Chapter 1

Introduction

One bright Saturday morning in March 2013 I travelled to an affluent and attractive suburb of north London to meet with Hayley,[1] a 38-year-old television and radio producer who, two-and-a-half years earlier, made the decision to freeze her eggs. Hayley, a warm and friendly woman dressed in an oversized grey woollen jumper welcomed me to her spacious and thoughtfully styled flat where we talked for several hours about her hopes and desires for motherhood, the difficulties she had encountered in finding the 'right' partner and her experience of drawing on what was at the time a very novel form of assisted reproductive technology. Hayley is in good company; between 2010 and 2016 the numbers of women undergoing egg freezing soared, with data from the UK Fertility Regulator, the Human Fertilisation and Embryology Authority (HFEA), reporting a 460% increase in the number of egg freezing cycles performed (HFEA, 2018a, 2018b). It appears that whilst growing numbers of women and couples may be choosing not to have children (Ashburn-Nardo, 2017), motherhood remains a life goal and expectation for many women, and some are willing to spend a significant amount of time and several thousand pounds on a technology that may increase their chance of being able to conceive, carry and give birth to a genetically related child in the future.

This introductory chapter seeks to situate the new technology of egg freezing within its specific social, economic and technological context. It examines how socio-cultural changes in the lives of women have reshaped the process, as well as experience, of relationship and family building and identifies how these changes have come into conflict with the immovable realities of women's natural fertility. In exploring the possibilities offered by new reproductive technologies more widely, this chapter begins to examine the promissory potential of egg freezing and provides a discussion and justification for the precise nomenclature that is adopted throughout this book. In introducing the technology, this chapter also explores key issues related to egg freezing 'success rates', the subject of access and the cost of the procedure, and the risks associated with this form of reproductive technology. The chapter then concludes with a brief discussion of the research and scholarship which underpins this text and provides an overview of the book as a whole.

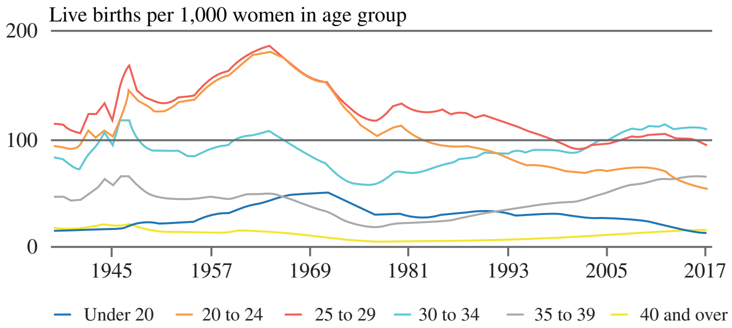
[1]Pseudonyms are used throughout this text.

1.1. Socio-cultural Context

The last 40 years have seen a persistent shift towards later childbearing in many Western countries including the United Kingdom (Kreyenfeld, 2010; Ní Bhrolcháin & Toulemon, 2005). During the 1970s, women in England and Wales were on average 26 years of age at the birth of their first child; however, by 2016 this had increased to 28.8 years (ONS, 2018). As Graph 1.1 indicates, the number of women having children at a younger age (under 20, 20–24 and 25–29) has significantly declined since the 1970s, and in the same period the number of women having children at an older age (30–34, 35–39 and 40 and over) has increased. Indeed, prior to 2003 more babies were born to women aged 25–29 than any other age group; however, women aged 30–34 now have the highest rate of fertility (ONS, 2015).

When the total fertility rate fell in the United Kingdom for a fifth consecutive year in 2017, decreased fertility rates were observed across every age group except for women aged 40 and over where the rate increased by 1.3%, reaching the highest level since 1949. This increase is part of a general trend which has seen the fertility rate of women aged 40 and over more than treble since 1991[2] (ONS, 2014). Whilst this trend towards later motherhood has been most significantly observed in Western societies, a shift towards delayed and older motherhood has also been identified in new and developing economies such as India, China and Latin America (Allahbadia, 2016; Sobotka & Beaujouan, 2018).

Delayed motherhood and the shift to later childbearing have been attributed to a wide range of social, economic, personal and relational factors. These include the increased reliability of methods of contraception; changing social norms



Graph 1.1: Age-specific Fertility Rates (England and Wales, 1938–2017). *Source*: Office for National Statistics, 2018, used with permission.

[2]In 1991 there were 5.3 births per 1,000 women to mothers 40+ compared to 16.1 in 2018. An average of 32.1 women per every 1,000 had children between the ages 35 and 39 in 1991 compared to 65.1 in 2017.

related to the timing of parenthood; women's increased participation in higher education and the labour force; the normalisation of multiple partnerships prior to marriage; difficulties in finding a partner with whom to pursue parenting; perceptions of personal readiness; rising costs of living and childcare; as well as economic instability and market uncertainty (Chabé-Ferret & Gobbi, 2018; Daly, 2011; Daniluk & Koert, 2017; Mills, Rindfuss, McDonald, te Velde, & ESHRE Reproduction, & Society Task Force, 2011). Indeed, improvements in population health, advances in medical technology, and access to contraception and abortion have meant that many women and men in the global north now have an unprecedented level of control over their fertility. Furthermore, should they wish to have children, they can exert significant influence over the timing of parenthood (Lemoine & Ravitsky, 2015; Lowe, 2016). However, when the time comes to try and create their families, many women, men and couples find they have experienced only the illusion of reproductive control and are unable to conceive without medical intervention (Earle & Letherby, 2007).

Around one in six couples in the United Kingdom have difficulties in conceiving, and for many this is a highly stressful, emotionally difficult, isolating as well as stigmatising experience with the potential for long-term effects even if they do eventually become parents (Cox, Glazebrook, Sheard, Ndukwe, & Oates, 2006; Wirtberg, Möller, Hogström, Tronstad, & Lalos, 2006). Prior to the advent of assisted reproductive technologies the experience of infertility was something the sufferer was forced to live with which, whilst was disappointing for many, was ultimately unchangeable (Earle & Letherby, 2002). However, following the development of in vitro fertilisation (IVF) by UK scientists Robert Edwards, Patrick Steptoe and Jean Purdy, and the birth of the first IVF baby Louise Brown in 1978, there was a shift from the social problem of involuntary childlessness to the medical problem of infertility (Becker & Nachtigall, 1992). This shift, and the way that medicalised fertility treatment has become increasingly normalised and routinised, not only in the clinic but also among wider publics, reflects how the social and private lives of social actors have become increasingly dominated by biomedicine (Clarke, 2010).

