. I do not see the lack of non-pro-science events as a flaw in my sampling, but rather a flaw in the debate itself. Perhaps one of the reasons that my study found that proponents tend to dominate in these spaces (see Chapter Seven for this discussion) is because they have much more opportunities to shape the debate through these types of conference events. This could point to a real need for policy intervention, for example more funding for organisations that do not identify as pro-science to have similar opportunities to host events.

The social scientist in research

This project aims to raise some reflexive questions about what the role of the social scientist should be in debates concerning NEST. This idea builds upon work by Haimes, which concludes that it is possible to have a sociology of ethics (2002), and hence social scientists should strive to address ethical questions. Haimes argues that previously oversimplistic demarcations between normative and descriptive ethics and institutional programs such as ELSA[37] have relegated the contributions

[37] ELSA is the field of ethical, legal and social aspects of technologies, the programme has been widely criticised by researchers (see Haimes (2002) and Forsberg (2014). The most controversial of these examples were "[...] so-called

of social scientists to a 'handmaiden' role of simply providing 'facts' (2002, p. 89). As a result, the voices of ethicists and lawyers have dominated policy-making discussions.

While empirical social sciences can contribute to the understanding of ethics by evidencing how studies in the social sciences (such as (Franklin (2002) Price (1992), and Haimes (1992)) have produced empirical perspectives on normative questions. Haimes argues that social science research can enhance the field of ethics by better accounting for how ethics are socially constituted and situated (2002, p. 107). As such, during my PhD research, I have made ethics the topic of my empirical enquiry, focusing on ethical debates as well as the substantive issue of hGGE. Moreover, my (undergraduate) academic background in philosophy undoubtedly focused my research efforts in this way.

Moreover, my research builds on work by Evans (2002) and Hurlbut (2017) to examine how decision-making around the substantive issue of hGGE should function in the pluralistic context of the UK. Therefore, it is also the aim of my work to think about how hGGE debate can feed into ethical decision-making. Finally, by deconstructing ethical discourses posed by elite stakeholders concerning hGGE, I hope to contribute to and build upon Haimes' sociology of ethics by delving into empirical perspectives on normative questions.

integrated projects, where social science and humanist researchers cooperate in projects with natural scientists and technologists, and about the extent to which such projects should be prioritised in the programme. It is therefore hard to claim that there have been many taken-for-granted practices or an established social order that has defined the ELSA research community." (Forsberg, 2014: pp6).

CHAPTER FIVE: RUNNING WITH MOLECULAR SCISSORS: METAPHORS IN THE UK HGGE DEBATE

5.1 Introduction

This chapter highlights the relevance of metaphors to the UK hGGE debates, drawing upon the rich qualitative data I have collected. As discussed in the Literature Review, metaphors are integral to biotechnology debates. They shape shared understanding and contribute to the construction of sociotechnical imaginaries. The chapter outlines the different metaphors I have identified from my data and discusses how and why actors use these rhetorical devices in debate. The metaphors that analogise the function of genome-editing are either mechanical or moral. Mechanical metaphors include examples such as 'molecular scissors', whereas moral metaphors invoke images such as the 'slippery slope'. I will go into more detail on these in sections 5.3 and 5.4 respectively.

A by-product of metaphors is that they can also imbue debates with normativity. For example, Jeffery Lewis' study of the Human Genome Project (HGP) argues that metaphors used to describe the genome in the HGP indicated a trend of using reductionist strategies to understand human health problems, illness, and identity in the biological sciences (1999). A central metaphor in the HGP was the idea that '[...] genes are the essence of our personal identity." (Lewis, 1999).

This chapter proposes several metaphors I consider influential in the UK hGGE debate. This taxonomy includes emerging metaphors I have identified that are specific to the UK hGGE debate and those entrenched in preceding discussions of biotechnologies, such as the 'slippery slope' metaphor. Then, using examples from previous biotechnology debates — such as the UK debate on MRTs — I show how metaphors can be used strategically in NEST-ethics discussions to institute technical and normative understandings of emergent technologies. I then return to the

most prominent metaphors, both mechanical and moral, that I have identified in the context of UK discussions of genome-editing and reflect on how my interview informants describe their importance to the debate.

For the purposes of my research, I will examine the discourses of the hGGE, as they occur in the various agorae of the debate. By examining how and why actors employ metaphors, I show that we can better understand how metaphors contribute to argumentative patterns that shape the UK hGGE debate. I demonstrate that rather than being a valuable shorthand for explaining complex abstractions, metaphors blackbox the very concepts they try to elucidate. I show that metaphors can be used strategically and that, in some circumstances, actors argue to secure their preferred metaphor as dominant in the nomenclature of the debate. I conclude by explaining how metaphors in the UK hGGE discussions have contributed to the reification of NEST tropes and, as a result, compress ethical debate in the context of hGGE.

5.2 Metaphors in the UK the genome-editing debate

What is a metaphor?

As I discussed in the literature review (Chapter Three), for the purposes of my thesis I define metaphors as figures of speech in which a word or phrase is applied to an object or action to which it is not literally applicable. For example, a common metaphor found in discussions of genome-editing is 'molecular scissors'. The metaphor 'molecular scissors' refers to restriction enzymes, which cleave DNA at or near restriction sites. The restriction enzyme is not a scissor — it's a protein produced by bacteria — however, there is utility in the metaphor that refers to it as a scissor because the role of the restriction enzyme is to cleave (or cut) DNA.

The purpose of metaphors is threefold. Firstly, they describe new technologies (filling lacunae in vocabulary); secondly, they make sense of new technological innovations (fulfilling a heuristic function); thirdly, they are employed to mediate public understanding of innovations. However, a by-product of metaphors is that they can also imbue debates with normativity. As I mentioned in the introduction of this chapter, the HGP indicated a trend of using reductionist strategies to understand human health problems, illness, and identity in the biological sciences (1999). A central metaphor in the HGP was the idea that '[...] genes are the essence of our personal identity." (Lewis, 1999). Lewis argues that, whether explicitly or implicitly, the sequencing of the human genome was a normative goal in and of itself by successfully presenting the idea that there is a normal human genome rather than numerous normalities (Scully, 2005, p. 51). Therefore, the metaphors produced from this enterprise, such as 'discovering the book of life', were complicit in feeding into a narrative that seeks to erase many altered ways of living (Scully, 2005, p. 51).

Metaphors are an essential touchpoint for biotechnology debates and have been used in several analyses (see Haraway (1976), Keller (1995) and Evans (2002) for examples). In hGGE debates, in particular, work on metaphors has outlined that they're important cultural touchstones for participants in a debate (see Nelson and colleagues (2015), Baylis (2019), and Evans (2020), for examples).

Closely aligned, but not the same as metaphors is the rhetorical device of literary allusion. For the purposes of my thesis, I define a literary allusion as an implied or indirect reference to a person, event, or thing or a part of another text. Most allusions assume a shared knowledge between the speaker and the audience. There is a long history of using literary allusion to interpret biotechnology debates (see Lynch (2019), and Mulkay (1997) for examples) particularly around using science fiction to interpret utopias and dystopias (see Jasanoff and Kim (2015), Kendal

(2015), and Winner for examples). There is a small but rich epoch of literature that examines the use of literary genome-editing debates (see Evans (2020) and Baylis (2020) for example). I have chosen to include literary allusion in this chapter because I think allusion is being used in a similar way as metaphors in the debate, as a shorthand for more comprehensive concepts that can invoke techno-normative ideals.

How are metaphors constructed and contested?

As well as a subject of analysis, metaphors and literary allusion can also be used as a method of analysing debates concerning the ethics of new and emerging science and technology (NEST-ethics) (see Swierstra and Rip (2007), Swierstra and colleagues (2009), and Swierstra (2016)). NEST-ethics describes observable characteristic tropes and patterns of moral argumentation in ethical discussions. In their paper *Nano-ethics as NEST-ethics: Patterns of Moral Argumentation About New and Emerging Science and Technology*, Swierstra (2007) offers an inventory of the arguments and shows how these patterns evolve over time.

Metaphors in the hGGE debate are generally constructed in one of two ways: they are created specifically for the hGGE debate or draw upon previous UK biotechnology discussions as part of their repertoire. Metaphors are contested in several ways. For example, actors will question the utility of the metaphor (i.e. is it explaining the concept accurately) or try to offer an alternative metaphor. While this might seem innocuous, metaphors can be used by strategic actors in the debate to secure their preferred metaphor as dominant in the nomenclature of the debate.

Metaphors in the UK hGGE debates

Interview informants were asked to identify metaphors they had noticed in the debate and invited to reflect on their thoughts about the metaphors they cited. As Lakoff and Johnson argue,

dominant metaphors tend to reflect and influence values in a culture or subculture (1980). Therefore, by asking interviewees about metaphors, my aim was to better understand the debate more generally. These metaphors, and a brief description, are detailed in Table 3.

As well as distinguishing between metaphors and literary allusion, for the purposes of my research, I have also differentiated between two broad classes of metaphors; these are mechanical metaphors and moral metaphors.

In the context of the hGGE debates, mechanical metaphors aim to explain the moving parts that constitute genome-editing technologies. In this sense, they perform a heuristic function as they aim to explain the scientific processes that comprise genome-editing (such as cleavage or non-homologous end-joining). Examples of mechanical metaphors include 'molecular scissors', 'editing', 'genetic surgery', 'cut and paste' and RNA as a 'sat-nav'. On the other hand, moral metaphors aim to create shorthands for ethical positions in the debate. An example of a moral metaphor is a moral threshold metaphor — for example, the 'slippery slope', the 'thin end of the wedge' and 'letting the genie out of the bottle'. These moral threshold metaphors aim to invoke that the other speaker is suggesting an action that in some way would transgress existing ethical boundaries, passing a point of no return.

TABLE 3: DESCRIPTION OF METAPHORS IN THE UK HGGE DEBATE

Metaphor	Description
Molecular scissors	Used to refer to the transcription enzymes that cleave DNA during genome-editing.
(Gene/genome/genetic) Editing	Used to refer to a platform that facilitates targeted cleavage and non-homologous end joining in DNA to remove unwanted sections. Editing implies that existing DNA will be changed for the better (in the eyes of the editor).

Metaphor	Description
Disruptor/Disruptive (technology)	Used to refer to genome-editing being an innovative technology that will 'disrupt' existing approaches to genetic engineering.
(Genome) surgery	A metaphor to describe how hGGE would act like a surgeon to provide targeted (and therapeutic) outcomes.
Genetic code	A processing metaphor to describe how our DNA will shape and affect how we live our lives.
Cut and paste	Refers to how genome-editing can 'cut' out bad DNA and 'paste' in the correct DNA.
Find and replace	A word processing (editing) metaphor that describes genome-editing as a targeted technology that can locate and fix 'errors' accurately and effectively.
Sat-Nav	Refers to how a guide RNA can be programmed to correctly locate the target DNA.
Altering	Originally derived from tailoring, describe how genome-editing can change existing DNA so that it will be better (similar to editing).
Slippery slope	A moral metaphor that refers to circumstances where a certain initial action could lead to a chain of events leading to much more extreme results than the originally suggested initial action.
Thin end of the wedge	Similar to a slippery slope, this metaphor refers to action or procedure of little importance that is likely to lead to more serious developments.
Candle-lit path	This metaphor implies that techniques used in previous successful debates (e.g. MRTs) might suggest ways of conducting hGGE debates that may be similarly successful (e.g. resulting in the regulation of hGGE).

I have discussed in the literature review the importance of metaphor in creating cultural touchstones (Lakatoff and Johnson, 1980; Swierstra and Rip, 2007) that are drawn upon in the creation of sociotechnical imaginaries (Jasanoff and Kim, 2015) more generally and British biomedical culture (Dimond and Stephens, 2018) in particular. Therefore, I argue in this chapter that understanding how metaphors are used in debate and how actors have sought to promote or exclude metaphors can elucidate imaginaries actors are trying to construct around hGGE and its use.

I argue, as authors such as Jasanoff (1997), Jasanoff and Kim (2015), and Baylis (2017) have before me, that the use of metaphor in the creation and reification of sociotechnical imaginaries is tied to normative ideas about what actors think a society should be, in the context of emerging technologies. In this context, metaphors can be used as heuristics to signal a type of argument without expanding on the argument fully in debate. The use of metaphors as heuristics is also featured in the works of Swierstra and Rip (2007). They describe how debates concerning NEST fall into patterns whereby the same types of arguments are used interchangeably in debate, regardless of the technology in question.

Reflecting on metaphors in the UK hGGE debates

To reiterate, I differentiate between two types of metaphor with the debate: mechanical and moral. While I emphasise the importance of differentiating between mechanical and moral metaphors, this distinction is artificial, and some metaphors blur the demarcation I have set out between moral and mechanical. Moreover, metaphorical speech is always imbued with normativity. Therefore, it is almost invariable that metaphorical speech will convey some sort of ethical position (Lakatoff and Johnson, 1980).

While mechanical metaphors aim to have an explanatory effect in debate, sometimes, rather than being a valuable shorthand for explaining complex abstractions in debate, metaphors contribute to the blackboxing of genome-editing. Blackboxing happens when scientific and technical work is made invisible by its own success (Latour, 1999). In this context, the metaphors increase the opacity of the concepts they try to elucidate. Furthermore, the more opaque concepts are in debate, the more scope for actors to talk at cross purposes.

As I have previously mentioned, while all metaphors have a heuristic function, sometimes metaphors are used as heuristics to signal a type of argument. For example, the use of the slippery slope metaphor in debate not only conjures the image of a slippery slope but is also a highly normative term with a particular subtext (linked to spurious reasoning) (Govier, 1982). Therefore, sometimes metaphors are used as a placeholder for a type of argument without expanding on the argument fully in debate.

Metaphors can be used to 'close off' ethical debate, imbue the debate with normativity and invoke sociotechnical imaginaries. Sociotechnical imaginaries are "collectively held, institutionally stabilised, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff and Kim, 2015, p. 4). Sociotechnical imaginaries have been used to deconstruct biotechnology debates previously. For example, Dimond and Stephens highlight the importance of the sociotechnical imaginary and its relevance to the mitochondrial donation debate in the introduction of their primary theoretical contribution: "[…] enacting ethical futures" (2018, p. 14). So while metaphors can be used to close off debates, they can also expound useful sociotechnical imaginaries. For example, promissory metaphors — which imply promising claims about the future — are closely associated with narratives about how the UK pioneered previous

ARTs, such as IVF. These metaphors and narratives are used to create the sociotechnical imaginary that the UK should be at the forefront of the science and regulation of new and emerging biotechnologies.

5.3 Mechanical metaphors — visualising technology construction in debates

Mechanical metaphors perform a heuristic function by explaining the moving parts that constitute genome-editing technologies. However, while the main purpose of mechanical metaphors is to explain, metaphors can be used strategically to enforce normative understandings around emerging technologies. A key example of this from a previous biotechnology debate is the use of mtDNA as 'the batteries of the cell' metaphor. This metaphor is perhaps the most compelling used in the context of the UK MRTs debate and arguably contributed to an understanding of mtDNA that resulted in a regulatory change — distinguishing it from nuclear DNA.

Example case: MRTs debate — MtDNA as the 'batteries of the cell'

MRTs were legalised in the UK in 2015 following a decade of debate. MRTs were discussed regularly in the media and the public sphere until 2015 when they were debated in the Houses of Parliament. During these debates, proponents of MRTs used several metaphors to convey both the mechanics and morals in the MRTs debates. A critical mechanical metaphor employed was the portrayal of mitochondria as the 'batteries of the cell'.

Mitochondria as the batteries of the cell has been highlighted by a number of authors as a key metaphor in the debate (see Dimond and Stephens (2018), Baylis (2017), Herbrand (2017) (Haimes and Taylor, 2015)). The heuristic function of the metaphor was both to communicate that the mitochondria provide a power source to the cell but also to differentiate MtDNA from nuclear DNA. This communicates that nuclear DNA *is* DNA, whereas MtDNA is *only* a power source.

The metaphor proved particularly prominent in the debate because it was used in response to a different metaphor employed by UK newspapers that described MRTs as producing 'three-parent babies'. The 'three-parent babies' metaphor was used to explain that offspring produced following the use of MRTs would contain nuclear DNA from two sources (the mother and father) and the MtDNA from a third source (the mitochondrial donor). At the time, several prominent scientists pointed out that the 'three-parent babies' metaphor was inaccurate (due to the mtDNA only contributing one percent of genetic information to the resultant offspring, compared with nuclear DNA that contributed the remainder (Habbane et al., 2021)). Therefore, the purpose of equating mtDNA to batteries was to explain the role and function of mitochondria and emphasise that mitochondrial DNA and nuclear DNA were different. The result was that mtDNA was to be equated with providing energy to the cell (batteries) and that nuclear DNA provided the genetic information; and therefore, mtDNA was not to be equated with genetic relatedness and, correspondingly, parenthood.

These competing metaphors were both concurrently trying to represent the genetic contribution of mtDNA and infer what relationship this genetic contribution bore to parenthood. As the academic literature pointed out at the time, there was a false equivalency in the implication that genetic relatedness was intrinsically linked to parenthood. While these metaphors effectively counteracted what scientists in the debate were saying, as the inaccuracy of the 'three-parent baby' metaphor, the 'batteries of the cell' metaphor also conveyed normative ideals around what constitutes parenthood — namely, genetic relatedness. Therefore, the conceptualisation not only pushed the benefits of the technology, but mitochondria as the 'battery of the cell' also underplays the genetic contribution of the mitochondrial donor and implies the 'replicability and dispensability of batteries' is a quality of mtDNA (Stephens and Dimond, 2018).

While the metaphor of mitochondrial DNA as the 'batteries of the cell' appeared only to provide a heuristic for explaining the mechanics of MRTs, the orthodoxy underpinning this metaphor had significant regulatory impacts on the debate. For example, the legal definition of germline modification was changed to exclude mitochondrial genetic interventions.

The key tension that underscores the 'three-parent babies' vs mitochondria as the 'batteries of the cell' metaphor is linked to the genetic contribution of mtDNA and the relationship that this genetic contribution bears to parenthood. In order to address this conflict, prior to the vote on reform to the HFE Act 2008 (which included (Mitochondrial Regulations 2015)), the DOH changed the definition of hGGE to exclude any edits made to mtDNA. As a result of these legal changes, the use of MRTs was legalised subject to licence for those who wished to prevent mitochondrial disease. These legal changes were made at least partly due to the change in regulation that meant that mtDNA was no longer considered germline editing (even in female offspring). In this sense, the mitochondrial DNA as the 'batteries of the cell' won out over 'three-parent babies' because this metaphor better reflected a more well-established orthodoxy in the debate and accepted the MRTs as a non-genetic contributing intervention. This example underscores how metaphors can genuinely impact legislative categories.

Mechanical metaphors and hGGE: editing and word processing

The metaphors that analogise the function of genome-editing are either mechanical or technological. The three most prominent metaphors that I have identified in connection with genome-editing are:

- 'Molecular scissors'
- Genome-editing as 'find and replace'

- RNA as a 'satnav'

The 'molecular' scissors and 'find and replace' metaphors both represent types of word processing metaphors, where typos are cut out (physically or digitally) and replaced. An example of the 'molecular scissors' metaphor is seen in the 2016 report from POST, which describes the nucleases involved in genome-editing as: "[...] enzymes that act like molecular scissors to cut the DNA at the chosen site(s)." (POST, 2016. p. 1).

The RNA as 'sat nav' metaphor is used to convey how the guide RNA locates the correct sequence to cut the DNA. However, these metaphors are not accurate. Kathy Niakan described the metaphor in her interview. At the time of interview, Niakan was a Senior Group Leader at Francis Crick Institute and now works as a professor of genetic regulation of early human development at the University of Cambridge. Niakan was the first scientist in the UK to receive a licence to use the CRISPR-Cas9 genome-editing platform in human embryos and regularly attends events that discuss the ethical implications of hGGE.

> *Kathy Niakan: Yeah, I think that people use the molecular scissors a lot if that's what you mean, so they use that because they're trying to convey the idea that the CRISPR method actually snips DNA and it does, like a little pair of scissors. And they use 'sat nav' to talk about the way that they guide the molecular scissors to the right site, they're not accurate ways of describing them.*

Director of the PET, Sarah Norcross, organises PET events and will regularly give an opening address at these events where she argues in favour of responsible research and innovation in the context of new and emerging biotechnologies. Norcross described genome-editing as molecular scissors: "Genome-editing is often described as molecular scissors, and for good reason." (Norcross, 2015) in an article for *The Guardian*. Moreover, A 2016 report by the NCoB used the term 'cut' on various occasions to describe the function of various genome-editing techniques and

described how RNA was able to guide these cuts, for example the report describes how "This (RNA system) guides the Cas9 to make a double-strand cut at the target site." (NCoB 2016).

While these mechanical metaphors have a heuristic function, they also have great explanatory power and make the underlying science easy to understand. In some cases (e.g., molecular scissors), they are ubiquitous in the discussion. The problem might be that they are taken too literally. Sandy Starr, the Deputy Director of PET who regularly organises and convenes panels at PET events as well as contributing to PET's *Bionews* publication described this phenomenon:

> *Sandy Starr: As I say, the scissors and satnav and the word processing they also have their limitations, you know, we've had people take the scissors analogy very literally, thinking that you're literally using a pair of scissors.*

Informant One had a different view, criticising the utility of the mechanical metaphors used in debate:

> *Informant One: In the early days the metaphor that I saw used most was the 'sat-nav' which helps you find the correct place in the DNA and then the 'scissors' which make a cut. I think the work that I have seen since says that that wasn't a preferred metaphor and that people found that more confusing. One of the things that I was concerned about was that the preferred metaphors did not seem to capture the technical essence of what is being done and that is often the part that is not well explained. The idea that you are using a targeting sequence and an enzyme that makes a cut in the DNA but that actually the editing process happens by the cell's own DNA repair mechanisms, and it depends whether it's one mechanism or the other. For example, whether it's non-homologous end joining (NHEJ) or homology-directed repair (HDR).*

However, the alternative is that you use the scientific terms, and then the debate is not accessible to everyone, as Sandy Starr explains:

Sandy Starr: It's a metaphor. It's ultimately a way for people to think about these things. If they go far enough — and some people will go far enough including lay people — they'll be talking about the thing itself. Not the analogy or the metaphor for it. But on the way you have to make do.

I also found that some of the key documents also talked about the dangers of using metaphors, for example the NCoB 2016 report describes how:

> The danger of the metaphor lies not in the fact that it is a metaphor, and therefore a non-reducible way of referring to complex realities; it lies in the possibility that the metaphor might either dissemble significant ethical questions through the use of euphemism, or lead reasoning astray by overstretching the power of analogy (2016, p. 20).

Sociologist Amarpreet Kaur also picked up on the point made by Informant One that 'cut and paste' was somewhat of a misnomer, as it didn't account for NHEJ in genome-editing. At the time of interview Kaur was a member of the Sociology of Reproduction Research Group (ReproSoc) in the Department of Sociology at the University of Cambridge. Her doctoral research focussed on human germline genome-editing as a potential reproductive choice in the United Kingdom. During her doctoral research, Kaur co-authored a POSTNote on Human Germline Genome-editing. Kaur has since taken up a position at the University of Birmingham.

Amarpreet Kaur: It's not 'cut and paste', [...] because there's no repair in a cut and paste

The prevalence of the molecular scissors metaphor was highlighted during the interview phase of my research, when the majority of interviewees cited this metaphor, when asked about metaphors in the debate. However, Güneş Taylor pointed out that the metaphor does not really accurately represent the technical aspects of what CRISPR is doing — in that it is more similar to TALENs.

Taylor is a Postdoctoral Training Fellow in the Lovell-Badge Lab at the Francis Crick Institute who completed her PhD in the Sauka-Spengler Lab at the University of Oxford.

> *Güneş Taylor: So I don't know who coined it [the molecular scissors metaphor] first, but I know for a fact I've used that as well. I actually don't mind it at all. If I was going to nit-pick, I'd say it's a bit more like have you heard of the TALENs?*
>
> *Fiona Coyle: Yeah.*
>
> *Güneş Taylor: Yeah, right. So I would say technically TALENs work as molecular scissors, because scissors come in two halves that together will cut through things. This is exactly how TALENs work, but it isn't technically quite how CRISPR works.*

While — as Taylor points out — the 'molecular scissors' metaphor is not necessarily accurate to describe the mechanism that underpins CRISPR—Cas9 it might be more accurate to other technologies that have two mirrored enzymes that cleave DNA like TALENs[38]. However, regardless of how the genome-editing platform cleaves DNA the point is that it is not tiny scissors that do the cutting. As such, this raises the question: what are the mechanical metaphors imparting more generally?

The metaphor that genome-editing platforms contain within them 'molecular scissors' that cut DNA implies precision. Moreover, particularly when the scissors metaphor is combined with the 'RNA satnav' the implication is that these scissors are guided by a complex technological solution (as opposed to a map or the instruction manual as Taylor mentioned in her interview). Therefore, a function that the mechanical metaphors have is that they present CRISPR—Cas9 as a simple,

[38] TALENs (Transcription Activator-Like Effector Nucleases) "[...] comprise a non-specific DNA-cleaving nuclease fused to a DNA-binding domain that can be easily engineered so that TALENs can target essentially any sequence" (Joung and Sander, 2013).

but precise tool. However, scientists that use CRISPR—Cas9 in their own research regularly cite that the technique can lead to off-site mutations and mosaicism (Zhang et al., 2015). While the imprecision of genome-editing is not excluded from discussions of genome-editing (see NCoB (2018) for an explanation of mosaicism in the genome-editing of human embryos) the idea that genome-editing as imprecise is not conveyed by the 'molecular scissors' metaphor.

Another implication of the 'molecular scissors' metaphor stems from the intense focus on the molecular level. The focus on the molecular level associated with this framing of the technology makes the scientist and the embryo invisible — highlighting only the DNA. This *making invisible* of scientists serves the function of implying that genome-editing 'does itself' or that genome-editing has its own agency. However, in reality, scientists use genome-editing technologies to achieve pre-specified edits to DNA.

As I outlined in the methodology section of this thesis (Chapter 4), at the start of my doctoral research I spent some time in a lab learning how to use genome-editing so I could gain some practical insight into the technique. Up to this point, my understanding of genome-editing had been shaped by metaphors and diagrams of the technique (which often literally depicted scissors cutting the DNA). As such, I did not know what to expect from using the technology in real life. What I found during this scoping study was that I understood why metaphors were needed beyond the lab space, especially given the invisibility of the techniques, given its microscopic nature and the tiny amounts of reagents used. This experience did not gel with my initial expectations based on the images and metaphors associated with the technique.

The documentary analysis I conducted uncovered that metaphors were a point of interest for organisations such as the NCoB and the PET. For example, the 2018 NCoB report described how

the organisation was interested in the framing of the technique, due to the implication this would have on how meaning is ascribed to hGGE:

> [...] how we 'frame' questions about genome-editing in human reproduction. How we frame our questions encodes social phenomena in particular ways. Interrogating the framing of social phenomenon helps to reveal what people think they are talking about when they engage in discussion of a particular subject, and therefore how meanings are assigned, asserted and circumscribed and how misunderstandings arise. (2018, p. 22)

The NCoB described how framing was different from rhetorical devices that might influence public attitudes to uses of genome-editing, and that metaphors had an acceptable role in shaping how the public made sense of these technologies.

However, this is contrasted with the NCoB 2016 report in which the council emphasised that the ubiquity of the 'editing' metaphor was potentially problematic, noting that there was a need for "[...] a coherent relationship between systems of concepts within science and within normative discourses by which they are governed, such as those of law and morality." (2016, p. 12). The NCoB 2016 report made an important connection between the 'editing' metaphor that comprises the term genome-editing and the connotations associated with editing. The report went onto say:

> [...] it is technical, is not dependent on scale (as it applies equally to changes large or small) and is seen as corrective or improving (at least in relation to the editor's vision). In this way, the concept of editing has a certain thickness, whereby, while apparently descriptive, it implies a tacit evaluative judgement. (2016, p. 20)

As I have discussed in this section, metaphors are an important tool within science communication. They allow space for analogy in discussion and erase the need to use only scientific

jargon in debate. However, the reliance on metaphors in the debate is problematic. Firstly, they do not represent an accurate version of reality, and they convey 'editing' (either traditional editing with scissors or through computing processing metaphors, e.g. 'find and replace') which implies normativity in that 'editing' has corrective connotations.

The focus on the molecular level associated with this framing of the technology makes the scientist using the technique invisible. This metaphor also serves the function of implying that genome-editing 'does itself' or that genome-editing has its own agency.

Another way of presenting the mechanics of genome-editing is that the technology is often presented as a tool. There are a number of examples of genome-editing as a 'tool' from key documents in the UK genome-editing debate, such as in the 2018 report of the Science and Technology Committee that describes genome-editing as "[...] a powerful tool for research, and which has significant promise for therapeutic use." (Science and Technology Committee, 2018). Nick Meade described genome-editing as a 'tool' metaphor in his interview. Nick Meade is the Director of Policy at Genetic Alliance UK and member of the National Institute for Healthcare Research (NIHR) Advanced Therapy Medicinal Product (ATMP) Group. Meade regularly contributes to the UK hGGE debates, representing the views of rare disease patients:

> *Nick Meade: If you ask me why genome-editing is so interesting and why people are so concerned it is because it seems to be able to do so much […] some of it will be harmful [...] But that's, you know, the same as tools.*

Helen O'Neill — a lecturer and molecular geneticist at University College London (UCL) at the Institute for Women's Health in UCL — also described the technology as a tool.