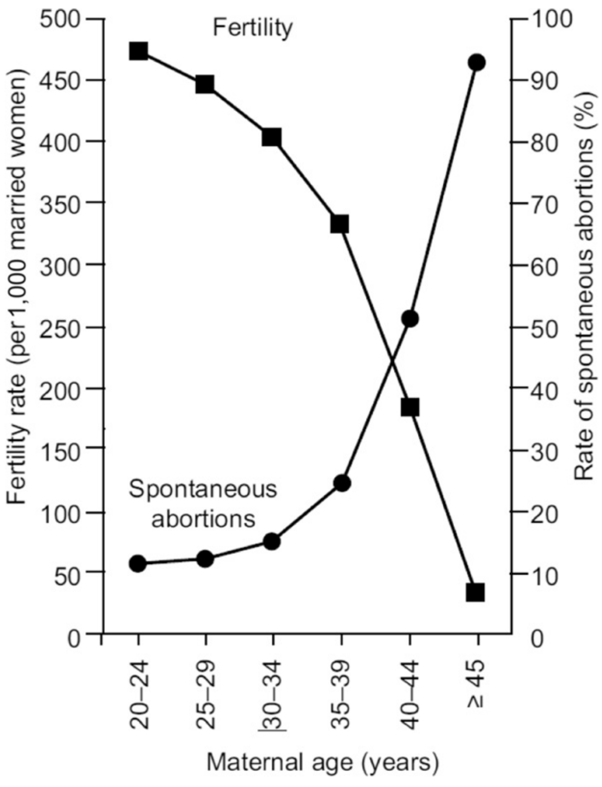
It is estimated that over eight million babies have been born worldwide from IVF technologies. In the United Kingdom the National Institute for Health and Care Excellence (NICE) suggests that women should be offered up to three cycles of IVF funded by the National Health Service (NHS), subject to certain criteria. However, in England, Wales and Northern Ireland, access to NHS-funded fertility treatment is overseen by local clinical commissioning groups (CCGs), and as few as 12% of CCGs follow this national guidance with many offering patients only one cycle of IVF or in some cases none at all (Fertility Fairness, 2017). This approach to the rationing of IVF treatment means that depending on where a person lives, access to IVF and the conditions of this access varies considerably. In 2016, 41% of IVF treatment cycles were funded by the NHS, leaving the remaining 59% of treatments to be privately funded. The cost of a cycle of IVF varies across the country and by the needs of individual patients and couples but may cost upwards of £5,000 per cycle. Thus, medicalised fertility treatment is beyond the reach of many (Bell, 2009).

Despite the high financial as well as emotional costs of medicalised fertility treatment, almost three-quarters of IVF cycles do not result in a live birth (HFEA, 2016). The birth rate per embryo transfer (PET) for all fresh cycles of IVF in the United Kingdom in 2016 was 21%. However, when broken down by age, birth rates vary considerably, with women under 35 having the highest birth rate PET (29%) and women over the age of 44 having the lowest (below 15%) (HFEA, 2016). As such, it is worth noting that even in younger patients, IVF has only a modest success rate which sees less than one in three couples with a 'take-home baby' after one round of treatment. Nevertheless, stories of miracle IVF babies and IVF success continue to abound in all quarters of the media, leading many to overestimate the efficacy of the technology (Chan, Chan, Peterson, Lampic, & Tam, 2015; Lucas, Rosario, & Shelling, 2015). Furthermore, despite its seemingly ubiquitous nature, fertility treatment is not risk free (Kamphuis, Bhattacharya, Van Der Veen, Mol, & Templeton, 2014); yet there remains an expectation that individuals and couples who struggle to conceive will want, and will draw upon, new reproductive technologies in order to build their families (Bell, 2017; Sandelowski, 1991).

Since the birth of the first IVF baby over 40 years ago, the number of technologies, treatments and procedures to assist in the process of creating healthy human life has expanded significantly and the UK fertility industry is now estimated to be worth £320 million (Risebrow, 2018). This expansion of the fertility industry has not only enabled many heterosexual couples to overcome barriers to parenthood but, through technologies of reproductive donation as well as surrogacy, has seen the emergence and increased visibility of alternative family forms such as lesbian mother families, gay father families and families headed by single mothers by choice (Nordqvist & Smart, 2014; Norton, Hudson, & Culley, 2013; Zadeh, Ilioi, Jadva, & Golombok, 2018). Furthermore, new developments in genetic screening and mitochondrial donation have also enabled people with serious inherited diseases in their family to have children of their own, safe in the knowledge that they will not be passing on the disease to their offspring (Dimond & Stephens, 2018; Herbrand, 2017). Technologies of egg donation have also enabled some women of advanced maternal age, who have reached the end of their reproductive lives, to experience pregnancy, birth and motherhood (Osazee & Omozuwa, 2018). However, the age of a woman at the time of trying to conceive, either naturally or via medicalised fertility treatment, is universally recognised as one of the best predictors of a future live birth (Balasch, 2010; Dunson, Colombo, & Baird, 2002).