Helen O'Neill: It's not just a tool for editing genomes, it can be used for the detection of viruses, it can be used as a diagnostic tool.

Often the genome-editing as a tool narrative was combined with analogies to compare it to what type of tool it might be. Nick Meade used this approach in his interview:

Nick Meade: So, having identified genome-editing as an important tool for research and a potential treatment paradigm [...]. It's bit like discussing iron, iron can be used to make guns or buildings or scalpels or lots of things.

As well as informants describing genome-editing as a tool, I also saw this narrative regularly at conferences, for example, Dr Gillan Wright, a senior researcher at the Scottish Council on Human Bioethics stated about genome-editing: "There's nothing intrinsically wrong with a tool — it's how and when it should be used". (PET event, Edinburgh 2019). At the PET event in 2021, that I attended virtually, scientist Norah Fogarty used an image of a toolbox in her slides for her presentation. In this slide she represented the various applications of genome-editing technologies.

The genome-editing as a 'tool' narrative is regularly linked to the idea that genome-editing cannot be moral or immoral in and of itself, but rather it is more dependent on what it is being used for. Therefore, what these metaphors do is serve a heuristic function in terms of explaining the genome-editing technology. However, during this process the technology is blackboxed, we might understand what the technology does, but the process of how this is actually achieved is unclear.

5.4 Moral metaphors — conveying ethical transgressions in debates

Moral metaphors aim to create shorthands for ethical positions in the debate. An example of a moral metaphor is a moral threshold metaphor that aims to suggest an action would transgress existing ethical boundaries, passing a point of no return (e.g., slippery slope). An example of this

type of metaphor from the MRTs debate is the opposite metaphor to mitochondrial as the 'batteries of the cell' but instead was the 'three-parent babies' metaphor that was used to suggest allowing edits to MtDNA in the short term would lead to moral decline in the long term.

Example case: MRTs debate and the 'three-parent babies' metaphor

As I have previously discussed in the background (Chapter Two), 'the 'three parent babies' metaphor was used to explain that offspring produced following the use of MRTs would contain nuclear DNA from two sources (the mother and father) and the MtDNA from a third source (the mitochondrial donor). This was contrasted with the mitochondria as the 'batteries of the cell' metaphor which aimed to emphasise that mtDNA was purpose was to provide energy, and that nuclear DNA provided the genetic information, meaning mtDNA was not to be equated with genetic relatedness and, correspondingly, parenthood.

Arguments against the moral permissibility of MRTS included that they were a slippery slope to hGGE, or that they 'opened the door to' other types of non-nuclear family arrangements (Herbrand, 2017). While these metaphors were abandoned in the debate following the legalisation of MRTs, they are still used in biotechnology debates today.

While the literature shows how the metaphor of mitochondria as the 'batteries of the cell' won out over the 'three parent babies' metaphor, the concerns raised by the 'three parents baby metaphor' (and its associated moral threshold metaphors) had a normative impact on the debate. In order to allay fears of moral decline (associated with the moral threshold metaphors) proponents argued MRTS should only be used in a very small number of cases, that confirmed to morally conservative boundaries. I have found the same argument to be in my sample on the ethics of hGGE.

As I discussed in Chapter Two, one of the normative impacts of the mitochondria as the 'batteries of the cell' metaphor was that it diminished the contribution of the egg donors in the debate. Haimes and Taylor argued that the role of egg donors in the MRTs debate was strategically minimised to justify their de-identification (Haimes and Taylor, 2017, 2015). The de-identification of egg donors in the case of mitochondrial donation stems from the Nuffield Council on Bioethics (NCoB) recommendation that mtDNA donors be given less status than egg donors for gamete donation.

While the metaphor itself left little space for MtDNA to be viewed as anything more valuable than batteries, this was supported by a broader political tactic used by proponents of MRTs in debate (Haimes and Taylor, 2017) who sought to write egg donors out of the narrative on MRTs for purposes related to maintaining a conservative image (Haimes and Taylor, 2017) and to promote the narrative that these technologies produce heteronormative, genetically related families. As a result, the normative shift in the debate — the move away from 'three parent babies' — that was precipitated by the prioritisation of the mitochondria as the 'batteries of the cell' metaphor had a real-terms impact on how the technology was debated, regulated and around the legal contexts in how it might eventually be used (Cohen et al., 2020).

Moral metaphors and hGGE: the slippery slope to enhancement

Moral threshold metaphors generally refer to the irreversible crossing of a line or boundary that would invariably lead to moral decay. A number of moral metaphors were mentioned by a number of informants — including the Chair of London Futurists, member of the Institute for Ethics and Emerging Technologies (IEET), David Wood — mentioned this point during their interviews:

Informant Five: I think the ideology is 'science equals progress for society' and that especially when there is a medical benefit to be claimed that that medical benefit trumps any other social or ethical consideration.

Informant Three: There's narratives about humanness and changing the nature of what it means to be human, and preserving humanness.

David Wood: They say evolution is a wonderful thing and that we mess with it at our peril. There is this secular vision of this whole argument against hubris, which is that if you try and fly you will come too close to the sun and your wings will melt off and you will fall and crash and burn.

One key moral metaphor that was cited by a number of informants was the slippery slope. The slippery slope metaphor is a moral threshold metaphor and aims to act as a heuristic for slippery slope arguments more generally. Put simply, a slippery slope argument suggests that a certain initial action could lead to a chain of events with much more extreme results than the originally suggested initial action. As I mentioned in the literature review (Chapter Three) the slippery slope metaphor has a history of being used in biotechnology debates (see for example Dimond and Stephens (2018) and Mulkay (1997)) and in genome-editing debates in particular (see Evans (2020) for example).

The slippery slope metaphor appears in some of the key documents in the UK hGGE debates, such as the 2016 NCoB report, that describes the argument as such: "The concept of a 'slippery slope' whereby objections to further uses of genome-editing fail to gain purchase in the absence of a secure rational distinction between therapy (and prevention) and enhancement." (NCoB, 2016. p. 51). The 2018 NCoB report also cites the slippery slope metaphor a number of times, emphasising that the point of the argument is that "[...] the slippery slope is often adverted to as a reason not to embark on a particular course in the first place." (NCoB, 2018. p.55).

Slippery slope metaphors are used in the debate and recognised by elite stakeholders I interviewed as a prominent metaphor, with some leaning into the slippery slope argument and others choosing to avoid it. Bioethicist, Informant Two mentioned this in their interview:

> *Informant Two*: *One of the arguments I would never use now is a slippery slope argument, because unless you are extremely careful, and you spend ages looking at all of the different variables that are related to the slippery slope arguments or cause the slippery slope it's very difficult to prove. It's just too difficult from a logical perspective.*

Commonly, interviewees would point to how they would combat the moral threshold metaphor. As such this anti-rhetoric is used to combat the slippery slope, questioning both the validity of the line and the reasoning that underpinned the slippery slope argument. This trend was also observed at conferences, for example at the panel session of the PET annual conference in 2015 when John Harris diminished the 'slippery slope' arguments of other panellists, arguing that the *reasoning* that underpinned the metaphor was mistaken, similarly to his interview, he described only needing the right footwear to navigate them. Furthermore, at a different PET event 2018 Sarah Chan — who is also a bioethicist — criticised the utility of employing slippery slope arguments in this context, stating: "Just because we can't draw a bright line doesn't mean there aren't valid moral distinctions to be made" (Chan, 2018).

What Chan was arguing was that the germline is not necessarily the best place to draw the line. Chan was arguing in response to a claim that the germline should not be edited, as this would be contrary to human dignity, she argued against genetic determinism, stating: "We are far more than our genes, and I think it is an affront to human dignity to suggest that simply manipulating the human germline could take away what makes us special as persons." (Chan, 2018). By introducing the suggestion that genetic determinism (the argument that we are our genes) is an affront to

human dignity, she discharged the force of the original argument that stated crossing the germline was an affront to human dignity.

Another contrasting example of a moral metaphor used in the debate that was drawn upon by a number of stakeholders was 'playing God':

> *Bruce Whitelaw: The 'playing God' argument, that's one that comes up a lot.*
>
> *Informant One: This idea that scientists are 'playing God'.*

The 'playing God' example is another example of a moral threshold metaphor, however in this case the ethical transgression relates to scientists taking on too much control, as opposed to the technology getting out of control, as Whitelaw describes:

> *Bruce Whitelaw: [...] the fears are the same, there are slippery slopes, technologies can be uncontrolled, we might generate monsters.*

While the ethical boundaries I have discussed in this section are metaphorical, there have been opportunities during this debate to make them real through moratoria. Therefore, the rhetoric of metaphors and the orthodoxy that underpins them has the potential to make a normative impact on the debate, creating lines that ought not to be crossed. In this section I have addressed how moral metaphors can shape the normativity of the debate. I described how moral threshold metaphors in particular are common in the UK hGGE debates and that these metaphors (such as the 'slippery slope') are often carried over from previous debates. Moral threshold metaphors generally refer to the irreversible crossing of a line or boundary that would invariably lead to moral decay. This is a point I will discuss more in the next chapter that examines the role of boundaries in the UK hGGE debate (Chapter Six).

Moral metaphors and hGGE: literary allusion

For the purposes of my thesis, I define a literary allusion as an implied or indirect reference to a person, event, or thing or to a part of another text. There are a number of examples from the literature in which literary allusion is used to interpret biotechnology debates generally (see Lynch (2019) and Mulkay (1997) see Jasanoff and Kim (2015) for examples) and genome-editing debates in particular (see So (2019) and Evans (2020) for examples).

They key literary allusions I gleaned from the interview were:

- References from Greek mythology (Pandora's Box, Icarus, Prometheus)
- *Frankenstein* (1818)
- *Brave New World (*1932)
- *The Island of Doctor Moreau* (1886)
- *GATTACA*[39] (1997)
- *Never Let me Go* (2005)

The cultural touchstones associated with literary allusion are often linked to techno-normative ideals (Jasanoff and Kim, 2015, p. 123) and often contain references to those who have transgressed expected moral standards, for example the opening of 'Pandora's Box'.

Literary allusion was mentioned in some of the key documents in the UK hGGE debate such as the NCoB 2018 report and the 2017 Genetic Alliance UK and PET report. The NCoB report described how literary allusions have been linked to moral arguments around new technologies "This has been a device in imaginative literature and dystopian science fiction at least since the

[39] GATTACA is a film, but I have included it in the literary allusions section as it falls under the same umbrella.

time of Ovid (2004) Metamorphoses [...]; see, especially, Huxley A (1932) Brave new world [...], in which ectogenesis occurs via the Bokanovsky cloning procedure." (NCoB, 2018. Footnote. 269), whereas the Genetic Alliance UK and PET report cited how "[...] famous science fiction novels Frankenstein and Brave New World, which are still widely used as metaphorical shorthand for the perils of playing God." (Genetic Alliance UK and PET, 2017. p. 21).

Interviewees recognised literary allusion to be a key theme in the debate and often pointed to science fiction texts as a source of comparison to the existing debate. This point was best demonstrated by Sandy Starr:

> *Sandy Starr: Science fiction is wonderful. And it's interesting thinking about Prometheus. Frankenstein is subtitled 'The Modern Prometheus'. You know, Frankenstein celebrated its 200th anniversary last year. That's a story that is often, in my view misconstrued, people often talk as though Victor Frankenstein's sin was creating the type of life he created. I think it's equally legitimate to read the book as it being that his sin was to abandon his creation rather than seeing his experiment through and assuming responsibility for it. I think more than one moral can be taken from it yet.*

Some interviewees went further, arguing that literary allusions can be used as a stand in for broader ethical arguments. For example, David Wood shows how the complexity of two-tiered society arguments are captured in GATTACA.

> *David Wood: GATTACA we briefly talked about it, often seems to come up in discussions. People say, "well look at GATTACA that shows we don't want that kind of future world". Those who are Left-handed or had some other genetic defect that wasn't fixed. They were viewed as a second class, and they got the worst jobs to do. They weren't selected for the really exciting glamorous jobs. So that model is there and it's not a simple picture. That's a complex picture.*

While Sandy Starr was keen to praise the role literary allusion could play in debate, particularly as a tool for thinking about NEST-ethics, he did think it might be misleading if science fiction allusion was used too literally in debate.

> *Sandy Starr: Science fiction is a fantastically useful tool for thinking about new technologies, Frontier Technologies, and how they might be used in future. It's potentially misleading if you take it too seriously and it's never entirely accurate. And I think one thing that people fail to anticipate in science fiction about genetics and genomics is the extent to which genome sequencing might become ubiquitous, not forced on people by the state but potentially embraced by people with a curiosity about it and so forth.*

While some informants relished the use of literary allusion in the debate as a tool to promote reflexive thinking on new technologies, others pointed out that these arguments did not reflect the reality of our world.

> *Bruce Whitelaw: You could come up with any sort of science fiction story about how you could create sub-races and super-races and so on […] I think you've got to trust society; they aren't going to let it happen.*

Going further than Whitelaw, Helen O'Neill expressed her frustration that literary allusions travel from one debate to another little sense-checking on their utility.

> *Helen O'Neill: You could remove each of those words from those arguments and paste in "genome-editing" and they're the exact same arguments that are just being repeated throughout time. Ethical arguments mostly weigh in on the dystopian side. These arguments disregard the fact that there is very strict legislation around the use of gametes, the use of embryos and the use of genome-editing. [...] These arguments are repeated again and again with each generation of technology.*

Whitelaw echoed O'Neill's sentiment in an expanded earlier quote, where he describes how doesn't consider there to be a difference between the hGGE debate, and any other sort of technology debate:

> *Bruce Whitelaw: Deep down, I don't think there is any difference between this debate and with any other new technology debate, and the fears are the same, there are slippery slopes, technologies can be uncontrolled, we might generate monsters.*

Literary allusions are a type of moral metaphor that are used in the debate to encourage participants to think about how technologies might be used in the future. They are prevalent in the UK hGGE debate, but they are not new, rather they are often carried over from previous debates. While literary allusions are a good jumping off point in debate, they can be misused (So, 2019), and as Sandy Starr pointed out, they can be problematic if taken too seriously.

The purpose of the literary allusions — similarly to other types of moral metaphors — is to create a shorthand, rather than expounding an ethical argument. The way that literary allusion does this is in reference to a famous character who has committed a folly in the text (e.g. Dr Viktor Frankenstein). Often the subtext of these literary allusions is about losing control or not taking account of unforeseen consequences associated with a particular technology. This leads to the position that if we could control the technology then that would make it ethical — but this is not necessarily the case, there needs to be a fuller discussion about ethics.

Literary allusion can sometimes be unhelpful in debate, as they often lead to counter-narratives in debate. For example, I observed at conferences examples of where a literary allusion was used and another person on the panel challenged the argument based on the speaker's interpretation of the original source material. An example of this challenge occurred at the 2018 PET event in

Edinburgh, where Sandy Starr challenged Calum Mackellar's interpretation of the text *Frankenstein*. Mackellar was using the text heuristically to refer to why new technologies can represent threats to existing ways of living, whereas Starr corrected Mackellar's account stating the book represented to him an argument *for* responsible research and innovation (2018).

Moral metaphors are often derived from, and contribute to, sociotechnical imaginaries. Literary allusion is no exception: it aims to create opportunities to explore the potential consequences of new and emerging technologies, but in doing so can entrench normative ideas about what technologies are and how they may be used. Moreover, as these metaphors are developed in the agorae of the debate, it is likely they will migrate to the observatory and the arena in the future. In doing so, they will take with them a set of images and stories that reflect sociotechnical imaginaries in the debate, whether they be utopian (for the proponents) or dystopian (for the opponents) interpretations.

5.5 Metaphorical wranglings — how metaphors shape preparatory debates

As I have set out in this chapter, metaphors are an essential part of the language that shapes biotechnology debates. Another key concept that is related to how language is used in debates, and that is often metaphorical is securing the nomenclature of the debate. By 'securing the nomenclature', I refer to how the terms for what we call technologies are cemented in debate.

For example, I talked in the literature review (Chapter Four; Section 4.3) about the securing of the term 'pre-embryo' in the UK embryo research debates in the 1980s. The first 'real world' embryo debate I will address is that of the 'pre-embryo', which occurred in the UK in the 1980s. Pre-embryo is a term that was constructed specifically for these debates and refers to an embryo that does not yet have embryo status.

The example of the pre-embryo shows how language used in debate can shape ontology and normativity of a debate. In the case of the construction of the pre-embryo, discussions of future persons were excluded from embryo debates by drawing lines around personhood. Moreover, the example describes how rhetoric, metaphors and boundaries were essential to creating a version of embryo that could be palatable for the use of embryo research. This is one of the first examples of what I describe as the 'purification' of embryo debates.

Example case: securing the nomenclature of mitochondrial replacement techniques

I have discussed previously in this chapter the role of securing the metaphor of mitochondria as the 'batteries of the cell' over the 'three parent babies' metaphor. I have then discussed how the 'three parent babies' metaphor raised concerns for proponents of MRTs because they feared this metaphor both overstated the role of MtDNA (Baylis, 2017) and that this metaphor conflated genetic contribution with parenthood. While these examples show why it was important to cement metaphors used to describe MRTs, it was also essential for proponents to secure the nomenclature used to name the techniques in debate.

For example, by terming the technology 'mitochondrial replacement' those arguing for the legalisation of MRTS were able to imply a direction of travel that is the opposite of what actually occurs (Haimes and Taylor, 2017: p. 2). This is because it is not the MtDNA that is replaced during MRTs, but rather the patient's pronuclei that is transferred into an enucleated (donor) egg with normal mitochondria. As well as crudely attributing a direction of travel to the mitochondria during MRTs, the added benefit of the pro-science UK stakeholders securing the terms of 'mitochondrial donation' and 'mitochondrial replacement technique' in debate meant that terms more closely

associated with cloning, for example 'nuclear replacement technologies'[40], were erased from the debate (Baylis, 2017, p. 11). This example for the MRTS debate shows that it is essential to nail down the nomenclature in a period of preparatory debate[41], where actors 'prepare' their arguments for future policy debates, because the same terms might later be solidified in discussion.

Securing the nomenclature of the hGGE debates

A number of informants mentioned in their interviews how important language was in the communication of the UK hGGE debate. For example, Informant One, Amarpreet Kaur and Nick Meade all described how the communication of hGGE had been integral to debate:

> *Informant One: One thing that is interesting is how much attention to detail there has been to communication and to engagement as an important, and some may say integral, part of developing the science. Comparisons have been drawn with the debate on GM foods, which is a paradigm example of how not to communicate well.*
>
> *Amarpreet Kaur: It's about using the right terminology and making sure that it conveys what you are trying to express. It's making sure you get these early terminologies right.*
>
> *Nick Meade: We decided that given it is a controversial technique, and one that is not well-understood, that we would work to ensure our members understand it well, and also work to try and ensure it is discussed in clear and constructive ways to do our best to play a role in protecting the potential of genome-editing for our community [people living with rare and heritable genetic conditions] from any adverse*

[40] 'Nuclear replacement techniques' would be a more accurate name for MRTs as it is the nucleus or spindle that is moved to the enucleated egg cell of the mitochondrial donor. However, 'nuclear replacement techniques' were likely too close to 'nuclear transplantation' or 'somatic cell nuclear transfer' are both terms used to describe reproductive cloning techniques (Baylis, 2017).

[41] See Section 1.3 for a discussion of preparatory debates.

publicity discussions or bad press that might arise through spurious connections to other uses of genome-editing.

Fiona Fox, Director of the SMC built on Informant One's point in her interview, describing that the SMC was set up by scientist to help improve communication around new and emerging science and technology:

Fiona Fox: The Science Media Centre was set up by the scientific community because of stories like GM crops, MMR [a live vaccine that protects against measles, mumps and rubella] animal rights extremism and so a number of really big stories at the end of the 1990s and early 2000s that were not playing very well to the scientific community. So scientists were just not very effective in engaging with these ongoing rather hysterical media frenzies around these subjects. So we were set up to be a press office for science but not linked to any one institution, to be helpful to all of those scientists who found themselves with their area of science in the headlines.

What is particularly interesting about the UK context is the attempts made by organisations, for example a document jointly published by PET and Genetic Alliance UK, to control the discourse of genome-editing in the UK context. The report (*Basic Understanding of Genome-editing: The Report*) (2018) is written for people or organisations wishing to discuss genome-editing in public. The report contains a number of key recommendations for communicating genome-editing as well as reinforcing some of the boundaries I have discussed.

1. Use the term 'genome editing' exclusively. Do not use potentially confusing alternatives such as 'gene editing', 'genetic editing', 'genomic editing', 'genome engineering' or 'genetic modification'.

2. Before attempting to describe or discuss genome editing, ensure that your audience has some understanding of what a genome is. Explain this if necessary.

3. Prioritise explaining the use(s) of genome editing over explaining the mechanism(s) via which genome editing works. Deprioritise the term 'CRISPR' – do not use the term interchangeably with genome editing (as CRISPR is just one possible approach to genome editing), and think carefully about whether and when it is necessary to refer to CRISPR at all.

4. Explain genome editing as straightforwardly as possible, certainly in the first instance. Use simple analogies and metaphors – 'find and replace', 'copy and paste' and 'cut and paste' work well, and build on the fact that 'editing' is already something of a metaphor. Metaphors have their limitations, but they are useful in establishing basic understanding before attempting to go into greater detail.

5. When discussing uses of genome editing, distinguish clearly between:

- Human and other uses.
- Current and future uses.
- Research and treatment.
- Uses that are currently permitted and uses which would require regulatory change.

it may also be important to distinguish treatment from enhancement, but refrain from suggesting that there is a settled consensus on what this distinction means and where it lies (as that particular debate is ongoing).

6. When discussing a use of genome editing that relates to humans, take particular care to address whether or not it could (intentionally or inadvertently) affect the human germline – in other words, cause a heritable change to the genome.

7. Be prepared to have to differentiate between genome editing and genome sequencing and/or between genome editing and mitochondrial donation, as these are common areas of confusion. Having made it clear that these are different things, then bring the conversation back to genome editing.

8. Do not expect complete retention after one explanation of genome editing, no matter how well-received the explanation is. The message will need to be repeated multiple times, in order to achieve enduring comprehension.

FIGURE 3: EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS OF PET AND GENETIC ALLIANCE UK REPORT

The purpose of the PET and Genetic Alliance UK document is to "The project aimed to explain genome-editing to patients, parents and carers affected by genetic conditions to enable them to discuss genome-editing and participate in future discussions about this important technology." (Genetic Alliance UK, 2022). By trialling different explanations and metaphors around genome-editing PET and Genetic Alliance UK were able to glean useful insights on how best to shape the discourse around genome-editing. A key point of this exercise was to learn from negative metaphors that have impacted both the MRTS ('three-parent babies') and GM Crops ('Franken-

foods' (Hellsten, 2003)). The report also contains suggestion of the best metaphors to use, tested on publics to suggest which metaphors they found to be the most useful. Sandy Starr who helped facilitate the project described the project in his interview:

> *Sandy Starr: The project sought to find out what people thought and knew about genome-editing and what ideas and terminology are either an aide or an impediment to their understanding.*

Starr later condensed the findings from the report into an article in the *British Medical Bulletin*, where he described the "[…] comprehension of genome-editing and a *lingua franca* with which to discuss the subject are important prerequisites for informed debate." (Starr, 2018, p. 6).

Fiona Fox, the Chief Executive of the Science Media Centre who regularly contributes to UK biotechnology debates, reflecting on the role of language described this securing of the nomenclature of the debate in her interview as coming from the scientific community:

> *Fiona Fox: There's been an attempt this time round, to get the scientific community to use similar terms to each other, in order to not confuse the public and have people think that gene-editing is something different to genome-editing or CRISPR is something different again.*

Fox's quote might imply that while the findings of the PET report aim to reflect the terms the public sought to use in debate, the securing of the nomenclature is an activity that is being completed for the benefit of scientists. One of the most important features of this report, which was reiterated by Starr at following PET events, is that genome-editing is the term that should be used over 'gene-editing' or CRISPR. Starr describes the problems associated with the use of CRISPR: "In truth CRISPR is not a synonym but a synecdoche for genome-editing, and a potentially misleading one at that. The approaches that preceded CRISPR are not obsolete, but remain important in the present day (notwithstanding their limitations)." (2018, p. 9).

While acknowledging Starr's reasoning, Amarpreet Kaur rejected the term genome-editing when it came to recruiting a public sample to survey on the hGGE. She found the term was intangible for publics.

> *Amarpreet Kaur: One of the recommendations of that report is to use the word genome-editing, and my survey purposefully chose to use the word genetic editing, instead of genome-editing. [...] Because people knew what genetic editing was, they were more likely to click on it and that's how I got the response rate that I did.*

This point around the use of genome-editing, rather than gene-editing or genetic editing was also picked up by Informant one, Kaur and Nick Meade:

> *Informant One: Gene-editing, as it was first called, genome-editing is the term that has now come into use.*
>
> *Amarpreet Kaur: If you have read any of the recent literature you will have seen the evolution in the terminology. When discussions first started happening in 2015, we called it human germline genome-editing (hGGE) and now they are trying to call it something else.*
>
> *Nick Meade: We always use the term genome-editing, rather than jumping around between genome-engineering, and gene-editing, etcetera.*

What is most interesting about this attempt to control the nomenclature of debate in the UK is how readily it has travelled to different spaces for debate. For example, during the House of Lords debate in 2020 Baroness Bakewell stated at the beginning of the debate that the technology be referred to as 'genome-editing'. Lord Winton maintained an 'objection to the attempts to change the nomenclature' (Hansard, col. 1529). Winston likened these attempts to control the narrative of the technology to the change of the embryo to the pre-embryo (Mulkay, 1997).

What Baroness Bakewell aims to achieve, and what the PET and Genetic Alliance UK paper sets out is an attempt to cement the nomenclature of the debate. In her interview, Fiona Fox[42] set out why it would be important to be controlling discussion in this manner:

> *Fiona Fox: I used to be the chair of the trust [PET], and I think they and Genetic Alliance have done a huge amount of work on this. I mean you notice I'm calling it genome-editing, not gene-editing. They came out with this thing to try and start to [...] learn the lesson from the mitochondrial DNA transfer debate. That debate got framed very early as a baby with three parents and the journalist loved that. They think it attracts readers to stories. So they write about it. The scientists really hated it and said it's really an inaccurate way to present it because the third person in the mix here is a donation of an egg. It's a donation like a blood transfer or donating a kidney or a piece of your liver. It's a donation of human material. It's certainly not parenthood and it's not the nuclear DNA. It's the mitochondria in the egg. So it certainly doesn't define what that child is like in terms of their personality and that's in fact the whole point.*

As Fox points out, securing the nomenclature of the debate can have an important normative function in debate. This has been particularly important for some actors in the debate such as PET and Genetic Alliance UK who have gone to great efforts to secure the nomenclature for the UK hGGE.

5.6 Conclusion

Metaphors are figures of speech in which a word or phrase is applied to an object or action to which it is not literally applicable. In the hGGE debates, prominent examples of metaphors used to explain genome-editing include editing metaphors (molecular scissors, cut and paste) and computing metaphors (find and replace, RNA as molecular sat-nav). In this chapter, I examined

[42] Fiona Fox, the chief executive of the Science Media Centre.

these discourses as they occur in the various agorae of the UK hGGE debate. I showed how mechanical metaphors, such as molecular scissors, imbue the debate with normativity by implying 'correction' (through editing), emphasising a presumed precision of the technology, rendering the role of the scientist in genome-editing invisible. I demonstrated that rather than being a useful shorthand for explaining complex abstractions in debate, metaphors often blackbox the very concepts they try to elucidate.

I then gave an overview of some of the moral metaphors used in hGGE debates in the UK, such as moral threshold metaphors (bright line, letting the genie out of the bottle) and descents into moral decay (slippery slope, thin end of the wedge). I also examined the role of literary allusion in debate. I showed that moral metaphors were generally carried over from previous debates and were often used to create a shorthand, rather than expounding an ethical argument. Moral metaphors were often met with counter-narratives in debate, and they were often derived from, and contributed to sociotechnical imaginaries.

I showed that metaphors can be strategic and that in some circumstances, actors argue to secure their preferred metaphor as dominant in the debate. I also explored how some actors in the debate have worked to secure 'genome-editing' as dominant nomenclature in discussion. I have also shown how metaphors in the debate are used to create heuristics for key concepts and arguments without expanding them fully. When metaphors are used as a shorthand to refer to broader arguments, this constrains ethical debate, and blackboxes key concepts in discussion. Moreover, the use of metaphors and literary allusion have been used in biotechnology debates previous to the hGGE and therefore have contributed to the reinforcing of sociotechnical imaginaries in the UK hGGE debates.

CHAPTER SIX: GERMLINE IN THE SAND: BOUNDARIES IN THE UK HGGE DEBATE

6.1 Introduction

This chapter highlights the relevance of boundaries to the discourse of the various agorae of the UK hGGE debates, drawing upon the rich qualitative data I have collected. I also outline the types of boundaries I have identified from my interviews, supported by the analysis of documents, and discuss how and why actors use these rhetorical devices in debate. I show how actors establish, maintain, or erode boundaries in the debate: before recommending that by examining how boundaries are used strategically by hybrid elites, we can better understand argumentative patterns in the debate.

I define boundaries as real or imaginary lines that separate two things. Contrary to the findings of my literature review (Chapter Three) which suggests the ethics of hGGE is usually argued along two lines: the therapy-enhancement line and the germline. I instead propose several different boundaries — some ubiquitous (such as human/non-human) and others specific to the UK hGGE debate (for example, mono-genetic/poly-genetic and therapy/ART) — present in the data I have collected.

Then, through the example of the 14-day rule, I demonstrate that rather than being self-evident and stable, boundaries in the debate are in flux; maintained, reiterated, reconfigured, challenged, dissolved, and repeatedly rebuilt by actors in the debate. I then discuss how my interview informants reflect on prominent boundaries in the debate.

This chapter shows how the same boundary — such as the therapy-enhancement line — might be configured differently by different actors in the debate, that boundaries and their meanings can

shift, and that different boundaries have different functions. I will examine these shifting boundaries in the context of my claim that actors in the debate create scientific, ethical, and regulatory limits by employing discourse around boundaries judiciously. I conclude by examining how stakeholders use boundaries strategically to structure the preparatory debate around hGGE and suggest that proponents' use of boundaries contributes to regulatory slippage. Regulatory slippage describes the character of embryo research in the UK is marked by a linear path toward the regulation of new embryo research practices that promise transformative medical advancement, crossing historical lines in the sand.

Finally, I explore how boundaries can precipitate action in debate. For example, where the meaning of a boundary is open to interpretation or where the significance of a boundary has shifted can impact how actors use these boundaries. Therefore, the strategic implementation of boundaries can change how hGGE is constructed and understood. In this context, boundaries can be used to prioritise or block off specific arguments, or ethical reasoning.

The antithetical nature of boundaries implies two sides to every story. Where one group maintains and establishes boundaries (for example hGGE opponents), another group might seek to erode and redraw these boundaries (for example hGGE proponents) and *vice versa*[43]. I will elaborate on the proponent and opponent groups in Chapter Seven, when I discuss how boundaries are mobilised in the agora where I seek to represent these dynamics with the data I have collected. I also aim to emphasise the role of ethical boundary-work during this phase of the preparatory debate.

[43] I will elaborate on the proponent and opponent groups in Chapter Seven, when I discuss how boundaries are mobilised in the agora.

6.2 Boundaries in the UK genome-editing debates

What is a boundary?

For the purposes of my thesis, I define a boundary as a real or imaginary line that separates two things. For example, a common and useful boundary in the UK genome-editing debates is the differentiation between human and non-human. This boundary represents multiple types of distinction intrinsic to the human/non-human divide. The example of the human/non-human distinction represents a scientific boundary and a cultural boundary. Secondly, this boundary has a regulatory dimension (regulating genome-editing in humans would fall under the HFEA or the Human Tissue Authority, whereas separate regulators cover the remit of plants and animals). Thirdly, the distinction represents a legal boundary (the HFE Act 2008 regulates human embryology, whereas the Medicines for Human Use (Clinical Trials) Regulations 2004 would govern human somatic applications of genome-editing — such as gene therapy).

Boundaries are an important element of debates generally, and bioethical debates in particular (see Mulkay (1997) and Hurlburt (2018) for examples) as well as genome-editing debates (see Baylis (2019) and Evans (2020) for examples). Boundaries are also used to differentiate between two concepts that need to be separated from one another for debate. Again, the human/non-human boundary is an excellent example of this.

While genome-editing can edit the genome of both humans and non-humans, separating along the human and non-human boundary allows for a more heterogeneous group of actors to contribute to a debate that *only* discusses hGGE. The alternative would mean that other groups (such as plant scientists) might be included in the debate. Therefore, by separating debates to focus on human applications of genome-editing, they have more time (and concentrated relevant expertise) for

discussion. However, while this approach will likely produce the most succinct debate, that does not mean that this approach is best, and perhaps including a greater variety of expertise, comparing issues across species, could enrich debates.

The debates that I focus on in this research are further specialised still. The UK hGGE debates focus on proposed germline applications of genome-editing in humans and, as a result, exclude discussion of non-germline interventions (such as gene therapy). Thereby excluding these actors and their arguments from the debate. As, for example, it would be unlikely a gene therapy expert would be invited to speak at an event on the ethics of germline modification, and similarly they may not wish to attend as they may not consider the topic relevant. As such, the drawing of boundaries around the topic of debate has an important influence on the dynamic of debate, e.g. the broadness of discussion and expertise involved.

How are boundaries constructed and contested in debates

While some of the boundaries I have identified from the data are present in preceding biotechnology debates, other boundaries are new and specific to hGGE. For example, the germline was a significant factor in the UK MRTs debates, particularly concerning female offspring, whereas the line between mono-genetic/poly-genetic applications has been more central to the UK hGGE debate. Boundaries are a research tool used in a number of analyses in biotechnology debates (see Mulkay (1997), Dimond and Stephens (2018) and Evans (2020) for examples). The role of boundaries in debates can therefore be used as a research tool and it is also an element of analysis in the ethics of new and emerging science and technology (NEST-ethics) (see Swierstra and Rip (2007), Swierstra and colleagues (2009), and Swierstra (2016)).

As I discussed in Part Two of the literature review (Chapter Four) NEST-ethics is used to describe observable characteristic tropes and patterns of moral argumentation in ethical discussions. Swierstra and Rip offer an inventory of these arguments and show how these patterns evolve over time. Boundaries are an important element of argumentative patterns in NEST-ethics debates and often shape how proponents and opponents of a NEST interact. I offer a different type of analysis that is derived from interviews and non-participant observation, supported by key documents.

My empirical analysis highlights some boundaries specific to the UK hGGE debates and shows how these debates draw heavily on utilitarian approaches to ethical reasoning. These utilitarian approaches are individualistic and prioritise parental autonomy in reasoning. This approach is often combined with ethical boundary-work (Wainwright, 2006), where moral authority is placed onto the regulator to avoid fully unpacking ethical debate.

Boundaries in the UK hGGE debate

All informants interviewed identified boundaries as a feature of the UK hGGE debate and boundaries were evident in the documents I analysed. I also observed the debate of boundaries at conferences. While the literature shows that hGGE debated along two axes: the therapy-enhancement demarcation and the germline; additional boundaries were salient in the data collected. I give an overview of the boundaries I identified, as well as a brief description in Table 3 below.

TABLE 4: DESCRIPTION OF BOUNDARIES IN THE UK HGGE DEBATE

Boundary	Description
Human/non-human	Differentiating between human and non-human application of germline genome-editing. Human applications, including in human embryos, are within the purview of the HFEA, whereas non-human applications are beyond the scope of the regulator and are instead

	governed by the Department of Environment, Food and Rural Affairs (DEFRA). Non-human includes plants and animals, and in 2021 DEFRA announced a public consultation on the use of germline genome-editing in crops (Ledford, 2021). If genome-editing were to be regulated in the context of plants, this would represent a significant departure from EU approaches, which ban GM crops.
Therapy/enhancement	The therapy-enhancement distinction aims to distinguish what can be considered a therapeutic intervention and what is deemed to enhance rather than treat. However, the therapy-enhancement distinction is rooted in what constitutes 'therapy' and 'enhancement' derived from social and cultural understandings of human disease, treating human disease, and what practices go beyond treating human disease. As a result, the distinction is defined differently by different actors.
Mono-genetic/poly-genetic	The mono-genetic/poly-genetic line is a distinction between edits of single genes using genome-editing and editing multiple genes. Highly regulated mono-genetic applications of hGGE to address disease caused by a single gene was pointed to as a potential route for the legalisation of hGGE, whereas poly-genetic applications were more likely to be described as science fiction, more likely to be error-prone, and that science has not progressed such that these types of applications of hGGE in a clinical context could be considered any time soon.
Therapy/ART	The therapy-ART line aims to describe what type of technology hGGE would be, and therefore how it would be regulated. Those who refer to hGGE as an ART are more likely to be supportive of the regulation of the technology so that it may be used in the clinic, citing MRTs as a potential example of a similar technology that has recently been regulated. In contrast, those who did not define hGGE as an ART were more likely to question what sort of technology hGGE was. Some expressed that hGGE was a 'selection technology' (more analogous to PGD) or a 'disease avoidance technique'.
Germline/somatic	Similar to the therapy-enhancement line, the germline/soma barrier was regularly raised as an example of demarcation in the debate. Those who opposed the legalisation of hGGE were more likely to point to this barrier as a 'line in the sand' (citing arguments around the human germline representing a shared human heritage or dignity), referencing recent MRTs regulation as a key example of regulation stopping short of crossing the germline. In contrast, those who might support the legalisation of hGGE in the future were more likely to downplay the importance of this line pointing out the inconsistencies of permitting other technologies that could permanently alter the human germline

	(e.g. chemotherapy) while not regulating hGGE in certain controlled contexts.
Legal/illegal	The line between legal and illegal is key in regulatory debate as legal actions are permitted by law, whereas illegal actions are not. hGGE is illegal under the HFE Act 2008. For hGGE to be legalised, the HFE Act 2008 would have to be changed to legalise the practice. Some actors in the debate want hGGE to be legalised, whereas others don't.
Regulated/unregulated	Regulation refers to rules or directives maintained by an authority, whereas unregulated means that a technology is not controlled by regulation or laws. Although regulation does not currently exist to allow for hGGE, this does not mean that it is unregulated. The HFE Act 2015 stipulates that placing a genetically altered embryo inside a woman is prohibited.
Ethical/unethical	Ethical refers to whether an action adheres to moral standards. Ethical vs unethical actions are rooted in the individual's understanding of what constitutes a good act. Actors who see hGGE as committing a moral good (e.g. alleviating suffering) are more likely to think of hGGE as an ethical technology, whereas those who think that hGGE commits moral harms (e.g. by selecting persons) are more likely to view hGGE as unethical.
Novel/iterative technology	A novel technology is a technology that is considered entirely new, whereas an iterative technology builds on similar, previous technologies that came before. Actors who define it as a new technology are gearing up for new regulations, while actors defining it as an iterative technology seek to connect to existing regulations.
Thresholds for safety	Thresholds for safety refer to the boundary between the safe or unsafe application of hGGE. Currently, no actors prominent in the UK debate argue that genome-editing has yet reached this threshold for safety for use in humans, although some actors suggest that this could be reached in the future with advances in science.
Thresholds for efficacy	Thresholds for efficacy refer to the boundary between the efficacious and inefficacious application of hGGE. Off-target effects and mosaicism are cited as two problems that can occur with genome-editing that make it inefficacious. Similarly, to safety, currently, no actors prominent in the UK debate argue that genome-editing has yet reached this threshold for efficacy for use in humans, although some

	actors suggest that this could be reached in the future with advances in science.
Geographical boundaries	Geographical boundaries refer to borders between nation-states and differences in regulatory approaches seen in different geographical areas. Some argue for the UK as being exceptional and progressive in regulation, while others consider regulation in a more global context.
Temporal boundaries	Temporal boundaries are in reference to time and are often used to highlight when the discussion of a technology can be considered 'productive' or 'too early.

While some of these boundaries may *appear* self-evident, Hurlbut describes how distinctions between scientific and non-scientific claims are a product of social process (2018). In addition, in Evans' exploration of the therapy-enhancement line, he describes this distinction as susceptible to 'continuity vagueness' (2020, p. 37) due to the lack of a clear definition of what constitutes a disease.

My approach is slightly different to how boundaries are identified in the existing literature. Similarly, by focusing on examples such as the therapy-enhancement line and the somatic-germline, I demonstrate boundaries in the debate are the product of social processes. In doing so I explore how the concepts that underpin these lines are socially constructed and contested. For example, I show that one of the problems with clearly defining the therapy-enhancement line is because of the fuzzy concepts that underpin it. A result, stakeholders in the debate can interpret boundaries differently. This can stem from context or interpretation; however, I argue that actors will configure boundaries differently for strategic purposes in debate. For example, if actors can't agree on where to draw the line, they might be able to dismiss or compress discussion on the grounds that talking about it would not be productive as proponents and opponents would be speaking at cross-purposes.

6.4 Drawing the line: the strategic use of boundaries in the UK hGGE debates

One of the key ways that boundaries are used in the debate is to constrain certain types of discussion. A key example of this is where proponents of hGGE seek to constrain discussions of enhancement, because they think that a discussion around enhancement would not be relevant, as the technology would never be used in this context. What this argumentative strategy achieves is ensuring that the debate is 'ethically pure' and that there can be no accusations that hGGE may be used for unethical purposes (i.e. enhancement). However, this curtailing of the enhancement debate constrained more broad ethical discussion of hGGE. This purification is a process whereby objectionable elements of the debate are compressed or excluded from the debate, so that the debate held is in a way that proponents feel is appropriate. One of the ways the purification of the debate is achieved is by ensuring arguments included in discussion are 'legitimate'. This designation of some arguments as 'legitimate', and others as 'non-legitimate' subjugates the perspectives of opponents in debate by designating their contributions as irrelevant.

One of the reasons I suggest that enhancement represents a threat to the legitimacy of hGGE is that during interviews, informants from the scientific community were keen to point out that they only supported hGGE in a therapeutic setting. For example, developmental biologist Professor Kathy Niakan, the first scientist to be granted a licence by the HFEA to perform genome-editing on human embryos in a research setting, emphasised the importance of meeting a medical need in clinical applications of hGGE.

> *Kathy Niakan: I mean I'm pretty unequivocal that it really has to be medically justified, if at all. If we want to apply it in the clinic it has to be medically justified.*

Geneticist and Director of the Roslin Institute at the University of Edinburgh Bruce Whitelaw also emphasised the use for enhancement would not be 'wise' but acknowledged that more work was needed to understand in which contexts the technology should be considered enhancement.

> *Bruce Whitelaw: There is a strong belief that this technology could be really useful for humans, even germline therapy. Once we are better at it. Once we know what to do and have some thresholds for what is wise editing, and what is an enhancement, which is not wise.*

Informant One described the process of differentiating between applications of the technology as being a process of 'careful positioning' on the part of those participating in the debate.

> *Informant One: There was a process of careful positioning to say this is basic research and also a narrative around "we can help patients with infertility". So I think the UK's way of positioning itself has been "we want to make the most of this great new research technology, of course we are not going to use it to create genetically-modified babies, look at our regulation". So that's been the narrative that I think has emerged.*

Helen O'Neill also stated that she only supported therapeutic applications of hGGE and described how she preferred to use the limited time available at public engagement events to promote the potential therapeutic good of the technology rather than discussing potential applications for enhancement.

> *Helen O'Neill l: It's not that there's no point talking about it [enhancement] […] I deny its legitimacy because I would rather spend more airtime on the potential for things that would make a good change to people rather than focusing on the potential for enhancement.*

In the context of O'Neill l's quote, the therapy-enhancement line acts as a simple heuristic to differentiate between legitimate and non-legitimate applications of the technology. This is similar to Niakan's quote where she emphasised that she would only support therapeutic applications of

hGGE. This theme of therapeutic applications as legitimate has been borne out in the documentary analysis also. Policy reports on hGGE have discussed potential therapeutic applications at length whilst devoting comparatively less space to discussions of enhancement — often pointing out that enhancement applications are 'premature' and not supported by the consensus view. For example, the following excerpts from the NCoB 2018 report:

> If the purpose of the editing were to obtain greater-than-typical function, rather than preventing a disease, this would be a form of genetic enhancement. These types of uses of hGGE would likely be very controversial, raise many additional societal and ethical concerns, and be scientifically very premature. (p. 88)

The report continued that "[…] interest in using hGGE to "enhance" the human species involves different motivations and raises serious issues associated with discredited projects of eugenics." (NCoB, 2018, p. 96). The therapy-enhancement line is therefore being used tactically not just to represent a scientific line, but also to show that by supporting only therapeutic applications of the technology, actors can demonstrate that they support what they consider to be legitimate applications of the technology.

Organisational reports (see NCoB (2016) NCoB (2018) and Royal Society (2017) for examples) often contain definitions around the therapy-enhancement line to draw lines around acceptable and unacceptable interventions. This is a surprising finding because the purpose of the line is not to denote immorality, but the connotation is that using hGGE for enhancement would be an unacceptable application of the technology, regardless of the type of intervention. However, maintaining this boundary can be difficult even within the same organisation. The NCoB reports produced in 2015, 2016 and 2018 are examples of where changing definitions and approaches of

the therapy-enhancement line have contributed to maintaining this boundary and made the demarcation itself fuzzy and more challenging to understand.

A key reason for maintaining the therapy-enhancement line, therefore, is that over time, proponents of hGGE have sought to transform the boundary from being 'scientific' — aiming to stipulate where therapy ends and enhancement begins — to a moral boundary, seeking to differentiate between legitimate (therapy) and illegitimate (enhancement) applications of the technology. As a result of this shift, the therapy-enhancement line can now serve as a proxy for the legitimacy of hGGE in debate. This proxy for legitimacy serves as a heuristic between ethical and unethical applications of hGGE, as seen by the moralisation of the therapy-enhancement line, where therapy is a moral good and enhancement is *de facto* bad.

The moralising of the therapy enhancement line is not only achieved by the designation of hGGE for therapeutic use as legitimate. Other arguments that conform to this theme are the use of hGGE for enhancement negative purposes, such as creating 'designer babies' and 'genetic doping' in sport.

However, some informants pointed out pitfalls associated with the heuristic of therapeutic uses being necessarily good and enhancement being necessarily morally wrong. Similarly to therapy and enhancement being contextual, they were quick to point out that the good and the bad in therapy and enhancement were also contextual and that it does not necessarily follow that all enhancement is unethical and all therapy is ethical. Bioethicist and Senior Research Fellow at the Future of Humanity Institute in the University of Oxford Anders Sandberg describes how separating enhancement as a distinct practice should not impact whether we consider it a moral good.

> *Anders Sandberg: Now it seems that having it as a separate practice shouldn't affect the ethics of whether you're allowed to do it or not. You can't say that it's the social framing, however the social framing has an enormous effect on how we accept things in society. For example, where a certain practice can be acceptable in certain domains and not acceptable in others.*

Other actors in the debate are quick to point out that another reason for avoiding candid discussion about the therapy enhancement line is tactical because those who seek to use the technology — e.g. for basic science research — want to emphasise the moral good of their work delivered by legitimate applications of the technologies:

> *David Wood: They have taken a political decision, a tactical decision to deprioritise that possible line of discussion because they think it might generate opposition to what they do.*

The deprioritising Wood describes could be a further contributing factor as to why there is no solid definition of the therapy-enhancement line. Wood's quote describes how proponents of the technology seek to block off discussions of enhancement because of fear that this discussion of illegitimate (enhancement) applications might corrupt efforts to regulate hGGE for the clinic. However, it is likely that this blocking-off of the debate around the therapy enhancement line, or the lack of a candid debate as Sandberg describes, is causing debate around enhancement to be compressed — as it fits easily into the legitimate/non-legitimate, moral/immoral heuristic.

The blocking-off of debate regarding enhancement was also a theme generated from my non-participant observation at conferences. Commonly, where actors tried to engage in discussions of enhancement actors, the discussion would emphasise how the science in this area was 'premature', and it would not yet be technically possible to use hGGE for enhancement purposes. Informant Five picked up on this point:

Informant 5: They will say, we're not going to talk about enhancement because that's science fiction anyway, even though it absolutely isn't, and they will say that's not what's under discussion now, and we have to consider each case on its own merit.

This blocking-off of the enhancement discussion served three main purposes. Firstly, it avoids any clarification around the therapy-enhancement demarcation. Secondly, it shifts the focus of discussion back to legitimate (therapeutic) applications of the hGGE, and finally, it reinforces the discursive norms for discussing hGGE, namely that hGGE for enhancement is not a relevant topic of conversation because it is not considered technically feasible or ethical. However, at the time that He Jiankui case used CRISPR-Cas9 to delete the CCR5 gene in twin girls his actions were criticised because this application of hGGE represented an enhancement[44]. Therefore, enhancement at least cannot be considered technically infeasible.

Güneş Taylor points out the potential pitfalls of not having this discussion around enhancement:

Güneş Taylor: So inevitably mistakes will be made, but mistakes will definitely be made if people don't engage and actually have a conversation about this. We have to actually decide in advance. What do we think is good? What do we think is bad? And then put measures in place to prevent things like that happening. And put things in place where the good applications can be brought to fruition. That's just not a conversation we are having at this stage.

Taylor's reservations about moving ahead without a full discussion of enhancement echoes Sandberg's call for a candid discussion around enhancement. In her quote, Taylor is calling for a discussion at the societal level to determine the norms for the discussion of hGGE and stipulate

[44] The reason for this was because the deletion of CCR5 conferred onto the girls an immunity to HIV (Regalado, 2019).

a definition of enhancement. This is a common theme in both conferences where participants will call for further debate to determine the norms for hGGE, or in documents, which regularly call for broad societal debate on a topic (see NCoB (2016, p. 40), NCoB (2018, p. 100), and PET and Genetic Alliance UK (2017, p. 35) for examples). For example, calling for a broad societal debate is a common theme within bioethical debates (see Mulkay (1997) and Dimond and Stephens (2018) for examples). However, it is unclear how elites can adequately support this conversation if there is no robust discussion of the parameters around enhancement in the elite stakeholder context.

A final example of how the therapy-enhancement line is shifting from a moral boundary — concerned with legitimate and non-legitimate applications of the technology — to a morally agnostic, regulatory boundary. The transformation of the therapy-enhancement line to a regulatory boundary would, similar to the 14-day rule, remove the moral ambiguity of the line, rendering practices legal or illegal. Following the regulation of genome-editing in human embryos for basic science by the HFEA, proponents of hGGE have engaged in ethical-boundary-work to present the question of where to draw the therapy-enhancement line as a question for regulators. Wainwright and colleagues first used ethical boundary-work to define how researchers in ethically contentious areas of scientific research (for example, embryo research) would defer any moral judgments about their work onto the regulator. Wainwright's analysis is particularly relevant in the context of hGGE because both technologies are regulated by the HFEA, with their reputation as an 'expert regulator'.

In Wainwright's example, scientists deferred the ethical judgements associated with their work onto regulators and the regulatory frameworks that governed their work alone. However, because there currently exists no regulatory framework for the governance of hGGEs, this would mean that actors were more likely to defer moral authority to other non-scientific actors, for example,

regulators. The data I collected from non-participant observation at conferences highlighted that scientific actors would often confer moral authority onto ethicists or legal scholars in attendance. Furthermore, sessions that featured panel discussions around ethics were generally reserved for non-scientific stakeholders.

Other respondents, such as Helen O'Neill l, have a slightly different position, emphasising the context of the safety mechanisms associated with the UK regulator. These approaches assert the caveat that genome-editing is subject to strict regulation, which would make it difficult to misuse the technology. During interviews, scientific informants pointed to regulation as a 'legitimising framework' (Hobson-West, 2012; Wainwright et al., 2006) even though said regulation did not yet exist. Scientist Helen O'Neill l gave an example of how even basic logistical issues would ensure regulatory authority over the ethics of genome-editing in the lab.

> *Helen O'Neill: You need to have a specific licence for the clinic to give you embryos in order to do research on those embryos. The clinic itself has to have a licence to be able to store those embryos. It's a multi-faceted legal landscape in terms of even procurement, storage, or use of gametes and embryos. So those are the initial barriers that would even prevent you doing any embryo research, let alone germline genome-editing research.*

O'Neill is describing a 'legal barrier', which is a boundary in and of itself, and the ethical-boundary-work that transforms moral boundaries into regulatory boundaries and how regulatory arbitrage (e.g., the efforts labs must go through to ensure their practices are legal, is a clear entry barrier for non-moral practices within genome-editing). However, this is an example of ethical-boundary-work in the way that Wainwright described; just because regulators have set out specific licencing standards does not make practices right or wrong in a moral sense. However, what these regulatory boundaries achieve is conferring legitimacy onto certain practices that conform to regulatory

standards. This is particularly important in the context of the therapy-enhancement line because there is no clear definition of what constitutes enhancement.

This example of ethical boundary-work is deference to regulation (Wainwright et al., 2006) but it is also an example of performing scientific neutrality that is central to Wainwright's conception of ethical-boundary-work. O'Neill l is deprioritising discussions of enhancement neutrally, deferring authority onto legislative frameworks that would govern hGGE.

Whereas traditional approaches to ethical-boundary-work examine scientists, I also found the approach was evident amongst other actors. For example, Nick Meade, Director of Policy at Genetic Alliance UK describes a different type of reasoning for his ethical boundary-work around the therapy-enhancement line:

> *Nick Meade: dividing between use in the human for health context and use for enhancement is also important and then dividing between use in and outside of the human genome is also important. […] Some uses are desirable, and some uses are not desirable, and categorisation helps you make that decision. Also, you know, my organisation Genetic Alliance UK we can't talk about the use of genome-editing for enhancement because our charity is a health charity, for people with a specific set of needs.*

The way that experts talk about enhancement — or deprioritise discussions of enhancement — will inevitably impact the debate more broadly. Where scientists emphasise their support for hGGE in therapy, but not enhancement, they are doing ethical-boundary-work. Hobson-West described this approach as: "Using discursive boundaries, both sets of scientists create an image of their research as ethically legitimate" (Hobson-West, 2012). This idea of using discursive boundaries was not limited to the strategic maintenance of the therapy enhancement line.

Another example of this use of discursive boundaries as a legitimising force came from my non-participant observation at conferences where legitimacy was conferred on hGGE compared to widely accepted analogous technologies — PGD or MRTS. I consider this type of discursive technique serves two purposes. Firstly, it confers legitimacy onto hGGE by creating a 'nothing to see here' rhetoric, that hGGE does not raise any new ethical issues that were previously ethically contentious technologies. Secondly, this technique primes hGGE for regulatory debate.

The discussion of the therapy-enhancement line takes place in a context where most actors acknowledge that there is no clear definition of the line, as Informant Two describes:

Informant Two: We probably can't even draw a clear line, and even if we did, what would it mean?

In this section, I have described how actors maintain the therapy-enhancement line for strategic purposes by maintaining its fuzzy definition, constantly redefining the line, blocking-off discussions of enhancement, and prioritising the discussion of therapeutic (legitimate) application of hGGE. I described how over time; the boundary has shifted from a scientific boundary (to demarcate between therapeutic and non-therapeutic interventions) to a moral boundary (to differentiate between ethical and unethical interventions) to the priming of the therapy-enhancement line as a regulatory boundary through ethical-boundary-work (to distinguish between regulated and non-regulated practice).

Reflecting on boundaries in the UK hGGE debates

While boundaries seem near ubiquitous in the debate, and, although it is possible to create a table that describes the different boundaries, it is less simple to say what these boundaries mean to actors who use them in the debate. Put simply, boundaries can mean different things to different actors.

This contestation can happen for one of two reasons, firstly if actors do not agree on the utility of the boundary, or, secondly, if actors disagree on where to draw the boundary.

I argue that it is this contestation that makes boundaries such an interesting point of study. As well as being contested, boundaries in the debate are fluid and can shift over time. Moreover, I argue that boundaries in the debate have *lifecycles* and that they go through stages of: **establishment** (where the boundary is created and introduced into the debate), **maintenance** (where the boundary is 'kept alive' in debates by those for whom is benefits their arguments) and **erosion** (where the boundary is destroyed in debates by those for whom it benefits their arguments). At this point, the lifecycle starts over as a new line is drawn, and a subsequent **establishment** phase is commenced for the new boundary line. I will present an example of a boundary lifecycle in Section 6.4. Boundaries are contested, and that this contestation may contribute to the cyclicality of boundaries — it also argues that the meaning of boundaries can *shift* over time. I argue that boundaries can move from being considered **scientific** to **moral** to **regulatory** in debate[45].

These lifecycles and shifts that I have identified are not an inevitable linear development of the boundary and how it is used in debate, rather they are caused by the push and pull of actors in the debate to further their own agendas. Similarly, to metaphors, boundaries can be used strategically to constrain discussion and to ethically 'purify' the debate. By constraining discussion, I mean that — similarly to how metaphors were used in the previous chapter — boundaries serve a heuristic function in debate and can be used to blackbox key concepts[46].

[45] The example that I give in Section 5.4 describes the boundary moving from scientific to moral to regulatory, however, this movement is precipitated by proponents in the debate, and theoretically the boundary could move in any direction, in any order. I argue in my conclusion (Chapter Eight) that the examples movement of scientific to moral to regulatory may be evidence of regulatory slippage in the debate.

[46] Blackboxing happens when scientific and technical work is made invisible by its own success (Latour, 1987). In this context, the metaphors increase the opacity of the concepts they try to elucidate.

Another way actors (in most cases proponents) can use boundaries to constrain debate is by employing boundaries to carve out 'legitimate' debate and to confer ethical authority from those in the debate unto others through ethical-boundary-work, rather than unpacking ethical issues fully. Actors in the debate can rhetorically point to the barrier and state the existence (and importance) of the barrier, without the need for fully unpacking the barrier. This is particularly relevant where actors disagree on whether the boundary exists and where to draw the line, because often actors avoid seeking to interrogate boundaries in debate.

Actors disagreeing on where to draw the boundary may be an important element of regulatory slippage, as boundaries are eroded and re-drawn over time, this can lead to the liberalisation of regulation and policy. A final reflection on the boundaries I have identified in the debate is that while I acknowledge that there are a great number of boundaries in the debate, the best data I found on boundaries related to the therapy-enhancement line and the germline, and therefore these boundaries will be the focus of the rest of my chapter.

6.4 The lifecycle of a boundary — exploring the establishment, maintenance, and erosion of boundaries in debates

As well as identifying boundaries, I also collected data on how boundaries are used and understood by the stakeholders in the debate. Stakeholders reflected that they used boundaries to create demarcations that supported their arguments. An example of this from a previous debate is the 14-day rule, which has featured in a number of biotechnology debates in the UK.