1.2. Age and Fertility

A female foetus at 20 weeks has between 6 and 7 million eggs; however, at the time of birth her egg reserve will have already decreased by several million and she will continue to 'lose' eggs throughout her life. This loss occurs not only via ovulation and menstruation but also through the process of atresia, which sees the degeneration of ovarian follicles that do not ovulate during the menstrual cycle. This means that by puberty a girl has 300,000–500,000 eggs remaining, dropping to 25,000 at age 37, and by the time she enters menopause she may have as few as 1,000 eggs left, the majority of which will be of very low quality. This process of fertility decline is believed to occur throughout a woman's lifetime with a slight increase of the rate of decline beginning after she is 32, with a further pronounced and more accelerated loss of eggs occurring after 37 years (American College of Obstetricians & Gynecologists, 2014). As a woman ages, the quality and quantity of her eggs decline, which together has a significant effect on her ability to spontaneously conceive and carry a healthy pregnancy to full term (Utting & Bewley, 2011). Indeed, research has shown that as a woman gets older the chance of getting pregnant declines and the likelihood of a pregnancy ending in a miscarriage increases (Balasch & Gratacos, 2012; Heffner, 2004; Nybo Andersen, Wohlfahrt, Christens, Olsen, & Melbye, 2000) (see Graph 1.2), and by the time a woman is 40, some evidence has suggested that the risk of experiencing a miscarriage may overtake the chance of a live birth.



Graph 1.2: Fertility and Miscarriage with Advancing Maternal Age. *Source*: Reproduced with permission from Heffner (2004), © Massachusetts Medical Society.

Women who are pregnant at the age of 35 and older are routinely described in medical literature as 'older mothers' and are believed to be at an increased risk of many other complications throughout pregnancy and birth (see Tables 1.1 and 1.2), including gestational diabetes (Hemminki, 1996; Jolly, Sebire, Harris, Robinson, & Regan, 2000; Joseph et al., 2005), placenta praevia (Williams & Mittendorf, 1993), placenta abruption (Utting & Bewley, 2011), emergency caesarean section (Rosenthal & Paterson-Brown, 1998; Tough et al., 2002), chronic hypertension (Gosden & Rutherford, 1995), pre-eclampsia (Ziadeh & Yahaya, 2001) and post-partum haemorrhage (Jolly et al., 2000). Additional risks to children born from older mothers include an elevated risk of birth defects or genetic/chromosomal abnormalities (see Table 1.1), including trisomy 21, which results in Down's syndrome. By comparison, whilst some research has shown a link between advanced paternal age and negative health outcomes seen in children, these risks are less pronounced and occur at a much older age (Balasch, 2010; Bray, Gunnell, & Davey Smith, 2006; Hook, 1981; Toriello, Meck, & Professional Practice, & Guidelines Committee, 2008).

Table 1.1: Risk of Down's Syndrome and Chromosomal Abnormalities at Live Birth according to Maternal Age.

Maternal Age at Delivery	Risk of Down's Syndrome	Risk of Any Chromosomal Abnormality
20	1/1,667	1/526
25	1/1,200	1/476
30	1/952	1/385
35	1/378	1/192
40	1/106	1/66
45	1/30	1/21

Source: From Heffner (2004).

Table 1.2: Risks to Mothers in Pregnancy and Childbirth.

Maternal Age	Pre-eclampsia (%)	Gestational Diabetes (%)	Emergency Caesarean (%)	Post-partum Haemorrhage (%)
18–34	0.78	1	8.65	11.24
34–40	0.76	2.85	11.05	14.25
>40	0.79	4.56	14.24	17.99

Source: Jolly et al. (2000).

Table 1.3: Live Birth Rate Per Treatment Cycle (2014−2016).

Age	2014	2015	2016
Under 35	34	35	32
35−37	30	29	28
38−39	22	22	20
40−42	15	15	15
43−44	12	11	11
*44+	18	17	17

Sources: HFEA (2018a, 2018b).
Note: *The slight increase in live birth rates to women aged 44+ is likely to be due to the use of donor eggs.

The causes of infertility in women and men are multiple and largely known (see NICE, 2013 for further discussion); however, in up to 25% of cases no reason for infertility can be ascertained and the term 'unexplained infertility' is used (NICE, 2013). Although younger women can experience 'unexplained infertility', research has linked this to the age of women at the time of trying to conceive (Maheshwari, Porter, Shetty, & Bhattacharya, 2008). Whilst IVF technologies can help some women and couples experiencing unexplained infertility to conceive much wanted children, the success rates of IVF in older women remain low (see Table 1.3). Therefore, if a woman is unable to conceive via IVF using her own eggs due to problems with egg quality or quantity, she may be counselled to consider egg donation. This would see her attempt conception using eggs donated by another, sometimes younger woman.

The use of donor eggs in IVF has been shown to increase the chance of a live birth in older women as the capacity to conceive and carry a pregnancy to term has been shown to be affected primarily by the age of a woman's eggs, not the age of her womb (Navot et al., 1994).

1.2.1. Awareness of Age-related Fertility Decline

Whilst IVF and egg donation can enable some women to have children, these technologies cannot undo or redeem the fertility lost to the process of reproductive ageing (Alviggi, Humaidan, Howles, Tredway, & Hillier, 2009; Leridon, 2004). However, despite the significant consequences of age-related fertility decline (ARFD), scientific knowledge on this topic has been slow to develop and arguably even more slowly disseminated (Mac Dougall, Beyene, & Nachtigall, 2012). A substantial body of research has indicated that both men and women may lack a detailed understanding of the relationship between age and fertility, particularly as it relates to the fertility of women. Indeed, whilst a systematic review of 41 studies which quantitatively measured knowledge of ARFD identified a general awareness of fertility decline, as well as a good understanding of when fertility was at its peak, it found that the fertility knowledge of men and women was often insufficient particularly when it came to identify the time in the lifecourse when female fertility began to decrease more markedly (García, Brazal, Rodríguez, Prat, & Vassena, 2018). Similar research findings have been identified by Wyndham, Marin Figueira, and Patrizio (2012) who noted that whilst men and women most often have a general awareness that fertility declines with age, there is less understanding of the extent or rate of this decline or the time of its onset.