Using the example of the 14-day rule, I will show how actors have used this boundary to support their arguments. I will map out what I refer to as the lifecycle of the 14-day rule, where I track how

it was established, defended and eroded by those arguing in the debate as their arguments changed over time.

Example case: the lifecycle of the 14-day rule

An example of an important boundary seen in a number of biotechnology debates that I have already discussed in the Background chapter (Chapter Two) is the 14-day rule. The 14-day rule was initially proposed in the UK in the Warnock Report (1984) and then enshrined in law in the Human Fertilisation and Embryology (HFE) Acts of 1990 and 2008. The rule represents a temporal limit that prevents the in-vitro culture of human embryos beyond 14 days after the onset of embryo creation.

When the Warnock committee originally proposed the 14-day rule, the boundary was rooted in scientific principles. The orthodoxy that underpinned the boundary was that the 14th day should be the latest point in development that embryo research could be conducted as it usually marks the primitive streak and, therefore, the last stage at which twinning could occur (1984, p. 66). In the report, the ontological status of the embryo was deliberately avoided by the Warnock Commission on the grounds that such questions are complex amalgams of factual and moral judgments (1984, p. 3).

As I described in the Literature Review (Chapter Three), Mulkay describes how in the parliamentary debates that preceded the HFE Act 1990, proponents of embryo research (the pro-embryo-research lobby) sought to establish the 14-day point as a significant temporal limit. I refer to this process as **boundary establishment.**

Boundary establishment is the process of making boundaries. It serves two functions, firstly it reinforces that the boundary exists, and secondly it sets up a line for where that boundary should

be drawn. In the context of the 14-day rule the purpose of the boundary was to say that there exists a point at which life begins. The rationale for choosing 14 days was a tactic employed by those who supported embryo research in response to religious criticisms of embryo research. This religious perspective argued that life began at conception, and therefore all embryos should be afforded special moral protection and as a result no embryo research could be considered morally permissible.

The boundary was established and used in debate (see Mulkay, 1997 for overview of the debate) and was eventually passed into law with the ratification of the HFE Act 1990. The HFE Act stipulated that a licence could not authorise the keeping or using of embryos after the earliest of either 14 days or the appearance of the primitive streak.

A key way in which the 14-day rule has been enforced is through regulation. Regulation therefore is a process for **boundary maintenance**. Around the time of the ratification of the HFE Act 1990, scientists could not keep embryos alive for 14 days due to technical difficulties (Cavaliere, 2017). However, in the intervening years following the establishment of the 14-day rule in law, new techniques have made cultivating and storing embryos possible until the 14-day point. As a result, some actors — such as Sophia McCully of King's College, London — in the UK embryology debates are arguing for an extension of the 14-day rule to 28 days (McCully, 2021).

Now the 14-day boundary is less useful to those seeking an extension of the 14-day rule; these actors are seeking to erode the ontological and moral significance of the boundary. If, therefore, the HFE Act 2008 were reviewed, the 14-day boundary might be replaced with a boundary at a later stage of embryo development. I refer to this process as **boundary erosion** (and the process of redrawing the line would be **boundary establishment**). Boundary erosion is where actors seek to destroy or move lines in the debate. Tactics used in the boundary erosion and redrawing of the

14-day rule include emphasising the pragmatic sentiment of the original boundary (Franklin, 2016) and arguments that the 14-day rule did not intend to represent a firm moral boundary for embryo research, but instead a practical time limit (Hyun et al., 2016). Institutions, such as the NCoB, have also contributed to this debate, stating that, "[…] continuing need for a clearly defined line is independent of the question of how a proposed limit might be justified." (2017, p. 6).

In this section, I have presented an example of how the 14-day boundary has shaped the UK embryo research debates. The example shows that boundaries are not innate, inherent and inert; instead, they are in flux, contested, and political. Boundaries are negotiated through social processes, and different actors may think about boundaries differently. Boundaries can change over time. I have described how the 14-day rule has shifted from a scientific boundary to an ethical boundary to a regulatory boundary. During these shifts, I have described how actors can use boundaries strategically to compress broader ethical debate. Finally, I outlined when boundaries become less valuable, actors who seek liberalisation of policy might try to erode the existing boundaries and try and establish a new boundary through preparatory debate.

The life cycle of boundaries in the hGGE debate: the therapy-enhancement line

The therapy-enhancement distinction aims to distinguish what can be considered a therapeutic intervention and what is deemed to enhance rather than treat. As discussed in the literature review (Chapter Three) the therapy-enhancement distinction is therefore derived from social and cultural understandings of human disease, treating human disease, and what practices go beyond treating human disease. As a result, the distinction is defined differently by different actors.

Informant Two, talked about the difficulty in drawing the line in their interview:

> *Informant Two: Yeah, they [the concepts of therapy and enhancement] are very much constructed and we tend to take them for granted even as bioethicists. We will say, look, the therapy enhancement distinction is really problematic, but we can't agree on where a clear line should be drawn.*

This excerpt outlines that the therapy-enhancement line is difficult to maintain for two reasons: firstly, the concepts (therapy and enhancement) that comprise the boundary are socially constructed, and there is no consensus as to where the line should be drawn. Secondly, Informant Two describes how bioethicists take the concepts of therapy and enhancement for granted, which suggests that disagreement around where the line should be drawn could be a symptom of the lack of clarity in the discussion caused by the disagreement about the meaning of these concepts.

One of the problems associated with defining enhancement is that enhancement as a concept is highly contextual. Helen O'Neill, illustrated that one of the reasons that the therapy-enhancement line is difficult to define, may stem from the contextual nature of enhancement:

> *Helen O'Neill: Let's not forget that the enhancement is also a very context dependent situation and, culturally, the context is very critical as well.*

The point that O'Neill is raising is similar to that of Informant Two. They both describe how enhancement is 'contextual'. The contextuality that O'Neill describes is likely contingent upon the social construction of the concept of enhancement itself. However, the contextual nature of the therapy-enhancement line O'Neill l describes contributes to problems in maintaining the therapy enhancement line because if actors in the debate acknowledge the line is both constructed and context-dependent, it may cease to be helpful demarcation in the discussion.

Philosopher Anders Sandberg, a Senior Researcher at the Future of Humanity Institute at the University of Oxford, points out that the ambiguity around the therapy-enhancement distinction could be addressed by a candid discussion around what constitutes enhancement.

> *Anders Sandberg: So already conventional medicine has in some sense these real problems with the therapy enhancement distinction, by essentially saying we are putting the flag very squarely saying this is actual enhancement we are actually aiming at improving something beyond normal function and we are not going to be whispering about that, no we are going to be saying this is the point, that leads to this interesting discussion.*

However, it is evident across the data that I have collected — particularly in the documents and conference spaces - that the candid discussion Sandberg suggests around therapy and enhancement has not featured in the debate up to this point. One of the reasons for not having this candid discussion could be it functions as a tactic for those who seek to maintain the therapy-enhancement boundary. Whilst there is acknowledgement in the literature and in the data that I have collected that the therapy-enhancement line is difficult to define and is underpinned by fuzzy contexts, informants I interviewed continued to cite the line as a meaningful boundary in the debate.

While those in the debate widely acknowledge the therapy-enhancement line to be a social construct, it is evident from the data that I have collected that the line is still an important feature of the hGGE discussion in the UK. The constant redefining of the line in reports and at conferences is a notable example of how this boundary is maintained[47]. For example, the panel discussion at the 2015 annual PET conference titled: *Germline in the sand: The ethics and law of*

[47] Ironically, I have found that the line between boundary maintenance/boundary erosion and re-drawing is in itself fuzzy.

engineering the embryo addressed the question whether editing the genome of an embryo could be described as a therapy or enhancement. Actors in the debate acknowledged that the line was not clear cut and sought to define it.

A notable exception to this theme is the 2018 POST note on hGGE, that did not seek to define the line, but did seek to differentiate between the application of hGGE for "[…] nonmedical enhancements and/or aesthetics" (Border and Kaur, 2020, p. 4) from clinical application. This note, therefore, took the existence of the line, and its meaning as implicit. This is an example of another way of treating boundaries is by using them, but not unpacking what they mean. The tactic is particularly contentious in the context of the therapy-enhancement line because actors generally do not agree on the meaning of the line, or where it should be drawn.

When maintaining boundaries, avoiding candid discussion of the line is a strategy employed by actors in the debate. However, a similar but related strategy for maintaining the therapy-enhancement line is by continually redefining the line. As a strategy, this redefining might be seen as an erosion and line-redrawing. However, in this context they do not change the meaning of the line in any particular way, they just seek to establish the line (and the importance of the line) in discussion.

This line redefining strategy was particularly prominent in my documentary analysis, where policy reports continually redefined the line. Even consecutive reports produced by the same institutions sought to redefine the line for new publications. For example, successive reports on genome-editing written and commissioned by the NCoB in 2016, 2017 and 2018 all contained different definitions of the line, ranging from "[….] some specifiable concept of normal functioning so that treatment (and prevention) concern restoring (or preserving) what is considered normal function and enhancement involves moving beyond normal." (NCoB., 2016, p. 51) to basing the distinction

on moral and legal entitlement, where "[…] healthcare treatments might be owed to people by states, healthcare professionals or insurers as a basic social good, whereas enhancements are pursued privately, for personal advantage." (NCoB, 2018, p. 71).

The redefining seen across the successive reports of the NCoB serves two functions: firstly, it avoids creating a fixed definition and avoids the candid discussion described by Sandberg, which aims to create consensus around definitions of the therapy-enhancement line. One reason proponents of hGGE may wish to avoid creating a fixed definition of the therapy-enhancement line (if this were possible) is that because the line is contested, constantly redefining the demarcation is a strategy essential to maintaining a boundary. Given that informants regularly point out that the line rests on ill-defined or contextual concepts, the line is weak to critics of hGGE, who state that there is no clear demarcation between those applications of hGGE that would constitute therapy and those that would constitute enhancement.

While it is evident that boundary maintenance is a strategy used by proponents of the regulation of hGGE, it is not necessarily clear why. I think that proponents may benefit from a fuzzy definition of the line because they consider enhancement as a threat to the legitimacy of hGGE more generally. As a result, they are more likely to seek to redefine the line successively, rather than having a candid conversation around the line or establishing consensus around the concepts that underpin the line.

6.5 Boundary shifts — how boundaries are configured as scientific, moral, or regulatory in debates

I will now return to the case study of the 14-day rule to explain how boundaries can shift in debate. In boundary shifts, I refer to how the meaning of boundaries can change over time. I argue that

boundaries move from being considered **scientific** to **moral** to **regulatory** in debate. I will show how the changing conception of the 14-day rule as a boundary caused it to shift from it being a scientific boundary, to a moral line, and finally a regulatory boundary.

Example case: boundary shifts and the 14-day rule

As I discussed in the literature review chapter, the fourteen-day rule is not a clear-cut boundary, and it is rooted in contested scientific claims about embryos. Baroness Warnock, who originally set the boundary for the 14-day line in her report, argued that there was no clear boundary that necessitated the line to be drawn at that point. Baroness Warnock reflected on the process stating the rule was arbitrary in the sense that the temporal limit might have been set at a different number of days, "[...] though not very greatly different" (Warnock, 2017).

The rationale that underpinned the 14-day rule (stipulating that the line was drawn at fourteen days) was **scientific**. The Warnock Report made a *de facto* judgement that the fourteenth day (prior to the primitive streak) was the latest point in development that embryo research could be conducted as it is that last stage that twinning could occur (Warnock, 1987, p. 66).

In his book, *The Great Embryo Debates,* Mulkay describes in detail how the 14-day rule became a hugely important **moral** boundary. This transformation from scientific to moral happened when proponents of embryo research sought to influence parliamentary debates by creating the concept of pre-embryo to curtail the burgeoning impact of the anti-embryo research lobby who sought to ban all embryo research. As a result, the proponents of embryo research established the 14-day point as an important moral boundary that stipulated the origin of personhood (Mulkay, 1997). As I have previously outlined in the literature review, it's likely that scientists did not decide on this

temporal point of the boundary out of any true principlism[48] rather out of what Franklin describes as a "[...] certain type of English pragmatism" (Franklin, 2016) cited in (Shaikly, 2017).

The boundary shifted again to a **regulatory** boundary following the ratification of the HFE Act 1990. The HFE Act stipulated that a licence could not authorise the keeping or using of embryos after the earliest of either 14 days or the appearance of the primitive streak. Around the time of the ratification of the HFE Act 1990, scientists could not keep embryos alive for 14 days due to technical difficulties (Cavaliere, 2017).

However, in the intervening years following the establishment of the 14-day rule in law, new techniques have made cultivating and storing embryos possible up until the 14-day point. As a result, scientists in the UK embryology debates are arguing for an extension of the 14-day rule to 28 days.

Boundary shifts in the hGGE debate: the somatic-germline barrier

As I outlined in Part One of my literature review chapter (Chapter Three), the distinction between somatic and germline interventions, where, somatic interventions attempt to modify somatic cells, while germline interventions modify germ cells. The somatic-germline distinction is a scientific boundary and refers to a theoretical scientific concept called the Weismann barrier. Weismann proposed "[…] that hereditary information moves only from germline to body cells and never in reverse" (Surani, 2016), meaning that there is a strict distinction between the lineage producing germ cells and somatic cells. Nick Meade picked up on this point in his interview:

[48]I.e. in this context the scientists did not develop a principle that they thought life began at 14 days, following the primitive streak.

Nick Meade: If you divide them [different approaches] in two, then potential treatments can be as a somatic therapy, potentially involving a genome-editing technique or tool. Or, more hypothetically, as a germline therapy, or a reproductive choice technique.

In their interviews a number of informants stated the view that somatic genome-editing was almost universally considered ethical as most people agree this is an iterative instance of gene therapy. However, they stated that the germline represented a clear moral boundary in the debate, as Sandy Starr explains:

Sandy Starr: There is an assumption, in some circles including ethical circles, that — you know — germline genome-editing is a much more problematic technology, or application of technology, than somatic genome-editing.

While the majority of informants cited the germline-somatic divide as an important discussion point in the debate, the importance of the distinction varied between interview participants. While some informants constructed the germline as scientific or moral, other participants downplayed the importance of the germline, choosing to highlight instead the purposes for which the technology would be used rather than its outcomes. They made the point that it is not necessarily clear why the germline should be used as a distinction between moral and immoral applications of genome-editing. For example, one could envisage applications of germline editing for the benefit of individuals and somatic applications that might harm an individual. Sandy Starr explains that publics are much more interested in the outcome of genome-editing when considering whether it is considered ethical, rather than if it is somatic or germline.

Sandy Starr: And in our [PET] experience, and that of a few other recent papers, the public has not been overly vexed by the idea that you are editing the germline and they've been far more preoccupied with the

purpose for which you're doing it. So is it [the reason for which you are doing the genome-editing] a good one or not, is it justified or not etc. The distinction remains important, but I think that should be taken into account. We shouldn't assume that the public will be more vexed by germline genome-editing even once […] the public understands how that is different from somatic genome-editing.

This point is reiterated by bioethicist John Harris who in a comment piece for PET pointed out that there might actually be a moral obligation to allow germline genome-editing where it might benefit the individual: "Just as justice delayed is justice denied, so therapy delayed is therapy denied." (Harris 2018). The sentiment of this moral obligation is also reiterated in the 2020 POST note, that describes one of the overall arguments in the UK hGGE debates: "The first of these is that hGGE should be for the greater benefit of the individuals born as a result of its use (by outweighing potential risks) provided that their rights and wellbeing are protected." (POST, 2020).

This moral obligation argument is contrasted with those who argue the use of germline-genome-editing would harm future generations, unintended consequences, and question who has the right to make decisions on behalf of future persons or choose that a certain type of future person should not exist.

Informant Two: *So it's very interesting that in our society once a person exists, we include them as best we can and give them all sorts of support, but we still say, basically (quite out loud), that these people shouldn't exist because there's so much going on to deselect these people before birth. So how do you see this ability is very interesting because of these contradictory messages being given.*

Pete Mills: There are no people who are being treated or enhanced, it's about bringing about people with certain characteristics.

> *Informant Three: For example, they said there were cases in which there was no option but reproductive gene-editing if people want to have a related child and I just think that's specious. Their examples were so extreme and not actually pertaining in the real world. Yeah, there is no demand that can be met exclusively by reproductive gene-editing and even if there were, that wouldn't morally mean we were compelled to meet that demand.*

Informants who supported germline applications were more likely to employ broadly consequentialist arguments to diminish the moral relevance of the germline-somatic barrier. Technological pessimists tended to problematise the consequentialist arguments of their opponents. These types of arguments included unintended side effects of technologies. In the case of genome-editing, the erroneous 'unintended consequences' were transformed into 'off-target mutations'. Off-target mutations (or mosaicism) were cited as primary concerns by several participants (Informant One; Informant Five; Informant Two); however, off-target mutations were as likely to be cited by technological proponents as a reason to continue to engage in basic research to refine the technique over time (Niakan, Taylor, O'Neill) so that these risks could be avoided in the future.

As I have discussed previously, the UK hGGE debates are in a phase of preparatory debate. Therefore, while the somatic-germline barrier is still shifting between being considered a scientific and moral boundary the regulatory nature of the barrier may become more relevant as opportunities arise to reform the HFE act 2008. More research would be needed at this time to understand how this boundary is configured in the context of these debates.

6.6 Conclusion

In the introduction to this chapter, I suggested that by examining how boundaries are used strategically by stakeholders, we might better understand argumentative patterns in the discourses of the debate. This chapter went on to propose a number of boundaries I consider influential in the UK hGGE debate. I explored how a strategic implementation of boundaries can change how hGGE is constructed and understood to prioritise or block off specific arguments. Where boundaries are used to block off certain types of argument or ethical reasoning. I argued this was particularly pertinent in the example of the therapy-enhancement line. As it stands, the therapy-enhancement is used to differentiate between two hypothetical applications of hGGE, where it may be used either therapeutically or for enhancement. However, in this phase of preparatory debate, the boundary is used as a proxy for legitimacy and seeks to justify a style of regulation whereby (if hGGE were legalised) it would be regulated for therapeutic use only. The HFEA can then judge on case-by-case basis applications of hGGE that would be considered therapeutic. This is not only an example of 'purification' in the ethical debate on hGGE — where actors seek to stage an ethically pure debate — but it is also an example of ethical-boundary-work, where actors refrain from making their own ethical judgements on a technology, deferring to the regulator as responsible for the decision. Where regulators have the power to determine legitimate and non-legitimate practices of hGGE, this could allow for increasingly interventionist approaches to hGGE to be permitted over time, contributing to regulatory slippage.

CHAPTER SEVEN: EXPLORING THE ROLE OF ACTORS, ARGUMENTS AND AGORAE IN THE UK HGGE DEBATES

7.1 Introduction

In my previous chapters I have focused on argumentation and patterns of argument in the UK hGGE debates, focussing specifically on metaphors and boundaries. While I have introduced the idea of proponents and opponents previously, this chapter explores the role of actors and arguments in the place they come together (the agorae). Based on the analysis of the interactions between arguments, actors and agorae I will argue that for debates to be more comprehensive, the agorae of the debate need to be destabilised to allow for more actors and their arguments to be accommodated.

In this chapter, I draw upon the non-participant observation data collected at conferences, supported by interview quotes. I show how actors, arguments and agorae are continuous and stable in the debate, and how they reinforce and shape one another. The continuity of both actors and arguments in the UK hGGE debates contributes to what I term as the 'stable' agora. I argue that this stability of the agorae that constitute the UK debates on hGGE contributes to ethical discussions that fail to capture the breadth of potential actors, enforces who can speak in which spaces, and dictates what types of arguments are seen as legitimate and non-legitimate in the spaces. These factors are compounded by the proponents of hGGE who work strategically to maintain the stability of the agorae through arguments and who they let into the debate.

The UK hGGE agorae are composed of a group of hybrid elites: including scientists, ethicists and policymakers who impose strict conventions regarding what types of arguments and narratives are seen as legitimate in these spaces. I point out that while the agora as described in the literature

(Nowotny et al., 2003) is meant to be an open democratic space this is not always how the agora *actually* functions in the hGGE debate. I argue that while the spaces where elite stakeholders meet in the debate do function as agorae in a traditional sense (in that it allows actors to meet and exchange ideas) it does not always conform to the principles of openness and democracy. As a result, there is a tension between how these spaces are represented in the debate, and how they work in reality.

Sometimes, developments in the debate such as regulatory reform or the entrance of new actors into (for example, He Jiankui) can give rise to changes in the debate that may destabilise the agora. When this happens, those who wish to preserve the *status quo*, will exclude these new actors and their narratives, or create new arguments and narratives to maintain stability in the agora. I refer to this process as 'ethical shifts'.

While these ethical shifts show that destabilising the agorae is possible, I show that the strategic ways proponents deploy actors, and arguments mean that the agora is incredibly resilient to change and will usually re-stabilise quickly. I argue that the stability of the agora is very difficult to challenge, however, while these debates are malleable, they should happen in the context of a wider discussion on the societal level.

While a debate that is dislocated from society more broadly (to allow for a stable agora) is good for some actors in the debate. For example, the *status quo* is most likely to benefit technological proponents in the debate as their arguments have traditionally been more dominant[49]. This dislocated debate may not be good for the UK hGGE debates overall.

[49] I use `technological' rather than `hGGE' here because hGGE is just one in a series of biotechnology debates. Analysis of previous debates shows a trend of the arguments of technological proponents dominating over opponents (see Mulkay (1997), Dimond and Stephens (2018) for accounts).

As I have mentioned throughout this thesis, the UK hGGE debates have a number of problems. In this chapter I argue that these problems are the direct result of a stable agora. Therefore, to see real change, and to create more comprehensive debate on the ethics of hGGE we may need to consider alternative ways of configuring debate[50].

7.2 Actors, arguments, and agorae in UK genome-editing debates

What are actors?

Actors are the people who participate in the debate. The majority of actors who have the opportunity to contribute to UK debates on hGGE are hybrid elite stakeholders. Hybrid elite stakeholders were originally described by Desmond. Her definition captures a group of elite actors who inhabit "[…] blurred academic, industrial and political fields." (2004). I will split the hybrid elite stakeholders in the hGGE debate into two groups, these are the 'opponents' to hGGE and the 'proponents' of the technology. While there are many ways these actors could be grouped (e.g. by discipline) I have chosen to conceptualise the actors in this way to build on the existing literature that examines other UK biotechnology debates (see Mulkay (1997) who uses proponents and opponents and Dimond and Stephens (2018) who use for and against clusters).

What are agorae?

The agora is one of three conceptual spaces that I have identified in my thesis[51]. It refers to the central public space in Hellenic society. Therefore, it is conceptualised and used in literature to refer to an open space and a democratic platform where different perspectives are brought

[50] I will discuss these alternative approaches to debate in the policy recommendations in Chapter Eight.

[51] The other conceptual spaces I use in my thesis are the arena and the observatory. For an overview of these conceptual spaces and how they interact please Section 3.6 in my literature review (Chapter Three, Part Two).

together, ideally "ultimately creating different visions, values and options" (Barr, 2001; Frederiksen et al., 2003). As such the agora is used to allude to democratic ideals of debate, invoking openness and transparency.

Discussions of the Hellenic public sphere generally refer to one agora at any one time. In contrast, Gibbons and Nowotny's (2001) agora metaphor leaves space for multiple agorae to exist at any one time. I conceive of the agora metaphor in a way that multiple agorae can exist at any one time, with some actors co-mingling (2001) with each other in different agorae. As I previously described in this chapter and my methodology chapter (Chapter Four), I have chosen to focus on the PET annual conference as an example of an agora[52]. Both interviewees and previous findings from similar research (Dimond and Stephens, 2016) highlighted the PET conference as a space for exchanging ideas on new and emerging biotechnologies. As well as the conferences themselves, PET produces material sources, such as conference texts and outputs.

The annual PET conference captures the ideal of the agora; it aims to host open and transparent discussion, and it is held up by many of my interviewees as an example of a space where actors can come together and exchange ideas. However, the conference also illustrates the inequality of the agora as a conceptual space, for example, in practice there are power imbalances in terms of who can speak. So, for example, while I was able to attend the PET conference and be present in the agora; I was not able to speak; neither were the vast majority of the other people present at the meetings.

So, while the PET conference styles itself like an agora — as an open space and a democratic platform — the spaces I observed during my non-participant observation are less of an ideal for

[52] I attended PET conferences on five occasions as part of my non-participant observation, see Table 1, in Chapter Four for details. I attended the PET annual conference in 2015, 2016 and 2018.

openness and democracy. In this sense they are closer to the original meaning of the Greek term of agora. In reality, the Hellenistic agora was less a marketplace for ideas — where the best reasoning 'won out' — and was more, a space where elite actors dominated, and many individuals did not feel empowered to speak. In Hellenistic life, for example, Athenian women were "[...] particularly marked by their confinement to their home and their exclusion from social, public and economic life." (Cohen, 1989) and as such could not have their voices heard in the agora. While the example of the exclusion of actors is more subtle in conference events like the PET, allowing actors in, only to shut down their arguments in debate, it does not represent an ideal for democratic reasoning.

As I described previously, the event is very selective in the speakers it invites to present. These speakers generally conform to the hybrid elite stakeholder profile, in this context the concern is that dissident voices might affect the direction of the scientific, social and ethical debates. PET is a pro-science organisation; therefore, its annual conference aims to promote the responsible use of emerging science and technology. The majority of the speakers at the PET conferences I attended were scientists. Other actors are included in the conference, such as lawyers and ethicists. However, organisers generally cite these non-scientific speakers as 'widening debate' (Stephens and Dimond, 2016).

Another feature of the agora is that the actors in the agora often call for open public debate. The call for open debate to create 'broad public consensus' has been a feature of every event I have attended in the agorae of the UK hGGE debates and comes from both the proponents and the opponents. However, it has not been discussed (at the events I have attended) what open public debate would look like, how it could be achieved and what form consensus would take.

7.3 Dominating debate: how actors maintain stability in the agora

This section focuses on which actors can speak with authority in the agora and how they construct their legitimacy through arguments. I show that proponents constructing legitimate arguments is essential to the stability of the UK hGGE debates. I focus on UK debates, and predominantly use the PET conference as an example of an agora in the debate, however I also attended other events, such as a Nuffield Council on Human Bioethics (NCoB) launch event and a Royal Society event (see Table 1 for details).

The reason I have focused primarily on PET events is threefold: firstly, PET events happen at least once a year, therefore there are plenty of opportunities to attend more PET events. As a result, the data collected from these events has been an invaluable resource as I have been able to compare these similar instances of agorae to examine the debates. Secondly, PET annual conferences have been used as a site of research by Dimond and Stephens in their research, so there was a precedent for using these events to gather data. Finally, PET attracted a number of speakers I was interested in, often hybrid elites from a range of backgrounds in their panel debates.

This section also builds on previous chapters by giving examples of how metaphors and boundaries are present in key arguments in various hGGE agorae, and how these arguments are an essential for the agora to remain stable. I show that these agorae are indistinguishable from the individuals who intentionally, or unintentionally, construct them. I then explore tactics used by actors in the debate to maintain the stability of the agora.

As I mentioned in my methodology chapter (Chapter Four), the sampling criteria I set out meant that the events I attended were mostly organised by organisations that style themselves as 'pro-science'. Pro-science organisations would include — for example — PET, The Royal Society, the

Wellcome Trust, The Francis Crick Institute and the SMC. While there is a broader range of institutions that do not explicitly identify themselves as 'pro-science' for example the NCoB, Genetic Alliance UK, the SCHB Genetic Alert UK and Med Confidential this does not make these groups 'anti-science'. Neither does this mean they are not comprised of actors with scientific backgrounds, rather, they have a broad variety of different aims they try and achieve in the debate. However, the explicitly 'pro-science' groups can use their 'pro-science' position in the institutional landscape to construct legitimacy in their aims (the progress of science).

As events organised by pro-science organisations will undoubtedly platform pro-science views in high-profile speaker slots and attract more pro-science attendees who will ask questions, it is inevitable that my choice of events will have shaped my data. Moreover, events with a greater number of pro-science speakers and attendees will invariably attract and promote a greater amount of pro-science rhetoric. As such, often my chapter will present proponents' voices and arguments as the dominant views. This was my experience at the events I attended, indeed, Dimond and Stephens found the same thing in their recent analysis of the MRTs debates, they describe how:

> The against-cluster[53] included a smaller set of institutions and individuals with different reasons for opposition. The against-cluster were unable and sometimes unwilling to cluster around a centralised and connected campaign and operated a set of boundary and alignment work practices to navigate and mitigate misalignment among themselves [...]. While the against-cluster recognised distinct challenges of operating against a well-resourced and dominant mainstream position [...]. (2018, p. 47)

[53] The against-cluster described by Dimond, and Stephens were against the legalisation of MRTs.

Moreover, I have found many of the actors who appeared at my events have also appeared in Dimond and Stephens work, therefore I think I can say with a reasonable degree of confidence that the opponents (or 'against-cluster' as Stephens and Dimond describe) were also a minority voice in the debates I observed.

It was clear from my observations at various agora sites that the relationship between actors, arguments and agorae is co-constitutive. Firstly, actors produce and shape the conference spaces, they structure the sessions and invite attendees. Secondly, actors produce the agora in the sense that if they were not physically (or virtually) present, there would be no agora to speak of. Agorae scaffold debate by providing the physical (or virtual) space where actors can meet and mobilise their arguments. When actors come together in agorae to exchange ideas and debate, they are also producing that agora. The final co-constituting factor is that arguments in the debate are both shaped by who can be there, and how the agora can accommodate these actors — this represents the physical limitations of the agora (e.g. can actors physically fit in the space) but also based on exclusivity (e.g. who is invited into the space and who can speak).

There are two main groups of actors in the UK hGGE debate. These are the opponents to hGGE and proponents. I think there is scope to group the actors differently (e.g. by discipline), however I have chosen to use opponent and proponent categories, firstly due to its utility, but also so that my research may build upon insights created by Dimond and Stephens in the UK MRTs debate (2018) which also used these categories. I conclude that from observations in the PET agora, individuals did not organise *themselves* within the debate based solely on whether or not they argue that hGGE should be regulated. Therefore, this categorisation is somewhat artificial — however, in my analysis I show how these different actor groups are more or less likely to converge on knowledge claims, narratives or arguments that support their overall viewpoint.

The most visible proponents of genome-editing in the PET conference were generally scientists or those from a scientific background. I found in my observations that these actors were often given high profile speaking slots at conferences, were usually given the opportunity to ask questions in moderated discussion sections and were very vocal about their support for genome-editing, in specific contexts. Typical examples of a proponent would include Robin Lovell-Badge (Francis Crick Institute), Helen O'Neill (University College London) and Kathy Niakan (Cambridge Stem Cell Institute)[54].

Some proponents would occupy other fields, such as sociology, philosophy or law. In the conferences that I observed, and a finding that others have noted (Dimond and Stephens, 2018), is that these proponent groups do not have the opportunity to dominate debate in the agora to the extent that proponents with scientific backgrounds were able to. A further pocket of the proponent group that was able to dominate debate was actors from the UK regulator the HFEA. During my observations, this role was filled by Andy Greenfield[55] (HFEA Board Member) and Sally Cheshire (HFEA Chair). Other proponents included representatives from rare disease charities, for example Nick Meade[56] (Genetic Alliance UK) or representatives from secular organisations, such as the British Humanist Society[57].

[54] Helen O'Neill l and Kathy Niakan were included in my interview sample. I approached Robin Lovell-Badge for interview a number of times, but he was unable to respond to my interview request. I was, however, able to interview Güneş Taylor, a Postdoctoral Training Fellow in the Lovell-Badge Lab at the Francis Crick Institute in London.

[55] Andy Greenfield left his position in late December 2018, I approached Greenfield for an interview, but he was unable to respond to my interview request.

[56] Nick Meade was included in my interview sample.

[57] I was unable to find a relevant informant to approach at the British Humanist Society. Those for whom I could find contact information had not attended any of the relevant events and therefore were outside of the scope of the sampling criteria.

In the PET agora in particular, these (proponent) actors contribute to stability by determining what arguments, narratives and nomenclature are legitimate. In this sense, I consider the proponents to be the dominant group in the PET agora. Moreover, these proponents do not only engage in either one agora, or one debate, at any one time. The British hGGE debate is the latest in a series of biotechnology debates that have prompted the liberalisation of embryology in the UK. These debates have taken place in agorae composed of similar — if not the same — actors. The continuity of the same proponents being present and acting in different agorae is one of the reasons why they have been so successful at dominating the debate through maintaining the stability of the agorae in which they participate.

A final way that actors maintained stability in the agorae of the debate was by excluding other actors and their views. For example, as Informant Five set out in their interview:

> *Informant Five: I think there are general problems with the discussion of these issues in this country. There are a set of all the institutions that are supposed to make policy on these issues, and they are dominated by scientists, they defer excessively to the views of scientists. People like me sometimes get a word in edgewise but that's about it. We don't get invited to frame the debate instead what happens is that the debates are framed by those institutions.*

Informant Five, similarly to Informant Two described themself as being included in the debate, particularly for example in panel discussions as a token:

> *Informant Two: They have people like me as a token presence.*

Who gets to frame the debate is key to understanding how technologies are constructed and communicated in debate. By, as Informant Five sets out, only including actors for the perspectives of performing open debate, and not giving them the opportunity to frame the debate, their

perspectives are not truly being included. This finding is commensurate with Dimond and Stephens' exploration of the MRTs debate, where they also found that against-cluster actors felt they were tokenised for the purposes of staging open debate.

While some actors felt they were tokenised, the point around exclusivity was also picked up by Amarpreet Kaur in her interview who said that while a lot of spaces like conferences were more open, the majority of events are invite only:

> *Amarpreet Kaur: A lot of the discussions that happen between the stakeholders in this area are generally always invited events. So you have to be known within the community or someone has to have invited you through a connection somehow. It's not just "oh this is happening, and do you want to come" I mean these are very selective panels.*

Fiona Fox picked up on this point of exclusivity when she described how the SMC identified experts:

> *Fiona Fox: We are very well connected with mainstream science in this centre, so we would know both scientists and science press officers in virtually every research institute in the UK [...] so a lot of it is done through press offices, but we also know people, like Robin Lovell-Badge is the most foremost expert on genome-editing in the UK he was arranging a lot of those early meetings where scientists and ethicists got together to look at this area and look at regulatory and ethical frameworks. We found Kathy Niakan because we heard from the HFEA that they were granting a licence to someone in the UK and we contacted Robin and he knew her, he was sitting in the office next to her. But we have criteria for how we recruit scientists: they are people who publish in peer-reviewed journals, who work for respected scientific institutions, who are senior and recognised in their field.*

How proponents construct legitimacy in the debate

One of the themes I identified during my non-participant observation was that proponents were very careful and coordinated about how they constructed legitimacy in the debate. In the boundaries chapter (Chapter Six) I discussed how proponents used boundaries — such as the therapy-enhancement line — as a proxy for legitimacy in the debate. In this section I will show three ways proponents construct legitimacy using argumentative patterns. These are: by promoting legitimate arguments, by curtailing non-legitimate arguments and by encouraging the staging of 'open debate'.

Legitimacy is of central importance to the UK hGGE debates. As discussed in my previous empirical chapters, elite hybrid stakeholders are keen to emphasise their positions as 'legitimate' in debate. Ensuring legitimacy in the agora for proponents meant three things:

- They supported the legalisation of hGGE if and only if there was broad public consensus
- They supported the legalisation of hGGE if and only if the evidence from basic science experiments could prove it was safe, and efficacious and that it would pose no harm to the individual
- They supported the legalisation of the technology if and only if it would be regulated by the HFEA under licence and that approval would be subject to a case-by-case review

As I have previously discussed, the genome-editing debate is the latest in a series of biotechnology debates in the UK. As such, a number of argumentative strategies pertinent to UK biotechnology debates has been set out in the literature up to this point. In this section I will show how when actors come together in the UK hGGE agorae to debate they produce a series of argumentative patterns, including curtailment of debate, the construction of the 'unmet need', and performing

'acceptable' narratives of risk. These argumentative patterns feed into the construction of legitimacy in debate, which I will discuss in Section 7.4.

Argument curtailment

Argument curtailment involves the 'blocking off' of specific arguments within the discussion. During my non-participant observations at conferences, I noted several instances where arguments were curtailed using various techniques. This strategy was predominantly used by proponents to constrain the debate of opponents, when they felt points opponents were making were 'non-legitimate' or 'not relevant'. However, from my observations, I judged that these interventions were more likely used strategically to curtail arguments that did not conform to the proponents ideal 'ethically pure' debate.

An interesting example of how certain types of arguments are gate-kept was raised by Fiona Fox in her interview who described the Science Media Centre's focus on mainstream science:

> *Fiona Fox: We are very mainstream science, we make no apologies for that, we are very open about that. So we are not very good on mavericks, and we are not looking for the minority view on climate change, or on GM crops. But we are very keen that if there are differences — or disagreements — within mainstream science, that we reflect that.*

While Fox is keen to acknowledge disagreement in mainstream science, what is unclear from her quote is how the orthodoxy of mainstream science is set and who decides what views go beyond a difference of opinion in mainstream science.

The first example of argument curtailment is where proponents shut down opponents' lines of reasoning on the grounds that they are speculative. This was a common trend that occurred at a number of PET conferences but most prominently in 2015. Argument curtailment on the grounds

of speculation was used to shut down hypothetical discussions by opponents that considered which applications of hGGE may be morally acceptable.

Proponents would make interventions to curtail this line of questioning, usually arguing that the science was not 'there yet'. Proponents would express frustration at the speculative nature of the ethical discussion and encourage that basic science research continue until the scientific capabilities are suitably advanced to have a relevant discussion. The result is that hypothetical ethical discussion of the application of hGGE is curtailed and does not feature in the agora anymore.

The second example of argument curtailment included was evident at the 2015 PET conference where Chief Medical officer Mark Walport encouraged separating scientific and value-based discussion. This type of argument curtailment — which I refer to as the science-value boundary — implies that ethical qualms get in the way of scientific progress. This type of argument curtailment is best summed up by Stephen Pinker's opinion piece in the *Boston Globe*, that described the primary goal for modern bioethics, to "Get out of the way" (Pinker, 2015).

The example of Mark Walport invoking the science-value boundary at the 2015 PET conference is much more nuanced than Pinker's antagonism. In his presentation, titled: *Why the UK should be leading the discussion on embryo engineering* Walport stressed he believed there were "[...] circumstances where genetic modification of human embryos could be acceptable and that the UK should open this path" (Walport, 2015). A feature of Walport's presentation was that he closed the debate on MRTs, commenting that it had been an excellent debate, and opened the UK debate on hGGEs in the agora.

Walport went on to emphasise that it was important to separate 'scientific' and 'value-based' discussion. By mobilising this science-value boundary in the context of the newly minted hGGE

debate, Walport employs boundary-work (Gieryn, 1983) to differentiate between scientific and non-scientific debate. By implying the success of the UK hGGE debates, the two should be kept separate, Walport legitimised argument curtailment though the science-value boundary. Moreover, Walport emphasised in his presentation that the UK was good at the discussion (Walport, 2015) of new and emerging ARTs — citing the MRTs debate — and suggested that the UK should continue to lead as it considers the discussion on embryo engineering.

The final example of argument curtailment in the agora relates to enhancement. An example of this was at the 2017 annual PET conference where panellists discussed this topic. I discussed in the boundaries chapter (Chapter 6) how the example of curtailment of the debate can refer to, among other things, discussions of enhancement. Similarly to the discussion of how hGGE might be applied, discussions of enhancement are raised by proponents as a risk of hGGE. Rather than the risk caused by harm to the individual (e.g., by off-target mutations) risk caused by enhancement is more multifaceted in terms of its ethical considerations. For example, enhancement could indeed harm the individual in a utilitarian sense if the benefit bestowed somehow made their life less happy, or more painful. However, there are a great number of other harms both to the individual and on the societal level[58] from harms associated with the individual having a more 'closed future' (Habermas, 2014, p. 63) to the impact of enhancement on inequality (Veit et al., 2021), and human dignity (Fukuyama, 2003).

My observations at events found that proponents usually curtail arguments regarding risks posed by enhancement in three ways. Firstly, they argue that scientists would never use hGGE for enhancement, and if they did try, it would be illegal. This approach defers moral authority to decide

[58] For an overview of the ethical implications of enhancement please see my literature review (Chapter Three, Part One).

what is and what is not enhancement onto the regulator and is an example of ethical boundary-work (Wainwright et al. 2006). A second response that also evoked a type of ethical boundary-work, although this interpretation was not included in Wainwright and colleagues' original conception of the term, is that publics would not support enhancement. A third and final way of curtailing the argument of risks raised by enhancement is the response by proponents that enhancement would not be feasible. However, by avoiding discussing enhancement by curtailing debate, as happened at the PET 2017, actors in the agorae forfeit the opportunity to arrive at a shared definition of enhancement through debate.

The examples of curtailment I have set out up to this point have been examples of actors in the agorae using arguments to compress debate and structure the topics of discussion in the agora. However, at the PET conference events there is also a structural way that some voices are given a platform to speak, whereas others had fewer opportunities to contribute to the debate. This structural curtailment was dictated by conference programming. Every Annual PET Conference I attended (2015, 2017, 2018) had a standard format. The morning designated for single-speaker scientific presentations that would set out the technologies that would be discussed that year. The afternoon would be devoted to Ethical, Legal and Social Aspects (ELSA) of discussion and would feature a panel debate. The afternoon would have fewer single-speaker presentations, favouring roundtables or panels. Moreover, these panels would often feature scientific speakers from the morning session. While I support the variety of formats, I do think the science in the morning and ELSA in the afternoon demarcation may be subtly reinforcing Walport's point that the science and value discussions should be separated (2015). As such the programming of the discussions in the agora, is structuring the debate and reinforcing existing power imbalances between actors and arguments.

Constructing the unmet need

The construction of the 'unmet need' has been a central type of argument for NEST-ethics debates (see Swierstra and Rip 2007), and the MRTs debate (Stephens and Dimond, 2018). The purpose of the unmet need is to show who would benefit from the technology today and who might benefit in the future if technology development were to continue. Informants Nick Meade and Bruce Whitelaw discussed this narrative in their interviews:

> *Nick Meade: Because of that massive unmet health need, we put a big focus on looking into the research and treatment development pathways, so ways to improve diagnosis and treatment […] and make sure that regulation is proportionate, so that good quality research can happen and drive towards the development of new cures and treatments for people living with rare and heritable genetic conditions.*
>
> *Bruce Whitelaw: There has to be an unmet treatment need.*

The unmet need is a type of 'promissory narrative' as is essential for maintaining the stability of the debate because it gives proponents an avenue for showing why they support the development and eventual use of the technology. Opponents however object to this approach, as Informant Five set out in their interview:

> *Informant Five: You have a bioethics that 99 percent of the time says that medical benefit is the overriding concern. It is increasingly neo-liberal and concerned with patient autonomy.*

As Informant Five describes, the unmet need is expressed as the medical benefit that can be obtained from the technology. Informant Five also points out that when constructing the unmet need the focus is squarely on the perspective patient (or parent of the perspective patient in cases of hGGE) rather than considering the impact of these technologies more generally.

In the MRTs debate, the construction of the unmet need was essential for garnering support for the technology. As a result, actors who were proponents in the MRTs debate and who are now proponents in the hGGE debates (for example Robin Lovell-Badge and Fiona Fox) aimed to once again construct the unmet need for hGGE in conference agorae. From my observations, I found that there were two arguments for the unmet need for hGGE. The first argument was that hGGE could benefit a small number of individuals and the second argument was a more diffuse promise that with continuation of research a discovery could be made that would benefit many people. Informant Three picked up on this point in their interview:

> *Informant Three: They also, on the basis of rather bad arguments, said that there were cases where there was no option but to use reproductive gene-editing if people wanted to have a related child. And I just think that's specious. Their examples were so extreme, and not actually pertaining in the real world. There is no demand that can be met exclusively by reproductive gene-editing, and even if there were that wouldn't morally mean we were compelled to meet that demand.*

In the debates, a majority of opponents to hGGE accept the argument that continuation of embryo research may yield a discovery that could lead to future benefits, apart from a small number of opponents object to embryo research in all of its forms. However, the majority of opponents would disagree with the construction of the unmet need as it is currently presented by the opponents. They do so on three grounds. Firstly, they argue that PGD is a legal technology that can eradicate the vast majority of genetic disease and therefore hGGE is surplus to requirements. Secondly, they are sceptical about whether the group who would represent the unmet need actually exist. Thirdly, they reject the idea that the couples who would meet the criteria of *needing* hGGE to have a healthy genetically related offspring have the right to have the option of using hGGE.

To unpack this argument further, I will now discuss the opponents first common argument, that the majority of people who would benefit from hGGE, can already benefit from PGD. PGD involves embryo screening and selection to implant the genetically 'best possible' embryo. PGD is legal and is in opponents view a better technology because the selection of disease-free (or genetically 'best possible') embryos precludes the need to edit them, as there is less chance of unintended consequences caused by off-target effects. Opponents used the argument that PGD would be a better and safer technology to use at every event I attended[59].

I will now return to the second argument opponents made, that the population having an 'unmet need' was negligibly small. While proponents at the events I attended were able to suggest hypothetical user groups, they could not point to a clear unmet need in the way they were able to with IVF, MRTs, or indeed PGD. However, at the launch event of the NCoB paper (2018) such arguments began to crystallise. The reason for this crystallisation was that the NCoB report set out on paper — for the first time — the envisioned user groups for hGGE. They stated, "The cases in which genome-editing offers the only option of having a genetically related child while excluding a specific condition (i.e. where a given couple could not conceive a child who did not inherit that condition) are probably very rare." (2018, p. 45). Due to the rare nature of the proposed user groups opponents have continued to attack the unmet need set out by proponents. A counterargument to this claim put forth by a proponent at the 2018 PET conference was that the rise of online community support groups means that patients are increasingly meeting others with the same genetic conditions and choosing to have children, creating the need for hGGE[60].

[59] Sometimes proponents would counter-argue that hGGE would involve less embryo destruction that PGD.

[60] Another counterargument raised by proponents is that hGGE would be a 'one-generation fix' for a number of technologies. This argument was raised by a proponent at the 2018 Edinburgh PET event. However, opponents argued that the 'one-generation fix' was a eugenic practice and was a way of choosing that certain types of people should not exist.

The third argument raised by opponents in response to the unmet need raised by hGGE, but also ARTs more generally, is the implicit value placed by the proponent community of genetically related children. While proponents were keen to frame the opportunity to choose whether to have genetically related children as a 'right', opponents pointed out that there is no 'right' to have children, let alone genetically related children.

Presenting acceptable narratives of risk

A key argumentative strategy I observed used by proponents in hGGE at all of the conferences I attended was controlling acceptable narratives of risks in the debate. The ways in which risk is constructed in the debate by proponents shows a preference for utilitarian ethics, with regulatory oversight ideally supported by broad public consensus. This position is best typified by John Harris who argued for this in the 2015 PET conference that I attended, but since then I have seen more proponents pick up elements of the risk narrative.

There are a number of ways in which this narrative of risk is set up in the agora. Firstly, narratives of risk were individualistic, this was pointed out by Informant Five where they described approaches to new technologies increasingly only focusing on the needs of the prospective patient. Secondly, risks to the individual included risks posed by the safety and efficacy of the technology, but broader societal risks did not feature in the narrative. These risks posed by safety and efficiency were mitigated by claims by proponents that steadily improving the technology would ensure better outcomes. Finally, proponents argued these risks would be managed by a statutory regulatory regime, implemented by the HFEA through licensing based on a case-by-case basis.

In my interviews, for example, both Kathy Niakan and Helen O'Neill pointed out that regulatory oversight would be essential to clinical applications of hGGE. An objection to the proponents'

narratives of risk was the potential for broader societal risks as set out by Calum Mackellar in the same 2015 PET conference panel as Harris. Mackellar raised risks posed by choosing what sorts of people should and should not live and risks to human dignity. In this particular example of the 2015 PET conference panel event, there was no resolution — with Harris and Mackellar speaking at cross-purposes.

Swierstra and Rip have highlighted in their work the stagnation that can occur in argumentative patterns when consequentialist and deontological modes of reasoning combine in debate (2007), and indeed it seems as though the gulf between the two approaches to risk in the 2015 PET agora was too great.

Another key argument that got lost in this debate was Mackellar's argument regarding the risk of enhancement. While Harris' position was that he was in favour of any type of enhancement that parents' deem acceptable for their own children (so long as it is in that child's benefit), MacKellar pointed out that this position was extreme. Furthermore, he outlined risks posed by enhancement. Other proponents on the panel did not wish to engage in the discussion of enhancement, stating it would be unrealistic to expect the HFEA to regulate enhancement (as Niakan and O'Neill said in their interviews). However, with most proponents adopting a utilitarian approach to risk, and with no consensus on what enhancement is, the lack of true engagement on what risks enhancement may pose certainly felt like a symptom of the gap between proponent and opponent approaches to risk.

There are two main themes that underpin the proponents 'legitimate' arguments' regarding risk. These are an individualistic, utilitarian framing of risk, and ethical boundary-work (Wainwright et al., 2006). This individualistic framing of risk was captured by Bruce Whitelaw in his interview when he compared agricultural applications of genome-editing with the hGGE debate.

> *Bruce Whitelaw: In agriculture, we care about the population of animals. The farmer may well care about the individual sow, or ewe that's giving birth or whatever, but generally what he wants is enough of his animals to survive, enough of his animals to reproduce to give him new stock or animals to sell, so he can make a profit. If there is one sick one, he's not going to put a lot of effort into that. So how we treat disease in livestock is a population-based decision. In human beings though, we do have societal questions, we care about the individual.*

While the risk framing considers that only the patient can be subjected to harm, as opposed to border society, the ethical boundary-work does more heavy lifting. There are two types of ethical boundary-work, one is as Wainwright and colleagues described, differing moral authority onto the regulator. The other type is differing moral authority onto the public. While I agree hGGE debates would benefit by being subject to high quality public debate, it is unclear how the broad public consensus described by proponents would actually be achieved practically in the agorae.

Finally, there is a tension with the legitimacy that the proponents set out through their ethical boundary-work. While they are participating in an ethical debate, they shirk any and all ethical responsibility. Publics will decide *if* hGGE will be regulated, regulators decide *how* hGGE will be regulated. Moreover, compared to other styles of moral reasoning, the utilitarian reasoning style discharges autonomy from moral decision-making.

This raises the question of why proponents try so hard to make debates look 'legitimate' and 'ethically pure'. I would argue that the answer lies in boundary-work in a traditional sense (Gieryn, 1983). Ensuring legitimacy in debate for proponents is about protecting the reputation of the UK, ensuring that scientists are seen as ethical practitioners of science and ensuring the continued regulation, and funding of basic science research and of scientists in the field.

Performing nationalistic narratives

A way that proponents try to promote their own legitimacy in the debate is nationalistic narratives. These narratives rest on the UK leading the way in the discussion and regulation of new ARTs, citing successes in IVF, PGD and MRTs. In the context of genome-editing, the critical narrative was that the UK was at the vanguard of regulating hGGE on non-viable human embryos. Therefore, following the licencing of Kathy Niakan's work at the Francis Crick institute in 2016 and the emphasis on the UK's position as a world leader in regulating ARTs and leading ethical discussions on ARTs was central at several events I attended (PET (2015), NCoB (2018), PET (2021)).

Lovell-badge highlighted at the PET event in 2021 that other states often look to the UK for guidance when it comes to regulatory issues. He described that there are "[...] parts of the world where there's traditionally weaker regulation of scientific and clinical research and practice" (Lovell-Badge, 2021), he described how countries like the US and UK should provide "[...] oversight of genome-editing with tools and guidance they might need to derive appropriate governance within the jurisdiction" (Lovell-Badge, 2021).

This point was reiterated by Amarpreet Kaur:

> *Amarpreet Kaur: Other countries look to our legislation for guidance. Especially on genomics because we are leading that field, and we did pioneer IVF.*

Nick Meade picked up the point of the UK's reputation, commenting on the quality of the debate, rather than the regulations:

Nick Meade: I think the UK, we've done Okay with previous similarly — I know it's a bit crass to lump these things in together — but, PGD research involving human embryos, transplanting hybrids, MRTs, these are all topics that have come along and been dealt with quite well within the UK from our perspective.

Meade's point feeds into another key narrative at the agorae I attended is that the UK is central to emerging debates on hGGE because they are a critical 'soft power' nation in debates. Various speakers drove this point home at conferences I attended such as using the metaphor that the UK had a 'seat at the table' for significant discussions such as the Global Summit on Genome-editing. To reinforce this idea of soft power, at the PET event in 2021, Robin Lovell-Badge gave a presentation on the WHO report (WHO, 2021), highlighting how influential the UK had been in its creation, and remarking on the large number of WHO representatives from the UK who contributed to it. In recognition of this soft power, the UK has been chosen to host the next Global Summit on Genome-editing, taking place in 2023.

Calling for open debate

A final way that proponents maintain legitimacy in the debate is by calling for open public debate. The call for open debate to create 'broad public consensus' has been a feature of every event I have attended in the agorae of the UK hGGE debates and the call for open debate comes from the proponents and the opponents. Informant One explained this feature of reports in their interview:

Informant One: There is a much more explicit acknowledgement that this [hGGE] can't really just be something that scientists do, and look after, and talk about. Public engagement or communicating with the public is essential. That has also been reflected in all of the reports and statements that have come out. Particularly around hGGE, there is a clear message that what we need is engagement.

However, what has not been discussed (at the events I have attended) or in these reports is what open public debate would look like, how it could be achieved and what form consensus would take. Later in their interview, Informant One reflected on this point at the global level:

> *Informant One: Everybody is saying it has to be a discussion at a global level, and yet there is very little substance to back up what is going to be an effective, ethical and legitimate way of achieving engagement with publics on a global level. And how that is going to lead to any sort of consensus, or what a consensus would look like.*

Moreover, the irony of this legitimising strategy on the part of proponents is that they fail to achieve open debate and consensus in the agora. As I have described, they often curtail the arguments of opponents and they rarely try to have open debates that might breed consensus, and therefore it is perhaps unrealistic to expect publics to be able to achieve this goal.

7.4 The impact of ethical shifts on the stability of the agora

As I have shown through my example of the PET conference, the UK hGGE debate is made up of actors, arguments, and agorae. Through my analysis above, I have shown how these components work together to ensure the stability of the debate. However, sometimes events occur in the context of the debate that change the moral landscape of the debate which can destabilise the agora by demanding new arguments.

In the remainder of this chapter, I will describe two such events, one an expected event (the legalisation of MRTs), and the other, an unexpected event (the He Jiankui case). I will explore these examples through the lens of ethical shifts. Ethical shifts are carried out deliberately to change legal, ontological, and ethical definitions in order to enable new narratives, arguments and legal instruments. I argue that proponents of hGGE use ethical shifts to shape the moral

dimensions of the technology. I conclude by suggesting that this tactic is uniquely effective in the regulatory landscape of the UK.

What are ethical shifts?

Ethical shift describes actors' deliberate (and often) successful attempt to change legal, ontological, and ethical definitions to enable new narratives, arguments and legal instruments. This stands in contrast to **ethical drift** which refers to the non-deliberate reframing of the assumed morality of an act based on changing societal preferences over time (e.g. having children outside of marriage).

Example case: ethical shifts following the legalisation of MRTs

While the potential of regulating genome-editing had been a topic of discussion in the UK (see Mulkay (1993). Before the MRTs debate, the legalisation of MRTS was a key development on the hGGE debate in the UK. The reform to the HFE 2008 Act that permits MRTs was ratified in 2015 following 10 years of debate on the topic (Dimond and Stephens, 2018), following this period of reform, the actors who had argued for the legalisation of MRTs began to shift their arguments to suggest that germline genome-editing in humans might be the next technological innovation that might help eradicate disease.

The legalisation of MRTs was important because it represented the culmination of a great amount of work done by proponents in the debate and it represented a victory for those who had supported the legalisation of MRTs. The legalisation of MRTs was an important performance of British biomedical culture. Britain was the 'leading the way' in the regulation of MRTs and enhancing its reputation for being at the vanguard of the research and regulation of ARTs. Finally,

the legalisation of MRTs represents a liberalisation of embryology policy, and importantly a legal precedent for hGGE (in female offspring).

There were a number of ethical shifts in response to the legalisation of MRTs, with actors changing their arguments to respond to the new ethical landscape. Notably, this move from the MRTs debate to the genome-editing debate in the UK was captured in Stephens and Dimond's paper "Debating CRISPR/cas9 and mitochondrial donation: Continuity and transition performances at scientific conferences" which described the PET conference 2015 as a 'transitional performance' signifying the closure of one debate (MRTs) and the opening of the next (hGGE) (2018). The 2015 PET conference was also one of the events I attended as part of my research, and I noticed a number of ethical shifts as actors in the agorae created and mobilised new arguments within the debate. One key narrative I identified around the closure of the MRTs debate was presenting the regulation of ARTs as a 'win' for proponents. Firstly, those who had supported the legalisation of MRTs usually presented their regulation as a win. An example of the closure of the debate was Sally Cheshire's presentation titled: *Why the UK is the best place for mitochondrial donation* which described the success of the debate.

In his presentation at the same conference, chief scientific advisor to the UK government at the time, Professor Sir Mark Walport described the UK as being both good at the technology, and good at the regulation of new and emerging ARTs. While this narrative clearly embodies British biomedical political culture, Dimond and Stephens described how this rhetoric represented a closure of the MRTs debate (2018). Walport's presentation showed a clear ethical shift in response to the changing landscape of the debate following the regulation of MRTs, as well as a technological shift with the introduction of genome-editing to the debate. Titled *Why the UK should be leading the discussion on embryo engineering* Walport stressed he believed there were "[...]

circumstances where genetic modification of human embryos could be acceptable and that the UK should open this path" (Walport, 2015). Given Walport's senior position at the heart of the UK Government, his statement did not only close discussions of MRTs, but opened (and legitimised) the genus of a true policy debate on hGGE in the UK.

Another feature of Walport's presentation was that he used the closing of the MRTs debate and opening of the hGGE debate to emphasise that it was important to separate 'scientific' and 'value-based' discussion. By mobilising this science/value distinction in the context of the newly minted hGGE debate. As I discussed previously in the chapter, Walport was not only doing boundary-work, but he was also signifying that the science/value distinction might be a legitimate boundary for the upcoming debate. As well as this example of traditional boundary-work (Gieryn, 1987), Walport also employed ethical boundary-work (Wainwright et. al., 2006) in his emphasis of the HFEA's world-leading capacity for conducting excellent consultation and regulation (Walport, 2015). This example invoked the narrative of HFEA as a 'gold standard' narrative, but implied that the role of the HFEA was central to the legalisation of MRTs. By emphasising the role of the regulator during this transitional debate, Walport was clearly signalling that the same things that make the HFEA a 'gold standard' regulator for MRTs would also make them a 'gold standard' regulator for hGGE. But as I have previously emphasised, effective regulation is not a stand in for robust and comprehensive ethical discussion, and public reason must dictate whether we regulate controversial new technologies, rather than regulatory expertise and capacity.