Whilst women and men with higher levels of education are more likely to delay childbearing, studies examining the awareness of ARFD in student populations in Sweden, (Lampic, Svanberg, Karlstrom, & Tyden, 2006; Tydén, Svanberg, Karlström, Lihoff, & Lampic, 2006), Israel (Hashiloni-Dolev, Kaplan, & Shkedi-Rafid, 2011), Denmark (Sørensen et al., 2016) and Canada (Bretherick, Fairbrother, Avila, Harbord, & Robinson, 2010) have found participants to significantly overestimate a woman's capacity to become pregnant at an older age, as well overestimate the age at which a woman's fertility most significantly declines and the probability of achieving a child from IVF treatment at an older age. Similar findings have also been identified in studies of midwifery students (Chelli, Riquet, Perrin, & Courbiere, 2015), obstetrics and gynaecology residents (Yu, Peterson, Inhorn, Boehm, & Patrizio, 2015), and other healthcare professionals, including general practitioners (GPs) and gynaecologists (Mortensen, Hegaard, Andersen, & Bentzen, 2012). Furthermore, some studies have also found men to be less aware of ARFD than their female counterparts (Daniluk, Koert, & Cheung, 2012; Hammarberg et al., 2013; Vassard, Lallemant, Nyboe Andersen, Macklon, & Schmidt, 2016; Virtala, Vilska, Huttunen, & Kunttu, 2011). This has led authors such as Daniluk and Koert (2013) to suggest that men as the other half of reproductive partnerships need to be more informed about the realities of female fertility decline.

As well as indicating some potential gaps in fertility knowledge, research has also indicated the presence of significant misunderstandings and 'myths' related to fertility amongst men and women. Mac Dougall et al. (2012) found that almost a third of the 61 women interviewed for their study expected their fertility to gradually decline until menopause at around 50 years of age and, as a result, anticipated being able to conceive at 40 with relative ease. Similar findings have been reported by García, Vassena, Trullenque, Rodríguez and Vernaeve (2015). Research by Bunting and Boivin (2008) also found that men and women believed negative health behaviours such as smoking, drinking alcohol and being overweight to have a more deleterious effect on a woman's fertility than being aged over 35 when attempting conception. This underestimation of the effect of age on fertility, when compared with other behaviours, is significant. These authors also identified the presence of fertility myths such as the belief that fertility could be increased by moving to countryside, by using a specific coital technique or by eating more fruit and vegetables. Such a belief that fertility is closely linked to a woman's general physical health has also been identified by other research (Hammarberg et al., 2013).

Forty years after the birth of the first IVF baby, there is now a common generalised belief that assisted reproductive technologies can overcome all barriers to pregnancy and birth, including advanced maternal age (Boivin, Bunting, & Gameiro, 2013; Chelli et al., 2015; Daniluk et al., 2012). However, as previously explained, IVF success rates are not particularly high and drop drastically past the age of 40 (Habbema, Eijkemans, Leridon, & te Velde, 2015). The overestimation of IVF success which has been observed in many previous studies (Benzies et al., 2006; Bretherick et al., 2010; Daniluk et al., 2012; Mac Dougall et al., 2012; Svanberg, Lampic, Karlström, & Tydén, 2006; Wyndham et al., 2012) may in part be attributed to the sometimes contradictory messages presented in the media about delayed childbearing and misleading stories about older motherhood.

Images and stories of celebrity older women who have become pregnant and had children at an advanced maternal age have become routine and almost unremarkable in glossy magazines and online. In their analysis of three commonly read women's magazines, Willson and Goldman (2017) observed how the reporting of celebrity pregnancies and new births to women of advanced maternal age was seldom accompanied by any discussion of assisted reproductive technologies even when the woman was 44 years of age or older at the time of giving birth. They also noted how the magazine articles contained no mention of the potential use of donor gametes nor the pregnancy-related health risks of advanced maternal age. As such, the authors argued that widely consumed popular media have a key role in downplaying the impact of age on fertility whilst simultaneously contributing to inaccurate representations of women's natural reproductive lifespan, which has the potential to be highly damaging to young women who may feel falsely reassured about attempting motherhood at an older age.

Due to the significant effect age has on women's ability to conceive, researchers, as well as women themselves, have advocated for greater education on fertility, delayed childbearing and the associated risks and costs of older motherhood (Daniluk & Koert, 2013; Everywoman, 2013; Hewlett, 2004; Mac Dougall et al., 2012; Schytt & Bergström, 2014; Ter Keurst, Boivin, & Gameiro, 2015; Wyndham et al., 2012). However public campaigns of this kind, in the USA as well as the United Kingdom, have been met with hostility and received criticism for the way they have been seen to impose limits on women's reproductive choices and result in unwelcome pressure on women to conceive at the 'correct' time (Cosslett, 2013; Soules, 2003). More recently, focus groups with women and men have suggested that the most effective way to communicate fertility information to people of reproductive age may be through primary healthcare providers such as GPs as well as via mass and social media utilising both printed and online tools and information (Hammarberg, Collins, Holden, Young, & McLachlan, 2017). However, whilst having more accurate information about ARFD may enable men and women to make a more informed choice about their reproductive decisions, research suggests this does not mean that they would necessarily have made their decisions any differently (Bunting & Boivin, 2008; Mac Dougall et al., 2012). Therefore, it seems likely that improved fertility education, while important, may not in itself necessarily reduce the number of women and couples experiencing age-related infertility. This is because despite being informed of the risks associated with delaying childbearing, men and women may still not feel ready for parenthood due to competing demands from their career, education, health and relationship status (Mac Dougall et al., 2012; Svanberg et al., 2006). These issues and how they shape the timing of motherhood are explored in more detail in Chapter 3.

However, it is in this conflict between the biologically optimal time for motherhood and the right psycho-social time to have a child that new technologies of reproductive cryopreservation have emerged. And as will be explored, these technologies are often presented as enabling women to realign their reproductive life-course within their own personal timelines, allowing them to pursue biological motherhood at the time of their choosing.