Walport emphasised in his presentation that the UK was "good at the discussion" (Walport, 2015) of new and emerging ARTs — citing the MRTs debate — and suggested that this should continue as the UK considers the ethical acceptability of leading the discussion on embryo engineering. However, the UK debate on MRTs has been widely criticised (see Scully (2005), Baylis (2017) and

Haimes and Taylor (2017) for examples). I would argue, therefore, that this narrative of 'good at the discussion' is a strategy to stage accountability through engagement and purposefulness through open debate.

In the final section of the PET 2015 conference there was a panel titled *The Ethics and Law of Engineering the Embryo*. Panellists for this event included bioethicist John Harris (King's College London), legal scholar Emily Jackson (London School of Economics), bioethicist Calum MacKellar (Scottish Council on Human Bioethics), and the Church of England's national adviser on medical ethics and health and social care policy Brendan McCarthy. This debate yielded both examples of the ethical shifts following the legalisation of MRTs, and — because this debate contained both proponents (e.g., Harris) and opponents (e.g., Mackellar) of hGGE — examples of different strategies for creating these ethical shifts in the debate.

A key point of tension was discussion of metaphors as actors argued about which metaphors were appropriate for hGGE. Proponents argued in favour of accepting that metaphors with explanatory function (e.g., what I have termed mechanical metaphors in Chapter Five) might have utility. However, they argued that metaphors that implied enhancement (e.g., designer babies) should be excluded from the debate because they are pejorative, and they imply a level of sophistication that genome-editing would be unable to achieve.

Boundaries also featured in this debate, most notably the germline-somatic barrier. Following the legalisation of MRTs a form of germline modification had been legalised. Opponents to hGGE expressed concern that this would be used as a legal precedent to legalise hGGE. Proponents of hGGE who had argued for a clear line between the manipulation of MtDNA and nuclear DNA in human embryos in the MRTs debates, shifted their arguments to de-emphasise the importance of this boundary. They argued instead that it was less important whether edits to the embryo

crossed the germline, than what they were used for. This argumentative strategy, originating from Harris, who stated that there was a moral obligation to edit the human germline in cases where there would otherwise be suffering[61], clearly framed the debate in utilitarian terms. This framing was challenged by MacKellar who took a more European-centric approach to bioethics, arguing that to edit the human germline would be contrary to human dignity (MacKellar, 2015).

This point was also picked up by Pete Mills, Associate Director of the NCoB, in his interview:

> *Pete Mills: Dignity is front and centre to the work that comes out of Germany and other European states, and that human rights discourse is extremely pervasive in other national contexts, and it doesn't feature in the same way in the UK.*

The status of the UK was a key feature, Mackellar had discussed this earlier in the conference in his talk titled *Brave New British Babies*. This challenged the rhetoric within discussion (standing in opposition to Walport's position that Britain should be 'leading the way'), painting the UK as a maverick state (MacKellar, 2015). Mackellar's position was opposite to the proponents who emphasised that the MRTs debate had promoted the UK's reputation for being a world-leader in ARTs debates and that it should serve as a 'blueprint' for future discussions of hGGE.

The legalisation of MRTs clearly changed the ethical landscape of the UK's biotechnology debate. The impact of the legalisation of MRTs meant that there were a number of ethical shifts that played out at the 2015 PET conference as actors sought to establish new arguments in the context of the burgeoning hGGE debate in the UK. Technological proponents sought to close the debate on MRTs and open the debate on hGGE (Stephens and Dimond, 2016), legitimise arguments for the

[61]Harris described the withholding of hGGE on the basis of ethical qualms where its use could reduce pain and suffering to be "wicked" (Harris, 2015).

permission of germline modification (by the erosion of the somatic-germline barrier), frame the ethics of hGGE in terms of risk to the individual, and highlight the impact of legalising the MRTs as impacting the UK's reputation in a positive way, cementing Britain's reputation as a world leader in the field of ARTs.

While the arguments in the PET agorae in 2015 changed, many of the proponents and opponents in the debate stayed stable between the MRTs debate and the hGGE debate. As a result, while the specific arguments changed, a number of the actors who were prominent in the MRTs debate also attended this PET 2015 conference. The stability of the actors in the agorae, (combined with the narrative that the MRTs debate should serve as a 'blueprint' for debates on hGGE, and Walport's assertion that the UK was good at the regulation, as well as debate on new and emerging biotechnologies) meant that while the arguments themselves were different the argumentative patterns remained the same. The example of how the legalisation of MRTs impacted the hGGE debate shows how shifting legal landscapes can cause ethical shifts in debate. However, it also shows that during times of instability the agora of the debate restabilises.

Example case: ethical shifts following the He Jiankui announcement

If the legalisation of MRTs is an example of introducing new arguments into the debate, the example of the He Jiankui announcement shows how the introduction of new actors into the debate can destabilise the agora. Before the announcement, a number of prominent UK actors were set to attend the Second International Summit on genome-editing. Pete Mills described the Summit in his interview.

> *Pete Mills: We have these international summits, but they are essentially summits between China, the US, the UK and maybe a few other countries. They are also summits of the 'republic of science'; they are the*

scientific elites from those countries. They are absolutely dominated by the discourses from there [the US, UK and China].

In a change to the expected plan for the Summit, in November 2018, two days prior to the Second International Summit on Human Genome-editing, a surprise YouTube announcement impacted the proceedings of the conference. Chinese biophysicist He Jiankui streamed a presentation from the Southern University of Science and Technology in Shenzhen where he announced the birth of twins who had undergone genome-editing to prevent HIV infection. The announcement was unexpected, and as a result it got a lot of attention from the media and the international community. A number of informants described this in their interviews.

Helen O'Neill described the initial shock of the announcement in her interview:

Helen O'Neill: And that "you did what?" has rippled across. I have no doubt there have to be people that concur that it wasn't much of a shock that somebody, somewhere would edit a human embryo for transfer.

Fiona Fox, on the other hand, highlighted the reporting of the issue. She praised the reporting but also highlighted how high profile the case had been:

Fiona Fox: I think, scientifically, the reporting of this issue is going really well. [...] The Chinese babies story was probably the biggest story of last year to be honest, and one of the very few that broke through the Brexit stuff to get properly big coverage throughout the world. And I think some people were extremely concerned that it would be a setback for the community, that people would say that this always happens, that science races ahead of regulation and public approval. But I don't think that was the reporting, that's what happened, I think it was legitimately reported.

The announcement prompted a response from the Summit's organising committee who responded that the experiment was irresponsible and that He Jiankui's work failed to conform to international norms. This theme was captured in a number of interviews I conducted for my research:

> *Bruce Whitelaw: There was an outcry about him breaking all the rules, there was a thought that we are the scientific community, and we uphold the rules. But there's also a thought that this stupid person has done this and it's going to put the whole field back. How dare he! So there was a little bit of academic arrogance from the scientific community. But then there was just the whole shock of it, and the choice of target. Personally, I think the genie is out of the bottle, it's not going back in.*

The sense of outrage captured by Whitelaw was reflected in a news article published in *Nature* following He Jiankui's presentation. David Baltimore described Jiankui's announcement as "[...] a failure of self-regulation by the scientific community" (David Baltimore, quoted in (Cyranoski, 2018)).

The 2018 PET conference that followed the announcement was held in December, less than a week after. At this event, that I attended, actors in the agora shifted their arguments in response to the events in Hong Kong. At this time, it was still unclear whether He Jiankui had, in fact, performed hGGE and rumours circulated at the conference that the announcement had been a hoax. Chair of the HFEA Sally Cheshire addressed the He Jiankui announcement in her opening address:

> In the week it was revealed a Chinese scientist may (or may not) have genetically modified a human embryo to make it HIV-resistant, germline genome-editing, the 14-day rule, the use of in vitro derived eggs and sperm in treatment or bringing embryo-like entities into

> regulation will all be challenges in the years to come and I hope we will manage robust debate and consultation on these issues before any legislative changes are potentially made. (Cheshire, 2018).

Cheshire's address captured a theme at the event where UK proponents of hGGE contrasted their approach to the hGGE debate with those of He Jiankui. A new argument that emerged in the debate was that hGGE would only be ethical if it were performed in a highly regulated environment. This point was captured by Helen O'Neill in her interview.

> *Helen O'Neill*: *In terms of the global response to it, I have no doubt that it would not have been the same had it been done in the UK or the US. There's a certain 'wild west' about the east, and people tend to typecast Chinese scientists.*

The UK was positioned as such a highly regulated environment. The legally permissive but highly regulated environment of the UK was cited as an environment where this technology could be used ethically. What is contentious about this line of reasoning is that it creates moral relativism in the debate. The relativism withholds an ethical judgement on hGGE itself and how it is used, and rather makes a moral judgement based on the *context* in which it is used. It is likely that had the context of He Jiankui's actions been different (e.g. had he operated in the UK or US under licence) the response would have been different.

However, as O'Neill 's quote points out, there is some justification for the moral relativism of this case. There are very clear moral failings associated with the secrecy of He Jiankui's work such as the lack of adequacy in the informed consent process — which could not have happened under a

highly regulated regime[62]. What does not follow is that if hGGE is used in an ethical context that the technology itself should be considered ethical. Moreover, this line of reasoning is similar to arguments in earlier biotechnology debates that portray the same technology as being regulated, transparent and ethical in a western context, and unregulated, underground and rouge in a non-western context. Informant One described this phenomenon in their interview:

> *Informant One: The geopolitics of science and innovation are really coming to the fore in this debate, perhaps in a way that is more obvious. The evidence divide is between China and the US, UK, Europe and other 'well behaved' countries.*

This type of relativism is similar to ethical boundary-work, because it confers ethical reasoning onto the regulators rather than unpacking whether or not the hGGE is ethical in and of itself.

In response to He Jiankui's announcement, a number of scientists, particularly those based in the West, presented a united front that condemned Jiankui's actions. This was true also for proponents in the hGGE debates who attended the 2018 PET conference.

The 2018 conference was initially slated to discuss proposed reform of the 14-day rule, however, during the session titled: *Science Marches On: Key Scientific Developments*, panellists[63] discussed the He Jiankui case. Panellists criticised the lack of transparency and sharing of information, arguing this was against the norms and standards of scientific communities. They raised grave concern about the lack of regulatory oversight. Finally, Niakan spoke on how this *particular* use of hGGE was not seen as acceptable. Niakan covered a number of topics including issues around consent and

[62] A contradiction associated with this approach is that He Jiankui was arrested and did go to prison in China (Cyranoski, 2020), so it does not stand to reason that the Chinese context was wholly unregulated.

[63] The panellists for this event were: Kathy Niakan, Evan Harris (former Liberal Democrat MP), Andy Greenfield — Roger Highfield chaired the session.

coercion[64], lack of transparency, He Jiankui's failure to notify his institution about his work, his contravening global consensus on hGGE and her assessment that the pre-clinical study was flawed. Niakan finished by stating "And these are just some of the issues" (Niakan, 2018). The panel denounced He Jiankui's use of the technology but said they urged scientific unity and argued that a moratorium may drive practices underground.

The announcements by He Jiankui prompted calls for a moratorium on clinical applications of genome-editing at the Second International Summit on Genome-Editing, these calls were later formalised into a *Nature* editorial by Lander and Colleagues (2019).

Since Lander and colleagues called for a moratorium on clinical applications of genome-editing technologies, few developments have moved the dial on international approaches to the ethics of genome-editing. In 2020 the Global Observatory for Genome-editing was established to expand the range of questions arising at the frontiers of emerging biotechnologies. However, there remains an impasse between those who would seek to ban the use of heritable applications of genome-editing in humans and those who think that it would be permissible to do so, subject to safety conditions and regulations.

One of the important elements of the He Jiankui case was that the announcement was leaked the day before He Jiankui's presentation. Informants that I interviewed stated this raised questions around whether He Jiankui should be given a platform and allowed to speak (Helen O'Neill, Kathy Niakan, Sandy Starr), but they agreed that it was good he was given an opportunity to explain his actions and informants described Robin Lovell-Badge as chairing this discussion well.

[64] Niakan noted that He Jiankui's team had allegedly funded the IVF procedure, this was confirmed in (Lander et al., 2019).

The development in the debate of the He Jiankui case brought about ethical shifts in UK agorae, most prominently the PET conference 2018 that I attended. When I attended this event, I noted that some of the boundaries, metaphors and arguments had changed subtly to account for this development in the debate.

A key shift I found at the 2018 PET conferences was that generalist narratives about 'rogue states' and 'underground practices' were now replaced with discussion of He Jiankui, who became a physical manifestation of this narrative. The previous PET conference in 2017 (that I attended) was titled: *Crossing Frontiers Moving the Boundaries of Human Reproduction* and covered a range of issues from synthetic human entities with embryo-like features to hGGEs. In a session titled: *The Wild East and the Worried West: Pioneers or Outlaws?* panellists[65] discussed the international dimension of biotechnology research and treatment (including the birth of the first baby born following the use of MRTs).

A key question raised by this debate was whether innovation can take place responsibly outside a regulated environment. There was discussion of the circumstances of the first MRTs baby — born in Mexico to Jordanian parents, assisted by a Chinese clinician based in the USA (Palacios-González, 2018). While this discussion did not represent the West as responsible technology guardians and characterise the East as 'outlaws' as the title of the session suggested, there was concern raised about how biotechnologies such as MRTs and hGGE could be used *ethically* in unregulated states.

An example of this narrative was seen in a report produced by PET in 2022, stating:

[65] The panellists for this event were: Sarah Rappaport, Henry Malter and César Palacios-González — Sally Cheshire chaired the session.

> We are glad to see that the 2018 scandal in China, where three children's genomes were edited in a way that breached scientific and ethical standards, has not turned the public against this technology. We must now do our best to ensure that if germline genome-editing is put to medical use, this is done in a scientifically and ethically rigorous way (p. 39).

While this is an example of ethical boundary-work, introducing moral relativism into the debate, stating the same use of a technology might be ethical if used in one context, but unethical in another, regulatory oversight was cited as the reason, over non-western national identities. However, the concerns raised in the debate were around 'rogue states', 'rogue actors', 'unregulated practices' as immoral and concerns that moratoria would drive practices underground, particularly in a globalised world where there have been instances of medical tourism. Where 'rogue actors' and 'rogue states' were used to justify these arguments against a moratorium in 2017, in 2018, the He Jiankui case — and China — were used as an example.

A final concern, which was raised by questions from the audience, was that He Jiankui's use of the technology would undermine existing attempts to use the technology in a 'legitimate way' (regulated, therapeutic). A number of audience members urged 'not to throw the baby out with the bathwater' by stopping genome-editing in human embryos for research purposes which could lead to 'ethical' applications in the future. Fiona Fox and Helen O'Neill picked up on this community performance in their interview. Fiona Fox cited the He Jiankui case, whereas Helen O'Neill cited Denis Rebrikov:

> *Fiona Fox (on the reaction from the UK scientific community): Which is real dismay, I mean real proper dismay. And I think that wasn't planned, we didn't decide on a key message. We didn't tell the people what to say, but I actually think that that was brilliant because they were, it was very clear to every*

journalist and every member of the public can read the coverage that the UK scientific community were appalled by this.

Helen O'Neill (on Denis Rebrikov): Again, it's just another rogue scientist who makes it more difficult for the rest of us who have a genuine interest in understanding biology and helping individuals with rare disorders.

Similarly to those at the 2018 PET conference, Fox and O'Neill were able to put names to long standing spectres of the debate — such as the 'rogue scientist'. These new scientists are not being let into the debate to discuss their ideas, because how they sought to use the technology was considered non-legitimate. Actors in the PET 2018 conference were highly concerned that allowing these actors into the debate may have a destabilising impact.

However, in many ways, by both excluding these actors from joining the debate and acknowledging their actions the actors in the UK agorae were able to further construct the legitimacy of their approach in portraying the UK as being a 'good' state in the debate. This culminated in a narrative of dismay performed by UK scientists at the PET conference, as Fiona Fox described.

Fiona Fox: [Scientists] *are not interested in putting this stuff into clinical trials before we know it's safe and properly dismayed by somebody who would put the whole field of research at risk in that way.*

While Fox argued the reaction from the scientific community in the UK reacted with *real dismay*, Helen O'Neill and Bruce Whitelaw were more sceptical about scientists' reactions.

Helen O'Neill: Everyone has been forced to adopt this, "oh we shouldn't do this" and "this is an outrage" stance, and while I agree yes, it is an outrage, I'm more annoyed about the fact that this has set back the technology because public and media perceptions of a technology have more of an effect than the science itself.

Bruce Whitelaw: The rules were in place before He Jiankui broke them, he just broke them. But all of these different groups have come out, are they coming out for the right reason, is it because they think that is what is best for society, or are they doing it because they want to promote their association?

What O'Neill and Whitelaw describe is a performance of boundary drawing, in that scientists recognise that their roles, particularly those who use genome-editing in non-viable human embryos for research, are under threat. This is because it may be hard to justify to funding bodies the utility of conducting basic science in a field where there is no clinical application. Moreover, embryo research must be necessary or justifiable because the acceptability of research in non-viable human embryos is often considered morally acceptable in a utilitarian sense. Furthermore, the HFEA cannot grant a licence unless it is satisfied that the basic research will have desirable outcomes (Hauskeller, 2004, p.514) because it can have life-saving clinical applications. Therefore, it is essential that they present this united front to show that this *particular application* of hGGE is unethical, but hGGE as a technology should not be considered unethical.

Since the He Jiankui announcement and the initial response at the 2018 PET event, there has been a more gradual shift in the debate. New arguments, for example emphasising the importance of informed consent, have now become more integral to discussion. What the He Jiankui and the HFEA licensing decision examples show, is that even when developments in the debate cause ethical shifts and arguments change, the agorae of the debate experience periods of instability, but they again re-stabilise.

A key example of this re-stabilisation is the 'writing-out' of He Jiankui from the narrative of the debate. In a presentation at the PET conference in 2021, Pete Mills essentially excluded He Jiankui's experiment from the UK's narrative.

> Perhaps in a slightly more distant future someone will develop heritable genome-editing then the question is how should we use it. So the first question is really a question about innovation: what kind of case do we need to make in order to make the first use of genome-editing. And I'm not actually counting this use that's already been made of it in China but I'll come to that in a minute. The first responsible use of human genome-editing. (Mills, 2021)

How Mills navigates the drawing of the boundary is interesting. The He Jiankui case is removed by virtue of its being considered illegitimate. This leaves scope for the UK's nationalistic narrative of being 'the first' to use hGGE, with the caveat of that it would only be the first to do so in a regulated context.

7.5 From the agora to the arena: waiting for the policy moment

As I have previously set out in my introduction (Chapter One) the UK is currently in a phase of preparatory debate. Preparatory debates are early upstream policy debates that take place in the agora. I described in Section 3.6 that when the 'policy moment' arrives, debates change from preparatory debates to policy debates, and they move from the agora to the arena.

For the time being, the UK hGGE debates are still in a phase of preparatory debate. I have described how actors in the agora use this opportunity to practise discussions, draw boundaries and set out what types of arguments are considered legitimate. When the 'policy moment' arrives, and the period of preparatory debate ends, actors and their institutions will lobby political decision-makers with the aim of promoting legitimate arguments crystallised in the agora with the hope they will travel to the arena and be used in political debate. This policy moment was picked up by Informant Four in their interview.

> *Informant Four*: *We don't have an active strategy to lobby the UK government for a change in legislation, I don't think that's where things are up to. Should things change dramatically and that's a conversation people want to start having then we would be very much part of those discussions, but I don't think that's where things are at this minute.*

In a number of interviews, this 'policy moment' was cited as the tipping point between where the debate on hGGE is speculative, and the point at which there is real curiosity about whether germline editing could be regulated. Informants indicated that this would likely commence with an open consultation by the HFEA and by the DOH to gauge public and expert opinion. Informant Four described the perfect 'policy moment' in their interview.

> *Informant Four*: *I think the perfect policy moment will have a combination* [of pressure from scientists and policymakers] *sometimes there is a big press from science because something has changed and needs consideration, but Westminster and the civil servants have been on the button about this stuff they are not just waiting for science to land on their doorstep.*

A 2022 PET report also made reference to recent attempts to influence the policy debate. The report stated that in 2022: "PET is cited in a parliamentary debate about genome-editing — including by a government minister, who says 'we have committed to engaging world-class academics and expert groups such as the Progress Educational Trust'" (p. 2). What PET is signalling in this report is not only that they consider a 'policy moment' on hGGE to be on the horizon, but also that when that moment arrives, they expect to be a key influencing figure in that debate.

While there is no clear policy moment for hGGE, a recent Regulatory Horizons Council (RHC) report[66] cited this idea of a 'policy moment' in their report on Genetic Technologies. The remit of the report covered "[...] the use of genetic technologies in all plants, animals and microorganisms contributing to agriculture and food production" (RHC, 2021, p. 6), but it did cite a "proposed regulatory trigger" (RHC, 2021, p. 40) for these applications of genome-editing. Moreover, a recent article published in August of this year set out a proposed consultation to be published by the HFEA next month that would consult on a raft of reforms to the HFE Act (2008). These reforms would include — for example — hGGE and The HFEA and whether to recommend extending the 14-day limit for embryo research. The article stated that the HFEA would consider hGGE "[...] if these techniques are shown to be sufficiently safe and medically justified" (Devlin, 2018).

While actors in the debate await this policy moment, it is essential to address the problems I have identified in the UK hGGE discussion. This requires changes to the actors and argumentative patterns which will have a lasting destabilising effect on the agorae of the debate. These changes should include making the agorae of the debate more accessible to a more heterogeneous group of actors, making space for more types of arguments in the debate and challenging compression of 'non-legitimate' arguments to encourage fuller discussion, and taking a more global approach to discussion of hGGE.

David Wood described his concerns with the debate in his interview.

> *David Wood: Some who favour [...] genetic editing, they are able to wrongly pigeonhole many of their critics as tree-hugging, backward looking luddites. In other words, they say we are not going to listen to your criticism because you've clearly never got what it takes to make progress happen, you want to go backwards.*

[66] Andy Greenfield, formerly of the HFEA, sits on the RHC.

So there's an unfair schism which can take place there, and that's why we need to have a more thoughtful, careful, evidence-based discussion, so that people can realise that although they might be quite different ideologically, at least there are some parts on that we can agree on how to examine the evidence and agree about how to go forwards.

Fiona Coyle: And how do you think that debate can happen? How can we address the problems with the debate as it stands?

David wood: It takes hard work.

I share Wood's sentiments that addressing the problems in the debate will be hard. The argumentative patterns I have observed in the hGGE debate — which are reinforced by the actors in the agorae — limit the debate. For example, by only allowing 'legitimate' arguments and ensuring that approaches to risk are focused on risk to the individual there is no space for a fuller discussion of the ethics of hGGE. Moreover, due to the stability of the agora, these patterns of debate are very difficult to challenge.

On the other hand, if these debates are to become more comprehensive, this has to happen while discussions are still malleable and while debates are still in the agora. I showed that in response to the evolving legal and ethical examples, actors in the debate could adapt their positions to create new arguments and narratives. Therefore, if agora were to be destabilised and new actors allowed to enter the debate, this may improve the variety of ethical arguments and approaches.

7.6 Conclusion

In this chapter I have explored the role of actors and their arguments in the agorae of the UK hGGE debates. I showed that actors, arguments and agorae are co-constitutive and that in shaping one another they reinforce some of the problems I have identified in the debate. I focused on how

elite stakeholders produce and mobilise key argumentative patterns in the agorae of the hGGE debates, showing how some actors in the agorae impose strict conventions regarding what types of arguments and narratives are seen as legitimate in these spaces. I emphasised that the exclusivity of the agorae in the UK stabilises the hGGE debate, reinforcing these dominant narratives and argumentative patterns.

I argued the continuity of both actors and arguments in the UK hGGE debates contributes to what I term the 'stable' agora and that the stability of the agorae over time in UK debates. I showed how the agorae of the debate centralises power, establishing dominant narratives, reinforcing ostensibly legitimate arguments, and repeating boundaries, metaphors and allusions from previous debates. This stability in the agorae reinforces ethical discussions that fail to capture the breadth of potential actors, or breadth of their arguments.

As I argued throughout this chapter, the agorae in the UK hGGE debates are not the idealised democratic spaces envisioned by the agora metaphor. Rather the agorae of the debate are elite spaces, and some of the people who might want to contribute to this debate are not being included. However, I have shown that the agorae *can* be destabilised and respond to change. The developments in the debate that have promoted ethical shifts show that the agora is not so entrenched that it cannot be different. There are clear and practical ways that the agorae of the debate can be altered to make debates more inclusive and more comprehensive, that I will set out in my conclusion chapter (Chapter Eight).

While the NEST-ethics tradition describes the NEST-ethics toolkit as an inventory of tropes and arguments, they suggest that an *arena* model (rather than an agora model) is the best way of understanding NEST-ethics debates. Swierstra and Rip argue that many stakeholders are not as interested in the debate on NEST ethics as they are invested in the outputs of the NEST debate.

This idea is highlighted by the use of institutional script following on both sides of the debate by actors (Swierstra and Rip, 2007) who are invested in a policy outcome, be this for the sake of politics, future career prospects or research funding.

By arguing that the NEST-ethics debates are played out in an arena model with proponents and opponents, Swierstra and Rip highlight how argumentative patterns are almost inevitable in NEST-ethics debates. Moreover, Swierstra and Rip's adversarial conceptualisation of NEST-ethics debates rejects the consensus-seeking agora model (2007, p. 18) and as a result, it is hard to see how debates around new technologies can be productive. In their conclusion, Swierstra and Rip argue that a pragmatist ethics might be a solution to NEST-ethics decision-making "[…] by helping develop different tools for 'conflict' and 'dilemma' management to enhance mutual respect" (2007, p. 19). However, the authors do not question how this pragmatist approach would be implemented in debate and if this would disrupt the NEST-ethical argumentative patterns observed in NEST debates. In my approach, which I outline in Chapter Eight, rather than focusing on a particular ethical solution, I propose a series of policy recommendations for improving the 'comprehensiveness' of the debate.

CONCLUSION: MITIGATING MODIFICATION: UNDERSTANDING THE UK GENOME-EDITING DEBATE

8.1 Introduction

This thesis examines debates surrounding the socio-ethical implications of human germline genome-editing (hGGE) technologies, focusing on how hybrid elite stakeholders' discursive and argumentative strategies have shaped hGGE debates within the unique regulatory landscape of the UK. I have analysed discourses as they appear in the various agorae of the debate, exploring how hGGE debates are architected through tools, such as the inclusion and exclusion of actors, rhetorical devices, and argumentative patterns, reflecting how metaphors, boundaries and arguments have been used strategically by stakeholders to imbue these discussions with normativity.

Common themes across my findings from the metaphors, boundaries and argumentative patterns can be organised into three broad categories: (1) the construction of 'legitimate arguments' and the compression of debate; (2) repertoires of risk and the utilitarian framing of discussion, and (3) nationalistic performances and the purification of ethical debate. In this section I will make a number of policy recommendations to address my concern that UK hGGE debates are not as comprehensive as they could be — or as they are presented by actors in the debate — due to the compression of arguments in the debate, the lack of heterogeneity of perspectives in discussion and the polarity of the differing ethical approaches. I will close by raising some questions that might be addressed by future research.

Chapter summary

In the introduction (Chapter one) and background (Chapter Two) chapters of this thesis I set out to examine critical regulatory shifts in UK embryology legislation and discuss how actors and groups influenced these policy changes. I drew similarities between these debates, concluding that UK biotechnology debates are iterative, and that the patterns that exist are a product of British biomedical culture. This section concluded by introducing the term 'regulatory slippage' to describe the linear progress of regulation.

In the literature review (Chapter Three, Parts One and Two) I described how previous scholarship informed my research questions and demonstrated how my own study addresses previously unanswered questions. I argued that my work addressed a gap in the literature in two ways. Firstly, it addressed the rhetorical strategy used to argue ethical issues in the UK hGGE debates, focusing on elite stakeholder discourse. Secondly, it employed conceptual tools such as NEST-ethics and, building upon Nowotny and colleagues' (2003) work on the agora would provide a unique lens for my work, setting it apart from existing accounts.

In my methodology (Chapter Four), I described the decisions I made throughout the research process, including how the study was designed and carried out. I justified using a qualitative approach to address my research questions and set out my rationale for combining elite stakeholder interviews, documentary analysis and non-participant observation at conferences to gather data on the UK hGGE debate. Additionally, I examined ethical issues associated with the project and how I sought to address them. For example, I explored how best to provide a robust consent process that would allow my informants to feel like they had control over the process. I utilised a 'two-way' consent process — adapted from the critical research tradition (Smith and Elger, 2014) — to achieve this.

In Chapter Five — the first of my empirical findings chapters — I gave an overview of the dominant metaphors employed in the debate and split them into mechanical metaphors and moral threshold metaphors. I argued that metaphors can be used as heuristics to signal a type of argument without expanding on the argument fully in debate. I conclude by suggesting that these metaphors constrain discussion and imbue normativity upon important narratives in the debate.