1.3. Cryopreservation of Reproductive Tissue

Practices of cryopreservation have historically been deployed within the biosciences in the storage and transportation of non-human organic materials not only to assist in the process of animal breeding (Clarke, 2007) but also to support the preservation of animal and seed biodiversity (Kroløkke, 2018; Loring, 2016; Radin, 2015). Routine practices of human tissue cryopreservation include the freezing and storing of stem cells from cord blood banking, as well as the freezing of reproductive material such as embryos, eggs, sperm and even ovarian tissue (Donnez & Dolmans, 2015; Machin, Brown, & McLeod, 2012). The process of cryopreservation allows various kinds of tissue and cellular material to be frozen, stored, thawed and then used without any apparent loss of vitality. By arresting biological processes and development, reproductive materials such as gametes can be held in 'suspended animation' and taken out of chronological time, allowing storage and transit not only across geographical borders but also across temporal space for redeployment at the time of a person's choosing.

Until recent years, women who were facing premature infertility as a result of a medical condition or treatment were encouraged to 'preserve' their fertility by freezing embryos either with a partner's or donor sperm. This is because, in contrast to eggs, embryos are better able to withstand the processes of freezing and thawing (Rienzi et al., 2017). Embryo freezing has become a major and routine part of IVF treatment. However, whilst embryo freezing is a reliable way to maintain future reproductive potential, it is not suitable for young women who do not have a partner or are not yet ready to commit to potential motherhood with such a partner. Furthermore, embryo freezing can be rejected on religious or moral grounds (Robertson, 2014). As such, the alternative possibilities offered by ovarian tissue and egg freezing provide much hope to these groups for whom embryo freezing is not a viable option.

When it was first developed in the late 1980s, egg freezing was primarily intended as a strategy to enable women to preserve a number of healthy unfertilised eggs when faced with the threat of infertility due to a medical condition or medical treatment. However, the process of freezing eggs presented a more complex problem than the freezing of sperm or embryos not only due to the size of human eggs (which are so large that they can be seen with the naked eye) but also due to their large surface volume and the fact that they predominantly consist of cytoplasm which can be disrupted during the process of freezing. As such, initial efforts at egg freezing were marked by technical difficulties, including damage to the egg caused by the formation of ice crystals during freezing (Aman & Parks, 1994; Baka et al., 1995; Rienzi et al., 2004; Stoop et al., 2015; Vincent, Pickering, & Johnson, 1990). Further difficulties were encountered when seeking to achieve fertilisation, as the process of freezing was found to harden the zona pellucida (the 'shell' of the egg), making it difficult for a sperm to penetrate (Carroll, Depypere, & Matthews, 1990; Fabbri et al., 2001; Matson, Graefling, Junk, Yovich, & Edirisinghe, 1997; Paynter, Cooper, Gregory, Fuller, & Shaw, 1999). The development of intracytoplasmic sperm injection (ICSI) in the early 1990s was able to circumvent zona pellucida hardening; however, the process of slowly cooling eggs down to a final storing temperature of $-196°$ remained problematic and saw many eggs lost through the process of freezing and thawing. It was not until the introduction of the vitrification or 'fast-freezing' method in the early 2000s, which substantially reduced the amount of damage done to the egg during freezing, that the procedure became more successful (Iussig et al., 2019).

As the clinical techniques of egg freezing have developed, the application of this technology has become increasingly diversified to include use by patients receiving gonadotoxic therapies for cancer and other illnesses (Rodriguez-Wallberg & Oktay, 2012), individuals with genetic conditions or illnesses which may result in premature infertility (Elizur et al., 2009) and individuals who object to the cryopreservation of embryos or who are undergoing gender-confirmation surgery (Armuand, Dhejne, Olofsson, & Rodriguez-Wallberg, 2017; Mitu, 2016). The increased use of egg freezing has also enabled the storage of eggs for use in donor IVF cycles as well as for research purposes (Kawwass et al., 2013) and has also enabled women not yet ready for motherhood to freeze their eggs for potential future use (Lockwood & Johnson, 2015; Petropanagos, Cattapan, Baylis, & Leader, 2015).

1.4. Describing and Conceptualising 'Social' Egg Freezing

The most appropriate terminology to describe egg freezing in an attempt to defer motherhood has been the subject of much discussion and dispute and remains largely unsettled (Daar et al., 2018). A variety of terms have been employed: for example, as the practice of self, or autologous, egg donation (Rybak & Lieman, 2009), 'planned egg freezing' (Daar et al., 2018), egg freezing for 'lifestyle' (Savulescu & Goold, 2008), 'elective' (Inhorn et al., 2018), 'non-medical', and 'social' reasons (Mertes & Pennings, 2011) as well as egg freezing for 'anticipated gamete exhaustion' (Stoop, van der Veen, Deneyer, Nekkebroeck, & Tournaye, 2014).

The term 'social' egg freezing has been criticised for minimising or trivialising the process of freezing eggs for potential future use (Pennings, 2013). Equally, the use of the phrase 'elective' egg freezing, or egg freezing for 'lifestyle' reasons, has been similarly critiqued for implying a deliberate desire on behalf of women to delay motherhood which may not wholly characterise the experiences of those using the technology. The process of egg freezing is also strictly speaking not 'non-medical' as it takes place in licenced medical clinics and is carried out by medical professionals. Whilst recognising how social changes have led to the postponement of motherhood, Stoop et al. (2014) have argued that it is the prevention of age-related infertility which motivates women to store gametes. As such, they advocate for the term 'AGE banking' or egg freezing for 'Anticipated Gamete Exhaustion'. More recently, the American Society for Reproductive Medicine (ASRM) proposed the term 'planned egg freezing' which they suggested removed any value judgements associated with the technology (Daar et al., 2018). Such terminology as proposed by Stoop et al. (2014) and the ASRM are no doubt attempts at more neutral representations of this process. However, this technology is inherently bound up with a complex set of political, social, economic and relational conditions which are important to emphasise in any discussion of this technology. Thus, whilst the term 'social' egg freezing has been deployed in the past as a contraindication to egg freezing for medical reasons, I adopt this term in a slightly different way to insist on the socially constituted nature of this technology. As such, the precise nomenclature used throughout this book to describe the practice of egg freezing to support the deferment of motherhood will be that of 'social egg freezing'. In describing women's use of this technology in such a way I hope to draw attention to the social and political context within which this practice is situated and highlight how women's reproductive choices, including their use of egg freezing, are inherently socially embedded. Furthermore, it is hoped that this phraseology will help challenge neoliberal discourse of individual choice which pervades much discussion of this technology and of women's reproductive decisions more generally.