In Chapter Six I highlighted the role of boundaries in the preparatory debate, setting out a full list of the boundaries employed in the debate before focusing on the therapy-enhancement line and the germline. I described the strategic role of boundaries for actors in the debate, describing how actors may seek to establish, maintain or erode boundaries, based on their position in the debates. I argued that boundaries are fluid, and could be configured by actors in a number of different ways, for example the same boundary could be considered ontological by one actor, and ethical by another. I concluded by arguing that boundaries were used to constrain discussion and to confer ethical authority from those in the debate unto others (e.g. regulators). For example, I showed how proponents of hGGE would argue a position of the liberalisation of the HFE Act 2008 — combined with strict HFEA licensing process — to allow for HFEA in 'ethical' contexts.

The final empirical chapter (Chapter Seven) introduced how the concept of the agora could enhance rhetorical analysis of hGGE debates in the UK. I described the role of agorae in the debate and how they differed from other conceptual spaces, such as arenas and observatories. I showed how agorae, actors and arguments were co-constitutive and argued that proponents of hGGE worked strategically to maintain the stability of the agorae through arguments. I concluded by suggesting that the stable agora consolidates argumentative patterns in the debate. Furthermore, because the agorae of the UK hGGE debates are exclusive and not easily accessible, the

heterogeneity of actors and arguments in the debate means that the debate is not as comprehensive as it could be. Rather, it reflects a narrow range of actors and their viewpoints.

Contribution to knowledge

My research fills a gap in the literature by focusing on rhetorical devices and argumentative strategies in UK hGGE debates. The research conducted to produce this PhD is novel in a number of ways. While there has been excellent research that has explored argumentative patterns in the US contexts (Baylis, 2019; Evans, 2020), my work has focused instead on UK debates. This represents a departure from existing accounts not only because of the geographical area of study, but also because of the unique regulatory context of the UK.

Where other works I have discussed in my literature review have produced rich accounts of biotechnology debates in the UK context (Dimond and Stephens, 2018; Mulkay, 1998; Baylis, 2017) they have not examined hGGE debates specifically. Other work, such as by Martin and Turkmendag (2021), has produced a comparative analysis of US and UK approaches to hGGE debates, however, this work focused on policy documents alone, as opposed to my own research which has also employed interviews with hybrid stakeholders and non-participant observation at conferences. This PhD has generated a novel dataset by interviewing a unique set of hybrid elite stakeholders on their experiences of the UK hGGE debate.

Furthermore, the bricolage approach which has been so central to my research design means that data collected through interviews and non-participant observation at conferences has been viewed through a unique lens. As discussed in my methodology (Chapter Four) 'bricolage' refers to a process combining methods that involves as the need for them arises. The purpose of bricolage in research is to reflect the complexity of the lived world, rejecting realism and instead focussing on

"[…] the clarification of his or her position in the web of reality and the social locations of other researchers and the ways they shape the production and interpretation of knowledge." (Kinchloe, 2011, p. 324). The bricolage component of my research not only contributed to the novel findings of the research study, but it also strengthened the interpretivist approach I took to my research.

As well as my unique focus on UK based hGGE debates I make three novel arguments during my thesis. Firstly, the thesis identifies multiple agorae where UK hGGE debates occur. Agorae are an important conceptual tool that I use to illuminate how different social spaces can accommodate different types of debate. For example, I identified the PET conference as a key site of study, focusing in particular the 2015 and 2018 annual conferences. Secondly, the research builds upon approaches from NEST-ethics to produce a taxonomy of argumentative patterns employed by hybrid elite stakeholders in ethical discussions of hGGE. I argue that argumentative patterns identified — such as the creation of boundaries or the use of metaphors — are reified and stabilised by the agora. I conclude that these argumentative patterns contribute to the compression of UK hGGE debates in several ways, for example, by excluding various social actors and their viewpoints. My third contribution is the introduction of the term 'regulatory slippage'[67] to describe the direction of travel in biotechnology debates in the UK that encourage the liberalisation of embryo policy through a process whereby successive technologies are regulated.

The contributions to knowledge that I have set out are important because if steps are not taken to develop the quality of debate, hGGE may be legalised prior to comprehensive ethical discussion on the topic. By 'comprehensive' I mean that the debates cover a wide range of perspectives and ethical arguments. In this sense, comprehensiveness is similar to Evans' 'thick' bioethical debates,

[67] I use the term 'regulatory slippage' to describe the notion of regulation going beyond its original intention and the linear progression of regulation in the UK context across historical lines in the sand.

that Evans cites as examples of good public reason. As I have previously set out, the hGGE debate in the UK is one part of a wider debate series of biotechnology NEST-ethics discussions. Therefore, if the quality of UK hGGE could be improved in meaningful ways, these suggestions may be transferable to other debates. To this end, I conclude by suggesting a series of practicable policy recommendations for improving hGGE debates. These policy recommendations include:

- Including a greater number of actors in the agorae of UK hGGE debates
- Improving the heterogeneity of actors included in the debate
- Ensuring that a greater breadth of ethical arguments are included in the debate
- Considering alternative approaches to traditional policy-making such as citizens' assemblies
- Ensuring a breadth of perspectives constitute public engagement activities

These recommendations will be particularly important because of the role of preparatory debate in UK biotechnology debates. Preparatory debates are early upstream policy debates that take place in the agora. Actors in the agora use preparatory debate to practise discussion, draw boundaries and set out what types of arguments are considered legitimate. After the period of preparatory debate ends, actors and organisations then lobby political decision-makers with the aim of promoting legitimate arguments crystallised in the agora with the hope they will travel to the arena and be used in political debate.

8.2 Manufacturing morality: how metaphors, boundaries and argumentative patterns imbue debates with normativity

Metaphors

Metaphors are figures of speech in which a word or phrase is applied to an object or action to which it is not literally applicable. In the hGGE debates, prominent examples of metaphors used to explain genome-editing include editing metaphors (molecular scissors, cut and paste) and computing metaphors (find and replace, RNA as molecular sat-nav). Some of the moral metaphors used in hGGE debates in the UK, such as moral threshold metaphors (red line, bright line, letting the genie out of the bottle) and descents into moral decay (slippery slope, thin end of the wedge).

By examining how and why actors employ metaphors, I show that we can better understand how metaphors contribute to argumentative patterns that shape the UK hGGE debate. I demonstrate that rather than being a useful shorthand for explaining complex abstractions in debate, metaphors *blackbox* (Latour, 1987) the very concepts they try to elucidate. I show that metaphors can be strategic and that in some circumstances, actors argue to secure their preferred metaphor as dominant in the nomenclature of the debate. For example, proponents of hGGE have worked hard to secure 'editing' mechanical metaphors like 'molecular scissors' over more morally charged 'designing' metaphors e.g. 'designer babies'. This reflects their normative vision for technology that would see it used for 'editing' out deleterious DNA mutations rather than as a way of 'designing' future persons.

I have shown that metaphors in the debate are used to create heuristics for key concepts and arguments without expanding fully in debate. I have shown that the use of metaphors as a shorthand to refer to broader arguments constrains ethical debate. Moreover, the use of metaphors and literary allusion in the debate has contributed to the reinforcing of sociotechnical imaginaries in the UK hGGE debates.

Boundaries

A boundary is a real or imaginary line that separates two things. I explored the role of boundaries in the UK hGGE debate where I described a number of boundaries such as:

- human/non-human
- therapy/enhancement
- somatic/germline
- mono-genetic/poly-genetic
- therapy/ART

I showed how actors establish, maintain, or erode boundaries in the debate: before recommending that by examining how boundaries are used strategically by stakeholders, we can better understand argumentative patterns in the debate. I argued that boundaries are fluid, contested and that they could change over time. I gave the example of the somatic/germline divide, which represented a 'bright line' in the MRTs debate, only to be eroded in the hGGE debate as actors emphasised that proposed applications of genome-editing should take into account potential harm to the individual, rather than whether the edit was somatic or germline. I examined a number of key points in the debate where boundaries had shifted and discussed how boundaries were used to constrain discussion and to confer ethical authority from those in the debate unto others (e.g. regulators).

Argumentative patterns

Argumentative patterns are rhetorical techniques used by speakers to communicate ideas in a particular way that are repeated across a number of debates. In Chapter Seven I set out the prominent argumentative patterns and how they appear in UK hGGE agorae. These argumentative patterns included the designation of legitimate arguments (to the exclusion of other types of arguments), compression of debate, narratives of hope and hype, the valorisation of genetic relatedness and the construction of the unmet need.

I focused specifically on how actors sought to confer legitimacy onto their arguments in an effort to 'purify' the hGGE debates. For example, how they framed the potential applications in terms of utilitarian narratives, prioritising risk to the individual over other (value-based) types of moral harm. I found in these contexts, actors advised that the ethics of hGGE should be informed by its application, and (if legalised) the application of hGGE should be tightly regulated by the HFEA through licensing. This is an example of ethical boundary-work as actors cite the regulator as a key moral stakeholder and defer authority onto them.

In the agora chapter (Chapter Seven), I argued that the agora, actors, and arguments are co-constitutive and therefore the argumentative patterns are bound up in the stable agora. However, actors and arguments are not unique to any specific agora, and they can be moved from one agora to another. Prominent examples of this is how actors from organisations such as the NCoB and PET have featured in the UK hGGE debates, but who have also featured in preceding biotechnology debates, such as the MRTs and the cytoplasmic hybrid embryos debates. With the movement of these actors between debates, they have brought argumentative patterns and strategies that were successful in previous debates or showed how they learned from missteps in previous discussions. For example, Fiona Fox (head of the Science Media Centre) pointed out that one of the reasons there had been such an emphasis of the use of 'genome-editing' was because of how the 'three parent babies' narrative took hold in the MRTs debate, and that this — at the time — has the potential to damage public trust in the technology.

As I have argued, the agora is an exclusive space, and while the public may have access to the spaces, they rarely have the platform, or opportunity to speak in the agora. Despite this observation, a key argumentative strategy used by both proponents and opponents in the agora was to encourage public debate. Public debate was even an example of ethical boundary-work with

some proponents arguing that genome-editing should only be regulated subject to broad public consensus. However, while calling for broad public debate was universal amongst actors in the debate, achieving public debate has been challenging. Some organisations have conducted public engagement exercises in order to facilitate public debate on the topic and presented their results in the agora. What these approaches achieve is that they are reasonably transparent and that they provide data on public opinion regarding genome-editing. However, the majority of these public engagement exercises are conducted by proponents of the technologies. Who has the means and opportunity to facilitate public debate (and collect data on this) will inevitably shape how the public expresses their opinions, particularly if there are educational components to these events.

The agorae of UK hGGE debates represent opportunities to exchange ideas in a democratic way. However, these spaces are exclusive and arguments that are not considered to be legitimate are curtailed in discussion. Therefore, metaphors, boundaries and argumentative patterns used in debate are both a feature of, and shaped by, the agorae of the debate.

How metaphors, boundaries and argumentative patterns contribute to dominant narratives in debate

The analysis of metaphors, boundaries, and argumentative patterns I have used in this thesis builds and expands upon Swierstra and Rip (2007), Swierstra and colleagues (2009), and Swierstra's (2016) analysis that show how tropes and 'storylines' are integral components of debates concerning the ethics of new and emerging science and technology (NEST-ethics). An example of one of these storylines is the nationalistic performances in the UK hGGE debates.

NEST-ethics is used to describe observable characteristic tropes and patterns of moral argumentation in ethical discussions. NEST-ethics analyses generally offer an inventory of the

arguments and describe how these NEST-ethics patterns in a debate are played out in arenas with opponents and proponents of the technology taking opposite sides. My analysis builds upon Swierstra and Rip's approach both by using NEST-ethics in a new context (the UK debates), Swierstra and Rip (2007) emphasise the transferability of the NEST-ethics tropes, which they argue constitute the grammar of debates concerning controversial new technologies. Moreover, I also apply the approach to biotechnologies. NEST-ethics analyses argue that actors in debate use these discussions to institute technical and normative understandings of emergent technologies.

Due to its background in leading biotechnology debates and 'being the first' to regulate new and emerging ARTs, actors in the UK have constructed a nationalistic narrative that the UK should be at the forefront of discussions regarding the responsible regulation of hGGE. However, this narrative was challenged by the He Jiankui case. With China at the forefront of innovation and being 'the first' to use the technology, UK scientists (as well as the international scientific community) banded together to condemn He Jiankui's actions. While there were a number of valid reasons cited, Helen O'Neill raised the point in her interview that perhaps the scientific community were not as outraged about the technology's use, and more concerned about the lack of regulatory oversight. This creates a sort of moral relativism where applications of the same technology are considered morally acceptable in some contexts, and morally reprehensible in others.

Common themes across my findings from the metaphors, boundaries and argumentative patterns can be organised into three broad categories:

- The construction of 'legitimate arguments' and the compression of debate
- Repertoires of risk and the utilitarian framing of discussion
- Nationalistic performances and the 'purification' of ethical debate

The construction of legitimate arguments and the compression of debate

As I have shown throughout my thesis, metaphors, boundaries, and argumentative patterns are used in both the construction of 'legitimate' arguments in the debate, but in a similar vein, to compress rhetoric that does not conform to the legitimate argument. I will discuss two ways that this is achieved across the metaphors, boundaries, and argumentative patterns. These are through securing the nomenclature of the debate, drawing boundaries and argumentative patterns that compress arguments that are not considered legitimate. Legitimacy of arguments are an essential currency in the debate — arguments considered to be legitimate (technical) and applications that are considered to be legitimate (therapeutic and safe) are given more space in debate and meet less resistance in discussion.

Nomenclature is the process of devising or choosing names for things. Therefore, securing the nomenclature in hGGE debates is a process whereby actors decide how technologies and techniques should be referred to. Ensuring debate uses the preferred nomenclature is essential to constructing legitimate arguments in the UK hGGE debates. Genome-editing was the term chosen to discuss the technique that would enable hGGE. Genome-editing was selected ahead of 'CRISPR', 'CRISPR-Cas9', 'gene-editing', 'genetic editing', 'genomic editing', 'genome engineering' or 'genetic modification'. One rationale for securing genome-editing as opposed to CRISPR, is because genome-editing is the technique, whereas CRISPR — or CRISPR-Cas9 — refers to technology, and in the future another technology may be used. Differentiating between genome-editing and other terms — such as gene-editing or genetic editing — were advised to promote consistency (p.14) and avoid confusion (PET and Genetic Alliance UK, 2018. p. 17). Genetic modification (GM) was explicitly discounted on the grounds that the term "[...] is liable to cause particular confusion if used in relation to genome-editing, as the term has traditionally implied the

introduction of foreign (transgenic) DNA into an organism (as in 'GM crops' and 'GM food')."(p. 16) However, eschewing GM from the nomenclature of the debate may also be linked to high levels of public distrust associated with the term following UK GM debates in the great GM food debate in the 1990's in the UK (Herman et al., 2021). Moreover, literature on the UK GM debates highlights GM's association with 'unnaturalness' (Hellsten, 2003).

Compressing arguments that are not considered legitimate is a tactic used by proponents in the debate. A key way this is achieved is by drawing boundaries. Proponents of hGGE seek to block discussions of enhancement because of fear that this discussion of illegitimate (enhancement) applications might corrupt efforts to regulate hGGE for the clinic. However, it is likely that this blocking-off of the debate around the therapy enhancement line, or the lack of a candid debate is causing debate around enhancement to be compressed — as it fits easily into the legitimate/non-legitimate, moral/immoral heuristic.

The blocking-off of debate regarding enhancement was also a theme generated from my non-participant observation at conferences. Commonly, where actors tried to engage in discussions of enhancement, the discussion would emphasise how the science in this area was 'premature', and it would not yet be technically possible to use hGGE for enhancement purposes. This blocking-off of the enhancement discussion served three main purposes. Firstly, it avoids any clarification around the therapy-enhancement demarcation. Secondly, it shifts the focus of discussion back to legitimate (therapeutic) applications of the hGGE, and finally, it reinforces the discursive norms for discussing hGGE, namely that hGGE for enhancement is not a relevant topic of conversation because it is not considered technically feasible or ethical.

A final way in which legitimate arguments were promoted and non-legitimate arguments shut down was in the way they played out in agorae. Here certain types of arguments were deemed

acceptable by actors in the debate (e.g. individualistic, risk-based approaches) and other types of arguments were curtailed, for example value-based claims around embryo destruction, claims hGGE would contravene human dignity and concerns about broader moral harms (e.g. those related to access).

The construction of legitimate arguments and the compression of debate imbues the debate with normativity by promoting ethically pure debate, prioritising some types of discussion over others, usually prioritising risk-based — individualistic — approaches over value-based discussion. This approach to debate implies that the needs of the individual are prioritised over societal needs more generally and that harms should be understood in terms of risk to the individual. Moreover, the way that the construction of legitimate arguments and the compression of debate leaves little space for the discussion of objectionable topics — such as enhancement — precludes fuller societal debate, kicking the ethical can down the road.

Repertoires of risk and the utilitarian framing of discussion

I have outlined throughout my thesis the UK hGGE debate's emphasis on utilitarian approaches to bioethics. This characterisation can be linked back to the Warnock Report, which emphasised the inclusion of utilitarian ethics to cater to a pluralistic society. I showed that when arguments do not conform to these framings they are not allowed to feature as prominently in debate. Moreover, in the hGGE debate, in particular, the utilitarian tradition in British bioethics featured alongside a focus on reproductive autonomy, diminishing important ethical boundaries in the debate, such as arguments related to human dignity and concerns about broader moral harms.

Proponents of hGGE would often appeal to utilitarian reasoning in debate through arguments around safety and efficacy. For example, by qualifying that they would only support the use of hGGE in the clinic, if they could be sure it would not pose harm to individuals.

Where the debate is compressed by the prioritisation of utilitarian approaches — that are risk-based on the individual — this imbues the discussion with normativity in important ways. Firstly, it implies that harm is confined to those activities that do not maximise utility for all affected individuals. Secondly, it implies that so long as affected individuals are not harmed, then hGGE is not a harmful technology. Finally, by prioritising utilitarian approaches to ethics over other approaches (e.g. value based), this prioritises the needs of the individual over society more generally.

Nationalistic performances and the 'purification' of ethical debate

The term British biomedical culture was originally coined by Dimond and Stephens to characterise the nationalistic performances of proponents in the UK MRTs debate. A key feature of UK's biomedical culture, as argued by Stephens and Dimond (2016) is high-quality policy discussions on new and emerging biotechnologies (as well as the reputational and monetary value of being at the forefront of biotechnology regulation) (2016). I have observed similar narratives present during my non-participant observation and my interviewees were able to point to these performances of nationalism.

Metaphors in the debate that conjured the UK's biomedical culture generally referred to how the successes of previous biotechnology debates in the UK should be used to guide future debates, such as blueprint and the candlelit path. While the argumentative patterns of proponents of genome-editing showed how lessons from previous biotechnology debates could be used to shape

and inform UK hGGE debates, opponents created a counter-narrative with its own set of metaphors and boundaries. These metaphors are generally moral threshold metaphors — such as slippery slope, thin end of the wedge, and, letting the genie out of the bottle — whereas the key boundary was the somatic-germline barrier. The somatic-germline barrier was a key narrative for opponents to hGGE in the context of the British biomedical culture because those who opposed the legalisation of hGGE were more likely to point to this barrier as a 'line in the sand' (citing arguments around the human germline representing a shared human heritage or dignity), referencing recent MRTs regulation as a key example of regulation stopping short of crossing the germline. In contrast, those who might support the legalisation of hGGE in the future were more likely to downplay the importance of this line and point out the inconsistencies of permitting other technologies that could permanently alter the human germline (e.g., chemotherapy).

The primary boundary interviewees pointed to in the nationalistic narrative were the geographical borders that separates the UK from other countries. These boundaries allow the UK to differentiate itself from other states, particularly on its reputation being at the forefront of biotechnology regulation. The argumentative patterns essential to performances of the nationalistic narratives because these arguments were generally hangovers from previous debates, such as the construction of the unmet need, valorisation of genetic relatedness.

The performance of British bioethical culture imbues the debate with normativity by envisaging governance of hGGE as a national issue rather than a global issue, which has implications for multilateral approaches — such as moratoria. The narrative of the UK aiming to 'be the first' to regulate new and emerging ARTs and biotechnologies creates the normative position that the UK should lead rather than cooperate, based on its previous success in this area. This approach attaches a sense of national pride to the regulation of new biotechnologies meaning that those who

go against proposed regulatory reform on ethical grounds may risk looking unpatriotic. This would be problematic in the UK context, and as a result would likely shut down opponents to the technology.

A final essential component of the nationalistic performances in debates was the 'purification' of the ethical discussion of hGGE in the UK. This purification is a process whereby objectionable elements of the debate are compressed or excluded from the debate, so that the debate held is in a way that proponents feel is appropriate. One of the key ways the purification of the debate is achieved is by ensuring arguments included in discussion are 'legitimate'. This designation of some arguments as 'legitimate', and others as 'non-legitimate' subjugates the perspectives of opponents in debate by designating their contributions as irrelevant.

The intense focus of holding an ethically pure debate is a tactic used by proponents to close down topics of discussion. An example I have talked about at length (see Chapter Six) is the compression of the enhancement debate. The therapy-enhancement line is used as a proxy for legitimacy in the debate where therapeutic interventions are seen as morally good and enhancement as morally bad. However, as I outlined in Chapter Six, therapy and enhancement are ill-defined concepts and actors do not agree on where this line should be drawn. In this context, proponents avoid unpacking the definition of enhancement, but instead defer authority onto the regulator (the HFEA), saying that if the technology were to be regulated the regulator would only allow applications that were therapeutic. The result is that the line is never clearly located, but the ethical concern posed by the threat of enhancement is seemingly discharged from the debate. Not only is this an example of compressing the debate, and blackboxing the therapy enhancement distinction but it is also an instance of ethical boundary-work, where actors avoid having the ethical discussion regarding enhancement and instead defer authority onto the regulator.

Based on my analysis of how key stakeholders understand and use particular language and discourse in UK debate on hGGE, I have shown that there are a number of problems with the UK hGGE debates. For example, discussions on hGGE recycle tropes from preceding biotechnology debates and create new heuristics, unclear boundaries and repeated metaphors. Furthermore, important actors in the UK debate are adept at reframing technologies to better fit into existing regulatory structures, curtailing avenues for policy debate.

8.3 How argumentative patterns contribute to regulatory slippage

Throughout this thesis I described how critical regulatory shifts in UK embryology legislation have contributed to the liberalisation of embryo policy over time — using the term 'regulatory slippage'. As I have described, the culture of embryo research in the UK is marked by a linear path toward the regulation of new embryo research practices that promise transformative medical advancement — however, they are generally only used in a scientific context, and although they help scientist learn more about conditions, they do not always translate into the 'cures' promised — iPSCs, MRTs.

My thesis, therefore, introduces the term 'regulatory slippage' to describe the linear progression of regulation in the UK context across historical lines in the sand, arguing that the centrality of consequentialist ethics to the UK's biomedical political culture contributes to this phenomenon. One of the critical components of regulatory slippage is the instances of ethical shift and ethical drift that underpin it. Ethical drift is a term borrowed from professional decision making and generally refers to an incremental deviation from ethical practice that goes unnoticed by individuals who justify the deviations as acceptable and believe themselves to be maintaining their ethical boundaries (Kleinman and Benson, 2006, p. 76). In my work, I use ethical drift to refer to the non-deliberate reframing of the assumed morality of an act based on changing societal preferences over

time (e.g. children outside of marriage) rather than individuals; it refers to normative change on a societal level. I contrast ethical drift with ethical shift, which describes actors' deliberate and successful attempt to change legal, ontological, and ethical definitions to enable new narratives, arguments and legal instruments.

Ethical shift and drift contribute to what Lucivero and colleagues refer to as changes to a technology's desirability over time (2011). Interactions between technology and ethics bring about these changes. Lucivero and colleagues describe how norms and values inform technological development and how new and emerging technologies can raise new ethical concerns that existing moral resources cannot cope with (2011, p. 137). I argue that actors can use ethical shifts to affect regulatory slippage for example by creating new arguments and narratives in response to developments in the debate.

My final empirical chapter (Chapter Seven) shows how ethical shifts have shaped the UK hGGE debate. I argue that proponents of hGGE use precipitate ethical shifts to shape the moral dimensions of the technology. I conclude by suggesting that this tactic is uniquely effective in the regulatory landscape of the UK. I argue that the UK's reputation for being world-leading in the field of embryology and embryology regulation has contributed to regulatory slippage. As increasing numbers of ethically controversial biotechnologies are regulated in the UK, they become established over time, causing regulatory and moral erosion. As a result, what was once controversial is now considered less controversial because of its regulated status.

I argue that the regulatory slippage I describe is a unique feature of the UK landscape. In the narrative of the UK's success as an expert innovator and regulator (what is referred to by Stephens and Dimond as the UK's biomedical culture (2018)), every new biotechnology that is regulated becomes a new success story for the UK regulatory regime. I believe this is due to the role of the

HFEA in the UK, which governs embryology and fertilisation specifically. However, I think some of the conceptualisations of the slippery slope in the literature draw on similar themes to my concept of regulatory slippage. For example, Jackie Leach Scully's description of technological advancement as a slow march that invariably leads to the regulation of novel biotechnologies (2005), regardless of whether there is a clear pathway to the clinic. Scully's concept is similar, but different to regulatory slippage, as one of the key components of regulatory slippage is that it is underpinned by a clearly 'unmet need' which is usually supported by 'basic science'. However, MRTs is a good example of regulatory slippage, where germline modification was regulated in the context of mitochondrial donation, although there was an 'unmet need' supported by research, following legalisation, the technique is yet to be used in the clinic.

The construction of ostensibly legitimate arguments and compression of debate leads to regulatory slippage by stopping fuller debate on hGGE by designating a smaller pool of arguments that are acceptable in UK hGGE agorae. The construction of legitimate arguments prioritises technical arguments of value-based approaches and leaves little space for the discussion of objectionable topics — such as enhancement. The designation of acceptable boundaries and metaphors in the construction of legitimate arguments means that they are not properly debated and fully understood which can lead to further compression of debate as these metaphors and boundaries are used as heuristics, in place of a fuller debate.

Utilitarian approaches to biotechnology debates in the UK are increasingly focused on harms to the individual and on what types of regulatory instruments could help mitigate these harms. This approach prioritises procreative liberty at the expense of value-driven arguments that might better determine biotechnology's impact on society. This approach to moral reasoning, combined with ethical boundary-work — which gives moral authority to the regulator — can lead to an

assumption that as long as technologies are safe and efficacious, and therefore do not pose harm to individuals, it is the role of the regulator to decide whether and how the technologies should be regulated. This is of particular relevance in the UK context where the HFEA is an expert regulator.

I have argued up to this point that proponents of hGGE frame the debate in utilitarian terms. This means that no technology (or indeed action) is considered ethical or unethical beyond whether its consequences cause pleasure or pain. Therefore, if the consequences are not harmful, the technology is ethically permissible. This approach is often borne out in metaphors around genome-editing that describe it as a tool, or in interview quotes that explain how the technology is not in and of itself ethical or unethical, but how it is used.

When utilitarianism is combined with an individualist framing and a strong preference for parental autonomy (e.g., hGGE as an ART) so long as the technology does no harm to the parent or resultant child the technology can be seen to be ethical. However, this reasoning does little to address broader societal concerns and address arguments that might be raised by those who do not stand to benefit from the technology directly. As a result, the prevalent ethical position of the proponents in the UK hGGE actually debates a very narrow application of utilitarianism. Utilitarian frameworks have the capacity to address wider societal harms which can and should be addressed particularly when a technology may have wide societal impact, for example if the technology were used for eugenic practices.

Although safety and efficacy are paramount — particularly in consequentialist models of reasoning — they should not be seen (in the absence of other motivating factors) as a reason to use a technology. Prioritisation of arguments around safety and efficacy mean that other arguments around whether it is ethical to use hGGE are often not addressed. Moreover, arguments that question whether they ought to be used often come back to 'only if it's safe' which creates

circularity in the discussion. It would be better to use time and space in the discussion to address a wider set of social and ethical concerns, however these arguments are often curtailed as 'the science is not there yet'. Less dominant normative positions, for example respect for human dignity, the protection of the shared human genome from intervention, harms to future persons and societal harms gain less traction as they are easily dismissed by technology proponents for being intangible, based on under defined concepts or, at worst, scaremongering.

While opponents were quick to point out the risks posed by hGGE and argue that these risks should result in a ban of the technology, proponents had to navigate a more difficult position of arguing for applications of hGGE they considered morally permissible, whilst arguing against applications they considered immoral. A key metaphor that aided in these strategies of fear was 'genome-editing as a tool'. By discharging the technology of any sort of moral status (in contrast to proponents who may argue that the use of this technology was never morally permissible) proponents were able to set up hGGE as moral in some contexts and immoral in others, which as I discussed in the empirical chapter on boundaries (Chapter Seven) would occasionally result in morally relativistic claims.

The prioritisation of utilitarian approaches to ethics combined with compressing value-based approaches is even more effective when combined with ethical boundary-work. Ethical boundary-work discharges the need to conduct ethical reasoning in the debate, emphasising the role regulators will place in governing the technology. This is particularly relevant when combined with the claim that regulators would take a case-by-case approach to granting licences for applications for hGGE.