As well as being explicit about the ontological assumptions underpinning the phraseology that is adopted throughout this book, it is also important to consider and explain the way in which this book conceptualises and understands the practice of social egg freezing. In much medical as well as wider social discourse egg freezing has commonly been referred to as a 'fertility preservation' strategy, particularly when being used by individuals undergoing treatment for cancer or by those who have conditions which may result in premature menopause (Elizur et al., 2009; Rodriguez-Wallberg & Oktay, 2012). The term 'fertility preservation' has also been somewhat uncritically applied to the practice of social egg freezing, yet there has been little discussion about how useful such a descriptor is in adequately capturing the application of this technology in such a different context (Martin, 2010; Mayes, Williams, & Lipworth, 2018). I contend that describing social egg freezing as a form of fertility preservation misrepresents and poorly characterises the aims and potential effects of the technology. Instead, for reasons I will shortly outline, I argue that social egg freezing is better conceptualised and understood as a tool of 'fertility extension' and 'genetic conservation'.

All women, whether they choose to freeze their eggs or not, will experience gradual fertility decline and eventually enter menopause with the associated physiological changes and effects. Therefore, whilst much of the advertising literature and discourses around social egg freezing draw on certain metaphors and tropes of 'stopping' or 'rewinding' the 'biological clock', of 'putting fertility on ice' or 'stopping time', the practice of social egg freezing does not in fact delay, stop or reverse the process of reproductive ageing. Indeed, it is likely that prior to turning to their frozen eggs in an attempt to have a child, heterosexual women will have tried to conceive naturally or by using assisted reproductive technologies such as inter uterine insemination and IVF with their remaining fresh eggs. Thus, at the point of drawing on their frozen reserve these women could be defined as no longer fertile as they are unable to conceive, carry and birth a child using their own genetic material. Whilst, as previously described, technologies of reproductive donation have long enabled women with a low ovarian reserve to experience pregnancy and birth, they have severed the genetic relationship between mother and child. However, egg freezing has the potential to enable users to maintain a genetic relationship with their future offspring by extending the amount of time it is possible to transmit genetic material along the maternal line, even going beyond that enabled by natural ovarian function (Martin, 2010; Mayes et al., 2018). As such, I argue that social egg freezing should be conceptualised and understood as a fertility extension technology which conserves genetic relatedness to potentially allow women to partake in the culturally valorised process of family building wherein the reproduction of genetic kinship relations is prioritised and maintained.

1.5. Key Issues in Social Egg Freezing

Egg freezing has been legal in the United Kingdom since 2000. However, the number of cycles performed in the United Kingdom has remained low until recent years. The HFEA, which registers the number of egg freezing treatment cycles undertaken each year, currently does not record the reasons given by women for accessing the technology. However, they have suggested that the recent increase in egg freezing cycles is likely to be due to larger numbers of women presenting for social reasons. As of 2016 around 62 fertility clinics across the United Kingdom offered egg freezing. However, data from HFEA show that most clinics are performing 10 or fewer egg freezing cycles a year with only 15% undertaking more than 20. Instead a large concentration of cycles are being undertaken by a small number of clinics,[3] with 78% of egg freezing cycles taking place in London. The last eight years has seen a significant increase in the number of egg freezing cycles performed not only in the United Kingdom but also in much of Western Europe, most notably in Spain but also in Belgium (ESHRE Working Group on Oocyte Cryopreservation in Europe et al., 2017) as well as in other high-income countries such as the USA, Australia and Israel (Daar et al., 2018; Inhorn et al., 2018; Pritchard et al., 2017; Waldby, 2015). There also appears to be an increased appetite and provision of social egg freezing in emerging and new economies as well as low- and middle-income countries (Allahbadia, 2016; Kılıç & Göçmen, 2018; Santo et al., 2017).

Research examining social egg freezing has suggested that the typical user of the technology is on average between 37 and 38 years of age at time of freezing (Groot et al., 2016; HFEA, 2018b; Waldby, 2015). This is noteworthy because, similar to IVF treatment more generally, the age of the woman at the time of

[3]Only three clinics performed more than 100 egg freezing cycles in 2016, with the highest performed being 186 (HFEA, 2018a).

undergoing egg freezing has been shown to have a significant effect on the likelihood of the procedure resulting in a live birth.

1.5.1. Success Rates

Egg freezing is a novel technology and currently only small numbers of women have returned to use their eggs in fertility treatment (Cobo & García-Velasco, 2016; Hammarberg et al., 2013). As such, it is difficult to access detailed information about the likelihood of achieving a live birth with previously frozen eggs, particularly in a UK context. The data available both in the United Kingdom and overseas are complex and success rates can be, and often are, presented in several different ways. Egg freezing 'success' can constitute a successful egg retrieval where a sufficient number of mature eggs are frozen following egg collection; a successful thaw process where a large proportion of eggs survive the freezing and thawing procedures undamaged; a successful fertilisation in the laboratory following ICSI; the development of high-quality blastocysts; a successful implantation in the womb; the indication of a chemical pregnancy; an ongoing pregnancy; and a live birth. It is perhaps the likelihood of achieving a live birth from previously frozen eggs that many women considering the technology are most interested. Nevertheless, it is important to recognise and be aware of the multiple ways in which egg freezing 'success' can be characterised and represented, especially by those who are 'selling' this procedure. The chance of achieving a live birth from previously frozen eggs is shaped most significantly by three key factors: the age of a woman at the time of freezing her eggs, the number of eggs she has frozen and the level of experience and expertise of the clinic providing the technology. The effects of each of these on live birth rates are now explored in turn.