What these approaches within the debate omit is that for hGGE to be placed under the remit of the HFEA the law would have to change. Therefore, the responsibility of ethical decision-making of hGGE is not a question only for regulators, but for society more generally — however, given the accessibility of the agora, this raises problems for the public reason of the debate. The tactic of drawing lines around what types of arguments are appropriate or shifting the boundaries on what types of genetic interventions should be permissible under law are examples of strategies used to facilitate regulatory slippage.

8.4 The role of the agora in the preparatory debate

Regulatory slippage is consolidated by preparatory debate in the agora. I have argued throughout this thesis that the role of the UK hGGE agorae is to function as spaces where hybrid elite stakeholders meet together to exchange ideas, co-create consensus, draw boundaries, and perform community norms. While agorae are sometimes presented as idealised open spaces and a democratic platform in the literature, my empirical research showed that this space is less of an ideal for openness and democracy but is closer to the original meaning of the Greek term agora, and is, in reality, a space closed-off to many individuals.

The hGGE discussion in the UK is in a phase of preparatory debate. In the preparatory debate actors in the debate practice arguments and tactics to determine what types of approaches might be successful. When the time comes for hGGE to be debated in the arena, arguments from the preparatory debate will most likely then form the basis for lobbying activities to influence debates in the arena.

As I have discussed previously (Chapter Seven) actors, arguments and agorae are co-constitutive and mutually influencing in stabilising the debate. The agorae of the UK hGGE debates are very stable because they have a continuity of actors from previous UK biotechnology debates, and they

borrow a number of arguments, boundaries and metaphors from previous UK biotechnology debates. However, as I have pointed out in this chapter, there are problems with the UK hGGE debates such as the compression of debate and the narrow framing of risk and harm.

Proponents and opponents in the debate differ in their approaches to their rhetoric, ethics and performances of biomedical culture in the debate. In this thesis I have set out the rhetorical devices — such as the argumentative patterns used by proponents to promote 'legitimate' arguments, and compress the arguments of opponents — used strategically by proponents to set out the best case for hGGE. Opponents on the other hand have an 'anti-rhetoric' (or set of rebuttals) they use to combat proponents' rhetoric. For example, opponents are more likely to try and maintain boundaries in debate, and more likely to employ moral threshold metaphors.

In terms of their ethical arguments, proponents were more likely to employ pro-innovation, utilitarian and individualistic framings of risk, whereas opponents are more likely to appeal to public reason, deontological ethics, human dignity, human rights, and the precautionary principle. Given, as I have pointed out, that the British biomedical culture is underpinned by utilitarian approaches to ethics, the opponents' perspectives do not speak to the mode of ethical reasoning employed by proponents. As such, rather than engaging in balanced debate to try and establish a shared moral truth or achieve a compromise, proponents and opponents engage in crosstalk with one another.

Another framing of risk that is slightly different but related to the individualistic risk is parental risk. I have not discussed the framing of parental risk (or indeed autonomy, authority and parental 'want' for a genetically related child) fully in my thesis, but I did note examples of this phenomena (for example in the NCoB (2018) report). The construction of the unmet need in the hGGE

debate tries to follow the formula of the construction of the unmet need in the MRT's debate but is not a successful argument, because the unmet need is statistically unlikely. I think future research would be valuable to uncover whether including parents in the framing of this technology is constructing an unmet need, instating a new type of ethical boundary-work, or is the framing of parental risk being used to construct the technology as an ART?

While ethical arguments in UK hGGE agorae rarely impact the positions of proponents and opponents, these groups do react to the shifting moral context of the debate. For example, in response to the He Jiankui case, opponents renewed calls for a moratorium, whereas proponents emphasised the importance of international cooperation, robust informed consent processes and responsible research and innovation — citing the case as a failure in regulation and governance, rather than a moral failure. This response on the part of proponents re-stabilised the agora, following the destabilisation caused by the He Jiankui case.

Based on my analysis, I argue that in order to address the problems with the UK hGGE discussion there must be changes to the actors and arguments which will have a lasting destabilising effect on the agorae of the debate. These changes I propose, should include making the agorae of the debate more accessible to a more heterogeneous group of actors, making space for more types of arguments in the debate and challenging compression of 'non-legitimate' arguments to encourage fuller discussion, and taking a more global approach to discussion of hGGE as I set out in the below discussion.

8.5. Discussion

My argument

I have argued during this concluding chapter that (1) actors use metaphors, boundaries, and argumentative patterns to imbue debates with normativity, that (2) the argumentative patterns in debate lead to regulatory slippage, which describes the linear progress of liberalisation of embryology law in the UK, and that (3) these processes are stabilised by the agorae of the debate.

The dynamics in the conceptual spaces (arena, agora, observatory)[68] are essential to understanding the UK hGGE debate and preparatory debates in the UK more generally. The ways in which the proponents try to limit the variety of arguments in the agora, is because they want their own arguments to dominate in the preparatory space. However, by curtailing the arguments of the hGGE opponents using the strategies I mention they are limiting a wider debate on hGGE.

The agora is the space where preparatory debates happen, and it is the space where arguments are parsed out by key elites to test whether they stand up to scrutiny. Arguments considered by proponents to be legitimate, receive more time and attention in this space. Actors in the agora regularly reference waiting for the 'policy moment' or upcoming reform to the HFE Act 2008 as a future milestone[69]. When this milestone arises, actors in the agora will want to use their arguments that they refined during the preparatory debate to shape the arena. The arena is more exclusive still, with only elected MPs and Lords able to debate reform to the HFE Act. Therefore, during

[68] As established in Chapter Seven, the arena is a conceptual space where proponents and opponents come together to debate, where some win and others lose, and consensus is never reached (Swierstra and Rip, 2007, p. 18). The agora is a space where actors come together to exchange ideas. Finally, the observatory was described as an international space comprised of scholars and institutions dedicated to gathering information and observing how debates unfold to provide analysis and oversight of developments.

[69] A recent article in the Guardian newspaper an HFEA consultation that could mean reform the HFE Act (2008) may be on the horizon (Devlin, 20222).

this time, a period of lobbying and influencing activities will take place to try and ensure arguments used in the preparatory debate on both sides, in the agora, make it into the debate in the arena.

As I have previously discussed, the agorae of the UK hGGE debates are very stable, it is difficult for non-elites to access these spaces, for different arguments to be heard in these spaces and for ethical discussion to shift. However, the agorae do experience periods of instability that lead to ethical shifts, both externally (e.g. He Jiankui case) and internally (e.g. the licensing of hGGE in non-viable human embryos). These shifts may cause change (particularly in the redrawing of boundaries, of the refining of central arguments, or changes to dominant narratives that underpin the debate) but they rarely cause a threat to the agora, which mostly stabilises following periods of destabilisation.

When the time comes for arguments to shift from the agora to the arena (a parliamentary space), the normative position created by the arguments of the hGGE proponents correspond to key deliverables set out by the UK Government in the Integrated Review. Therefore, the normative position set out by proponents would be attractive to parliamentarians because it promotes a sense of British patriotism, as well as highlighting the economic benefits of advancing clinical applications of genome-editing.

I therefore argue that the very existence of agorae directly contributes to regulatory slippage. The agora is exclusive and does not represent a full range of voices. The agora compresses arguments of proponents, therefore does not represent a full range of arguments. The agora is incredibly stable, and as such it is very difficult for a more heterogeneous range of actors and arguments to be included — despite calls from those in the agora for wider debate.

My primary concern with UK hGGE debates is that they are not as comprehensive as they could be due to the compression of arguments in the debate, the lack of heterogeneity of perspectives in discussion and the polarity of the differing ethical approaches. The agora is a protected space that not all actors who may wish to participate in the debate can access, speak in, or have their arguments heard.

Without comprehensive debate that considers a range of perspectives and ethical approaches, it is likely that hGGE debates will move from the agora to the arena and that regulatory reform will mean hGGE is regulated prior to a full debate on the ethics of hGGE. While I do not take a normative stance on whether the use of hGGE would be ethical, I take a normative stance that up to this point the ethical discussion has not been robust enough to determine whether the clinical application of hGGE would be ethical.

Contextualising my argument within the wider literature

Swierstra and Rip argue that discussions of NEST invariably fall into patterns and that these patterns are unproductive. Swierstra and Rip recommend reflexive tools and a pragmatist approach to ethics to solve these problems.

NEST-ethics is a useful lens for the debate. I have found that analysing biotechnology debates in the UK has raised new and interesting issues not accounted for in the NEST approach, I set these argumentative patterns out in Section 7.3 of my thesis. Similarly to Swierstra and Rip I have shown through my research that the UK hGGE debates do fall into patterns that compress debates and prioritise certain types of ethical framings. My approach is different from Swierstra and Rip because I have taken a UK focus, I have evidenced my list of argumentative patterns in the debate through elite stakeholder interviews, and I have contextualised the argumentative patterns by exploring their role in the agorae of the debate.

While I recommend some practical solutions to the problems, which I have detailed in Section 8.6. I have observed (that are mostly centred around destabilising the dynamics within the agora) I do not recommend a pragmatist ethics, unlike Swierstra and Rip (2007). My concern with the use of a pragmatist ethics is that it would not address the underlying issues within the debate, which is that the types of ethical framing used, particularly the utilitarian framings used by proponents, are not compatible with a range of ethical approaches.

Evans explores US biotechnology debates — including embryology debates and hGGE — to show how these debates have progressed and what their significance is to society. In his book *Playing God? Human Genetic Engineering and the Rationalization of the Public Bioethical Debate*, Evans explores the social forces that have contributed to a 'thinning' of the public debate regarding human genetic engineering (I). The primary aim of Evans' book is to show how early 'thick' debates on the values IHGE devolved into the 'thin' debates of our own time (p. 12), suggesting that debates have shifted from being formally rational to substantively rational.

My approach differs from Evans' with its focus on the UK, which led me to find different approaches to ethical reason (consequentialism rather than principlism) which reflects a key difference between the UK and US ethical contexts.

A challenge associated with the original intention of the research was that I was seeking to emulate and build on the work of others (Dimond and Stephens, 2018; Evans, 2002; Hurlbut, 2017; Jasanoff, 2007; Mulkay, 1997) who had conducted retrospective research and apply it to an emerging policy area. As a result, I have learned that regulatory changes move more slowly than I expected, particularly when parliaments are confronted with extraordinary and time-consuming policy challenges such as Brexit and COVID-19.

8.6 Conclusion

Policy recommendations

I have argued throughout this thesis that the UK hGGE debate is a microcosm for debates concerning controversial technologies in pluralistic societies more generally. As other authors such as (Evans, 2020, 2002; Hurlbut, 2017; Jasanoff, 2013, 2007) have pointed out before me, these types of discussions are fraught with difficulties as competing voices with competing interests try to shape the policy debate. However, what is clear from the research I have conducted is that UK hGGE debates are not as comprehensive as they could be due to the compression of arguments in the debate, the lack of heterogeneity of perspectives in discussion and the polarity of the differing ethical approaches.

Therefore, I suggest the following policy interventions to improve the debate:

Policy Recommendation One: Including a greater number of actors the agorae of UK hGGE debates

In Section 8.5 of this chapter (and Chapter Seven) one of the key problems that reinforces the lack of comprehensiveness in the UK hGGE debates is the stability of the agora. I showed that while the idealised agora is an egalitarian space where ideas are exchanged democratically, this is not the reality of the agorae I observed during my non-participant observation.

The agora is an elite space that consolidates argumentative patterns. I argue that actors, arguments and agorae are mutually constitutive, therefore including a greater number of actors would change the agora and the arguments and would help destabilise the agora allowing for new approaches to democratic discussion. A criticism of this approach is that by only including more actors, this may lead to more of the same types of argument and further reinforce the problems of the debate. That

is why I advocate that this policy recommendation is combined with Policy Recommendation Two: Improving the heterogeneity of actors included in the debate.

Policy Recommendation Two: Improving the heterogeneity of actors included in the agorae of UK hGGE debates

It is not enough only to include more actors in the debate, actors must be more heterogeneous. The lack of heterogeneity in the UK hGGE debates centralises the authority to decide what makes good arguments around the ethics of hGGE to a small group of people. If and when the time comes to debate the ethics of hGGE in the arena (e.g. if proposed reform to the HFE Act 2008 is tabled for debate) actors in the agora will lobby for their arguments from the agora to be used in the arena. Therefore, the preparatory debate that occurs in the agora, will have an impact on the arena debates.

By improving the heterogeneity of actors in the agorae we would likely see a greater variety of arguments and perspectives. This consequence of this would be diluting existing arguments, but also eroding the adversarial nature of the debate. Moreover, including a greater range of backgrounds and perspectives for the actors in the debate would allow for new arguments that we may not yet have seen and would likely contribute to better examples of public reason.

Policy Recommendation Three: Ensuring that a greater breadth of ethical arguments are included in the debate

Closely related to Policy Recommendation Two, ensuring a greater breath of ethical arguments is essential to ensuring the debate is more comprehensive. I have mentioned previously that the dominance of utilitarian approaches to dating the ethics of hGGE is one of the key problems in the UK hGGE debates. The prioritisation of utilitarian approaches in the debates excludes and compresses value-based (deontological) discussion. Moreover, the adversarial character that is

created by the juxtaposing of utilitarian and deontological approaches in debate often means that discussions are not collaborative, and actors speak past each other in debate.

Therefore, including a greater breadth of ethical approaches would have the effect of diluting existing arguments, but also eroding the adversarial nature of the debate which is implemented by the utilitarian-deontological divide. While ensuring a greater breadth of ethical arguments would likely be a product of including more actors in the debate, however, it could also be introduced artificially. Where, for example, time in the agora is devoted only to producing a greater variety of value-based arguments both for and against hGGE. This would likely contribute a greater variety of arguments and improve the comprehensiveness of the debate.

Policy Recommendation Four: Considering alternative approaches to traditional policy-making such as citizens' assemblies

A criticism of the debate, that I have associated closely with regulatory slippage, is that new and emerging biotechnologies in the UK have previously been regulated prior to robust and comprehensive ethical debate on the topic by a variety of actors. There is a process for regulating these technologies that includes government and regulator consultations and arena debate (in the HoC and HoL) prior to the legalisation of new and emerging biotechnologies in the UK. However, to include more types of voices and arguments the government should consider alternative approaches to traditional policy-making such as citizens' assemblies. Exercises such as citizens' assemblies have the benefit of hosting public debate in a new, (potentially government funded) more neutral agorae. These agorae may be closer to the original idea of the agora in the Hellenic society.

Convening a heterogeneous group of publics to discuss hGGE in these new agorae could contribute to substantively rational decision making and comprehensive ethical debate, the

outcome being good public reason. The sampling for these could be representative, and publics could be selected in a way to ensure political impartiality and diversity. This approach could even be preferable to the traditional approach of deciding whether or not the technology should be regulated in the arena (i.e. through debate and vote in the HoC). Although in the MRTs debate the decision was a vote of conscience - ministers will vote with the government, as in Mulkay's example of how votes were whipped in the embryo debates. It may be better to let the public, rather than politicians decide.

Policy Recommendation Five: Ensuring a breadth of perspectives to constitute public engagement activities

Related to the above point on citizen assemblies, it is essential that public engagement or public decision-making activities are informed by a breadth of perspectives. Publics will need enough information to do public research, but this information should come from a cross-section of actors in the debate to avoid having arguments transplanted from the existing agorae into new public spaces for debate.

Future research

Further research on this topic could examine how the arguments, boundaries and metaphors I have identified within the expert sphere of the UK hGGE debate will be communicated to different contexts, i.e. parliamentary contexts or in the mainstream media. This could show how these rhetorical scaffolds affect different areas of the debate or show how the mechanics of the debate play out in these new and different spaces.

If there were to be a full parliamentary debate on the topic of hGGE — which I assume there will be — research could be conducted to monitor how the discourses and strategies that I have

observed in the preparatory debate are translated into future debates (ideally) with a greater variety of actors. Moreover, this approach could also be used to examine — or construct — public debates or citizen decision-making activities that might occur.

A key point I have made throughout this thesis is that biotechnology debates in the UK up to this point have been in some way limited. Authors pointed out that debates on emerging biotechnologies in the UK context have lacked nuance (Haimes and Taylor, 2017; Baylis, 2017), have been of poor quality (Mulkay 1997), or have omitted important details (Herbrand, 2022).

While it is clear that there is space for hGGE debates to "improve" (Evans, 2020, p. 133), and although I remain neutral on whether I consider hGGE to be ethically permissible, I do think it is vitally important that stakeholders can produce productive, high-quality debates on the ethics of hGGE. I think the implementation of the policy recommendations set out in this thesis would likely go some way to ensuring higher quality debate. This is particularly important amidst increasing calls for 'inclusive and deliberative debate', in an international context where, as Hurlbut and Jasanoff point out, "The value of most applications of the technology [genome-editing] has barely been exposed to public review" (2018). It will be essential, therefore, to include a greater variety of actors — and their perspectives — to create a more comprehensive debate for hGGE and future biotechnology debates yet to come.

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APPENDIX

Appendix A: Table of documents

Title	Year	Author
Fertility, Genomics and Embryo Research: Public Attitudes and Understanding	2022	PET
Thirty years of PET	2022	PET
UK report reveals public attitudes to fertility, genomics and embryo research	2022	PET
Editing the Human Genome: Where Are We Now? What Happens Next?	2022	Alexander Ware (Bionews - PET)
Nuffield Council welcomes new international guidance on governance of human genome-editing	2021	NCoB
The regulation of genetic technologies: time for dialogue	2021	Pete Mills
House of Commons Science and Technology Committee publishes report: Genomics and Genome-editing in the NHS	2021	NCoB
Researchers call for greater awareness of unintended consequences of CRISPR gene-editing	2021	Francis Crick Institute
Changing the Human Genome: What Next for Germline Genome-editing?	2021	Anna Hallgarten(Bionews - PET)
Gene-editing: Recent Developments and Scientific	2020	House of Lords Library

Status		
Gene-editing Volume 801: debated on Thursday 30 January 2020	2020	Hansard
Human germline genome-editing	2020	Amarpreet Kaur Peter Border (POST)
Make Do or Amend: Should we Update UK Fertility and Embryo Law?	2020	Institute of Medical Ethics
Public Call for Evidence for the International Commission on the Clinical Use of Human Germline Genome-editing (The Royal Society)	2019	SCHB
Human germline genome-editing	2019	Rebecca Lea Kathy Niakan (Francis Crick Institute)
Human genome-editing licence renewed	2019	Francis Crick Institute
Speech delivered by Sally Cheshire at the 2019 Progress Educational Trust Conference	2019	HFEA
Germline in the sand: where should we draw the boundaries for genome-editing?	2019	Jen Willows (Bionews - PET)
Genome-editing and human reproduction	2018	NCoB
Genome-editing and human reproduction: social and ethical issues	2018	NCoB
Conference report for The CRISPR revolution: changing life	2018	The Royal Society
Speech delivered by Sally	2018	HFEA

Cheshire at the 2018 Progress Educational Trust conference		
HFEA at the PET 2018 annual conference	2018	HFEA
UK public cautiously optimistic about genetic technologies	2018	The Royal Society
Views on Genetic Technologies	2017	The Royal Society
Basic Understanding of Genome-editing for Scientists Explaining Genome-editing in Public	2017	Genetic Alliance UK and PET
Basic Understanding of Genome-editing: The Report	2017	Genetic Alliance UK and PET
Consultation: Genomics and genome-editing (House of Commons Science and Technology Committee)	2017	SCHB
Consultation response: Commons Science and Technology Committee inquiry into genomics and genome-editing	2017	The Royal Society
Supporting the development of genome-editing	2017	House of Commons Science and Technology Committee
Consultation response: Commons Science and Technology Committee inquiry into genomics and genome-editing	2017	Genetic Alliance UK
Consultation response: Commons Science and Technology Committee inquiry into genomics and genome-editing	2017	MedConfidential

Consultation response: Commons Science and Technology Committee inquiry into genomics and genome-editing	2017	Academy of Medical Sciences
Consultation response: Commons Science and Technology Committee inquiry into genomics and genome-editing	2017	Wellcome Trust and Sanger Institute
Consultation response: Commons Science and Technology Committee inquiry into genomics and genome-editing	2017	NCoB
HFEA at Progress Educational Trust's annual conference	2017	HFEA
Genome-editing research shows value of embryo donation	2017	HFEA
Genome-editing sheds light on human embryo development	2017	Wellcome Trust
Crossing Frontiers Moving the Boundaries of Human Reproduction	2017	PET
Genome-editing: an ethical review	2016	NCoB
Public dialogue on genome-editing: Why? When? Who?	2016	Roland Jackson
Submission to the Nuffield Council on Bioethics on Genome-editing	2016	The Royal Society
Genome-editing	2016	Marcus Dawson Peter Border (POST)

Niakan lab Human Embryo and Stem Cell Laboratory: Human embryo genome-editing licence	2016	Francis Crick Institute
Human gene-editing: Keep calm and carry on conversing	2015	Andy Greenfield
Council calls for evidence on genome-editing	2015	NCoB
First meeting of the genome-editing Working Group	2015	NCoB
Genome-editing working group announced	2015	NCoB
Council hosts scoping workshop on genome-editing	2015	NCoB
New Council project on genome-editing	2015	NCoB
Statement on Genome-editing Technologies and Human Germline Genetic Modification	2015	The Hinxton Group
Genome-editing research: not just a question for scientists	2015	Wellcome Trust
What is genome-editing and how does it work?	2015	Wellcome Trust
Human genome-editing research should proceed, say leading UK science bodies	2015	Wellcome Trust
Infographic on genetic technologies	n.d.	The Royal Society
The Threat of Human Genetic Engineering	n.d.	David King (Human Genetics Alert)
No to genetic engineering of humans!	n.d.	David King (Human Genetics Alert)

Decision to allow human genetic manipulation is not supported by the public	n.d.	David King (Human Genetics Alert)

Appendix B: Project Information Document

Project Information Document

Title: Understanding the UK Human Germline Genome-editing Debate

Fiona Coyle, PhD Researcher in Science and Technology Studies, University of Edinburgh

Supervisors: Dr Gill Haddow and Dr Niki Vermeulen

Project Funded by the Economic and Social Research Council

The Research

This research focuses on the use of genome-editing technologies for the purposes of human reproduction. The PhD examines how ethical discourses shape the discussion of genome-editing, these include the divide between disease avoidance and human enhancement, issues of who can be harmed by this technology and questions of fairness, and social justice. The intended outcome of this research is to gain greater insight into how debates concerning new and emerging biomedical technologies are shaped by participants of the debate. Importantly, this research is also a chance for experts from a range of contexts who have participated in the debate to share their experiences, have their say on what these debates mean for wider society, and how they think these debates should take place.

What Participation will involve

Participation will consist of taking part in an informal one-to-one interview. Broad topics addressed will include the interviewee's own experiences of the genome-editing debate in the UK context, the different groups involved in this debate and the strategies they employed to shape this debate. Taking part in a one-off interview would take no more than a maximum of an hour of an interviewee's time. The date and time of the interview would be arranged with what is most convenient for the interviewee. Research protocols surrounding anonymity, data storage and the right to withdraw will be thoroughly addressed prior to the interview, and any questions about these ahead of the interview are welcomed at the contact below.

Getting involved

If you might want to participate in this research, you are very welcome to get in touch with me as soon as is convenient for yourself in order for a date and a location to be arranged. If you have

any questions or comments, please do not hesitate to get in touch with me by email or telephone — my details are provided below.

[redacted]

Appendix C: Project Consent Form

Consent Form

Title: Understanding the UK Human Germline Genome-editing Debate

Fiona Coyle, PhD Researcher in Science and Technology Studies, University of Edinburgh

Supervisors: Dr Gill Haddow and Dr Niki Vermeulen

Project Funded by the Economic and Social Research Council

The Purpose of this Information Sheet

The information sheet explains your rights as a participant so that you feel fully informed before taking part in the current research. Please read this information sheet, the consent form and the accompanying documents very carefully and do not hesitate to ask questions about anything you do not fully understand. The signature at the end of this consent form confirms that you understand the contents of this information sheet and consent form at that you consent to have your data collected and used in the ways outlined. Your participation in this research is optional and you have the right to withdraw your participation in the research at any time, before, during or after taking part in the research. The signing of this consent form does not affect that right.

Details of Project

The research being conducted is for an ESRC-funded doctoral research project on expert debate on genome-editing in the UK context. Interviews are being conducted for this research to seek the views of individuals who are directly involved in the debate. By taking part in this research, participants will contribute to academic knowledge about experts' views on the genome-editing debate in the UK context. Please refer to the *Research Project Outline* for further information about the purpose of this study.

Use of this Research

The final product of this research will be a PhD thesis that will be publicly available online and in hard copy through the University of Edinburgh Library. Reports and, or publications containing analysis of the research findings will also be widely disseminated to academic and public audiences.

Data Confidentiality

Any audio or written data collected during this interview will be stored safely, securely and anonymously in line with the UK Data Protection Act 1998 and guidelines issued by the University of Edinburgh and the ESRC. As a solo PhD project, the primary researcher involved in handling the raw data is the researcher, Fiona Coyle. Any data collected as part of this research, including the audio recordings, will be kept separately from the names of participants and destroyed after the completion of the doctoral research.

Participant Anonymity

In this PhD, other reports and publications all individual participant names will be changed to numbers (i.e. Informant One). The option to waive anonymity will be discussed within the interview itself during the completion of the 'Participant Confirmation and Consent' section of the attached consent form.

Participants should note that organisations and institutions referenced *will* be freely named within the research. Therefore even participants who have been pseudonymised might be identifiable to some degree, especially given that the pool of participants being interviewed is small and those being interviewed are high profile.

Participant access to own data

Participants have the right to withdraw from this interview at any time and are under no obligation to answer questions they do not wish to answer. Participants may withdraw their data at any time

in the process of the current research. Once data is withdrawn, no extracts from the data will be used within any reports, talks or publications from the point of withdrawal onwards.

If you have any further questions, please feel free to ask.

Research Participant Consent Form

The Economic and Social Research Council (ESRC), the researcher Fiona Coyle and the University of Edinburgh attach high priority to the ethical conduct of research. We, therefore, ask you to consider the following points before signing them.

Please tick the appropriate boxes	*Yes*	*No*
Taking Part		
I have read and understood the attached information sheet	☐	☐
I have been given the opportunity to ask questions about the project	☐	☐
I agree to take part in the project. Taking part in the project will include being interviewed and recorded with an audio recorder and/or notes being taken	☐	☐
In understand that my taking part is voluntary; I can withdraw from the study at any time and I do not have to give any reason for why I no longer want to take part	☐	☐
Use of the information I provide for this project		
I understand my personal details such as my phone number and address will not be revealed to people outside the project	☐	☐
I understand that my words may be quoted in publications, reports, web pages and other research outputs	☐	☐
*Please read carefully and choose **one** of the following two options:*		
I would NOT like my real name to be used in the above research outputs and would like my data to be anonymised	☐	

I would like my real name to be used in the above research outputs and have been briefed on the subsequent implications of this concerning the identification of myself and any data I have given to the project ☐

In order for the information you provide to be used legally:

I agree to assign the copyright I hold to any materials related to this project to Fiona Coyle and the University of Edinburgh. ☐ ☐

_____	_____	_____
Name of Participant [printed]	Signature	Date
_____	_____	_____
Researcher [printed]	Signature	Date

Contact Details

For further information about the research or your interview data, please contact:

[redacted]

If you have concerns/questions about the research you would like to discuss with someone else at the University, please contact:

[redacted]

[redacted]

[redacted]

Appendix D: Interview Schedule

Section One: opening questions:

1. Can you explain a bit about your background?
2. In what ways are you involved in the UK genome-editing debate?
3. Do you feel you are able to participate in any way you wish, or do you feel your involvement hindered in any way?
4. What do you hope to achieve by participating in the UK hGGE debates?

Section Two: the genome-editing debate

5. Do you consider there to be a debate on hGGE in the UK, if so, where does the genome-editing debate occur?
    a. Prompt: in what sorts of spaces?
    b. Prompt: at what sorts of events?
6. What do you see as the key issues discussed in the UK hGGE debates?
    a. Prompt: do you contribute to — or critique — these issues
7. Who are some of the key actors/institutions that participate in the genome-editing debate?
    a. Prompt: why have you identified these individuals as 'key'?

Section Three: language in the debate

8. How do you think the key issues you have outlined are communicated in the debate?
    a. Prompt: effectively/ineffectively
    b. Prompt: through rhetorical techniques

9. Has the genome-editing debate effectively communicated the ethical and societal implications of genome-editing?
    a. Follow-up (if yes) how has this been achieved, and can you cite examples?
    b. Follow-up (if no) why do you think this is and can you cite examples?
10. Can you think of any other debates that are similar to the UK hGGE debates?
    a. Prompt: is this debate similar or different to other biotechnology debates in the UK?
11. Can you identify any prominent metaphors, images, or narratives employed by actors when discussing genome-editing?
    a. Follow-up (if yes): what are they and are they important?
    b. Follow-up (if no): why do you think there are no metaphors or images used?
12. Do you think that language is used strategically in the genome-editing debate?

Section Four: power dynamics of the debate

13. Do you think there are power dynamics in the genome-editing debate?
14. You've mentioned to me some of the actors and institutions you think are prominent in the debate, can you think of any actors or institutions who seek to participate in but are less successful?

Section Five: wind-down questions

15. Do you think that the debate on genome-editing is similar to other debates on new and emerging biotechnologies, or other reproductive technologies (or something else)?
16. Is the discussion of genome-editing one that could happen differently? If so, how would you suggest that it be changed?

17. How do you think that this debate will end?
    a. Follow-up: when might that happen?

18. Is there anything you would like to ask me?