1.5.1.1. Age at Freezing

As previously noted, a woman is born with all the eggs she will ever have and her ovarian reserve declines throughout her life as does her egg quality (Utting & Bewley, 2011). As such, the likelihood of achieving a live birth either by natural conception or via IVF technologies is strongly associated with the age at which conception is attempted (Balasch & Gratacos, 2012). Data show a clear inverse correlation between age at freezing and live birth rates which see 'older' eggs produce fewer live births than those taken from younger women (Borini et al., 2010; Ubaldi et al., 2010). Freezing the eggs of a woman in her 20s may be beneficial in terms of maximising the egg quality and minimising the number of cycles required to collect a sufficient number of eggs for storing. However, the younger a woman is when she undergoes the procedure the less likely she is to need them in the future because there is more time for her life plan to unfold and for her to attempt natural conception (Daar et al., 2018; Doyle et al., 2016). As such, egg freezing may prove to be an unnecessary medical intervention for a woman in her 20s. Indeed, statistical modelling has suggested that the optimum time to undergo the procedure is likely to be between the ages of 32 and 37 years old (Daar et al., 2018; van Loendersloot et al., 2011; Mesen, Mersereau, Kane, & Steiner, 2015). The reasoning here is that by making use of the technology at such

Table 1.4: Age at Storage Treatment, Years 2014–2016.

Year	Age at Storage					
	Under 35	**35–37**	**38–39**	**40–42**	**42–44**	**Over 44**
2014	248	163	139	100	24	3
2015	348	284	203	169	50	15
2016	375	355	216	168	39	18

Sources: HFEA (2018a, 2018b).

an age, the user is not yet likely to have experienced the most significant decline in their fertility but may still want to make use of their eggs in the future.

Whilst increasing numbers of women have been undergoing egg freezing in the United Kingdom in recent years, many of these women are doing so at what has been described as a biologically sub-optimal time. As Table 1.4 indicates, less than a third of the women who froze their eggs in the United Kingdom in 2016 underwent the procedure before they turned 35. Furthermore, in almost 20% of the cycles performed, the woman was aged 40 or over at the time of freezing. There may be some efficacy in freezing eggs at such an age; however, research and statistical modelling from Goldman et al. (2017) suggests that these women may need to store a significant number of eggs (40+) to have reasonable chance of achieving a live birth in the future.

Whilst evidence shows that women are more likely to achieve a live birth if they freeze eggs at a younger age, current UK regulations state that women are only able to store their eggs for a period of up to 10 years. Several authors have identified how such regulations could effectively promote poor clinical practice by encouraging women to undergo egg freezing at an older age when their fertility may already be compromised and at a time where they may need to undergo multiple rounds of stimulation and retrieval (Jackson, 2016). It is possible to obtain successive 10-year extensions to storage but only if 'a registered medical practitioner has given a written opinion that the person who provided the gamete […] is prematurely infertile or is likely to become prematurely infertile' (HFE, 2009). However, a woman with normal fertility who froze eggs at 32 is unlikely to be considered prematurely infertile at 42 and so will have to see her eggs destroyed. If she then struggles to conceive five years later when she is 47, she may be advised to consider using donor eggs. However, third-party assisted conception raises many significant concerns for donor, recipient and offspring and is thus a less desired route to parenthood for many people (Allan, 2012). As a result, there is an ongoing campaigning to amend current legislation to allow women to obtain extensions to the storage period until a time when they either no longer need or want to keep their eggs for potential future use (Harper, Baldwin, van de Weil, & Boivin, 2018).

1.5.1.2. Number of Eggs Banked

The second factor which affects the likelihood of a future live birth is the number of eggs a woman is able to bank; the more eggs a woman freezes the greater the chance that one of her eggs will result in a live birth. Having a sufficient number of eggs banked is also important as eggs are likely to be 'lost' along the way through the process of attrition. Whilst a woman may bank 20 eggs, some of them may not survive the thawing process or may not fertilise, and others may not develop normally at the blastocyst stage and therefore may not be suitable for implantation. Once the chosen embryo is placed into the woman's womb, this embryo may fail to implant, or the woman may miscarry. As a result, a sufficient number of eggs are needed to create enough embryos for use in the multiple attempts at IVF that a woman may need to undergo to achieve a live birth. Since egg quality declines as women age, older women often need to bank more eggs than their younger counterparts to increase their chance of a live birth in the future (Jackson, 2018). Indeed, research and statistical modelling provided by Goldman et al. (2017) (see Table 1.5) have suggested that if a woman undergoes egg freezing before her 35th birthday she may need around 20 frozen eggs to achieve almost an 80% chance of a future live birth.[4] By contrast, a woman who undergoes the procedure when she is 39 will need 50 eggs to potentially achieve the same likelihood of success.

Table 1.5: Likelihood (%) of At Least One Live Birth from Previously Frozen Eggs.

Age (Years)	**<35**	**35**	**37**	**39**	**40**	**42**	**44**
No. of Mature Eggs Frozen							
1	7	7	5	3	2	1	1
2	14	13	9	6	4	2	1
3	20	19	13	9	7	3	2
4	25	24	17	11	9	5	2
5	30	29	21	14	11	6	3
10	52	50	37	26	20	11	6
20	77	57	60	45	36	21	11
40	95	94	84	70	59	37	21
50	97	97	90	77	68	44	25

Source: Goldman et al. (2017).

[4]Such a figure assumes multiple rounds of IVF.

1.5.1.3. Clinical Expertise

When egg freezing was first developed, the live birth rates using thawed eggs were very low. However, in recent years it has been suggested that cycles using embryos from previously vitrified eggs can achieve comparable fertilisation, implantation and clinical pregnancy rates as cycles using fresh eggs (Doyle et al., 2016). However, many of the studies achieving such success rates not only involve eggs taken from women who are younger than the current average user of social egg freezing, and as such are not generalisable to the typical user of the technology, but also come from highly specialised teams in fertility centres which have been using this technology for several years and are thus highly experienced in using thawed eggs (Saumet et al., 2018). Currently, the only indication of the success rates being achieved by UK clinics come from HFEA data published in 2018. These data show that women who froze their eggs before their 35th birthday experienced a live birth rate per transfer cycle of 27%. However, the success rate dropped to 13% for women who underwent the procedure after the age of 35 (HFEA, 2018b). The data provided by the HFEA are the only widely available indications of egg freezing success rates occurring within UK clinics; however, they are limited in their utility as not only are they drawn from a comparatively small sample[5] but also include eggs which were 'slow frozen' prior to the wider adoption of egg vitrification which has been shown to be significantly more effective. As such, it will be some time until more reliable statistics about egg freezing success in the United Kingdom emerges.

Egg freezing success rates are known to vary widely between centres and according to the level of experience clinics have in freezing, thawing and attempting fertilisation with such eggs (Daar et al., 2018), and research suggests that it takes experience to become skilled at egg freezing (Potdar, Gelbaya, & Nardo, 2014). As such, it is unlikely that the success rates achieved in specialist centres such as those in the USA will be transferrable to all fertility clinics (von Wolff, Germeyer, & Nawroth, 2015). To ensure that egg freezing is not oversold as a way to 'stop the biological clock', the ASRM and other authors (Baldwin & Culley, 2018) have stressed the importance of women receiving as much individualised information as possible about egg freezing success rates which include clinic specific success rates (where available) stratified by the age at freezing. Furthermore, women considering using this technology need to be made aware of the limitations of current evidence. Indeed, ASRM guidelines recently suggest that potential users of the technology should be informed if the clinic they are attending has only recently started offering the procedure and should be told if no patients have yet returned to use their eggs to conceive (Daar et al., 2018).

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[5]Only 178 thaw cycles took place in UK clinics in 2016.

1.5.2. Access and Cost

Egg freezing for social reasons is not available in the United Kingdom via the NHS. A review of UK clinic websites performed in May 2018 (see Figure 1.1) showed the cost of one cycle of egg freezing to range from £2,720 to £3,929, with the median cost being £3,350 (HFEA, 2018a). However, these figures do not include the hormonal stimulation medication required, which can vary from £500 to several thousand pounds per cycle. Most clinics offer one or two years' storage inclusive of the initial egg freezing fee; however, beyond this time, women need to pay between £125 and £350 a year to keep their eggs frozen. As a result, the total cost of egg freezing can be quite considerable, especially if women need to undergo the procedure multiple times to bank a sufficient number of eggs. Should a woman want to use her eggs to try and conceive, IVF treatment using ICSI is estimated to cost between £1,650 and £4,000, with the average median cost being around £2,500 (HFEA, 2018a). Thus, two rounds of egg freezing, including five years of storage and one round of ICSI, to achieve a pregnancy may cost in excess of £11,600.[6] However, it is likely that a woman may need to attempt more than one cycle of ICSI using their frozen eggs to secure a pregnancy with the associated cost and may also incur further treatment fees related to the use of donor sperm or other IVF add-ons.[7] In the USA the cost of egg freezing is similar if not slightly higher and sees women generally pay upwards of US $10,000 for each cycle in addition to storage fees of as much as US $1,000. It is therefore not surprising that the users of this technology are most often middle class, highly educated and in professional occupations (Baldwin, Culley, Hudson, Mitchell, & Lavery, 2015; Inhorn et al., 2018; Stoop et al., 2015).

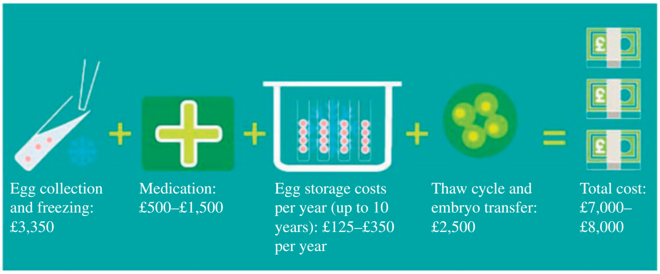

Figure 1.1: Average Costs of Elements for a Typical Egg Freezing and Thaw Cycle. *Sources*: HFEA (2018a), © HFEA, 2018a (reproduced with permission).

[6]Estimates based on two rounds of egg freezing at £3,350 per cycle (£6,700) + hormone stimulation drugs at £800 per cycle (£1,600) + five years' storage (one year covered by original treatment costs) £200 per year (£800) + one round of ICSI at £2,500 = £11,600.

[7]These add-ons may include expensive treatments such as pre-implantation genetic screening or other procedures such as time lapse embryo monitoring which could add further significant cost.

Whilst most women who freeze their eggs pay for the procedure themselves, a small number of women are able to access egg freezing through their employer, who 'sponsors' the procedure on their behalf. This issue of 'employer-sponsored social egg freezing' is explored in more detail in Chapter 2. A more common way, at least in the United Kingdom, in which women can access the technology free of charge is if they enter into an 'egg sharing' agreement (Blyth, 2002). The practice of egg sharing in 'fresh' IVF cycles has been the subject of much discussion with critics questioning the ethics and potential for exploitation for those involved in such schemes (Gürtin, Ahuja, & Golombok, 2012; Haimes, Taylor, & Turkmendag, 2012). Women who access egg freezing via a freeze share scheme can freeze their eggs for free if they donate or 'share' half of those eggs collected with another woman for use in fertility treatment. To undergo this process a woman most often needs to be 35 years of age or younger, as this is the maximum age at which women can donate eggs in the United Kingdom, and is required to have a certain hormone level indicating that she is likely to be able to produce a sufficient number of eggs for sharing. As the woman only keeps half of the eggs retrieved for herself, she may be counselled to undergo the procedure a number of times in order to collect a sufficient number for freezing (Donnez & Dolmans, 2013). Thus, unlike her fee-paying counterparts, she may need to undergo the process of ovarian stimulation and retrieval with the associated risks on two or more occasions. Furthermore, by entering into an egg sharing agreement the woman becomes an egg donor which has potentially significant long-term consequences, especially given that in the United Kingdom egg donors are identifiable to offspring when they reach the age of 18.

1.5.3. Risks of Fertility Treatment and Egg Freezing

Medicalised fertility treatment and procedures are well tested, used worldwide and are largely considered to be safe; however, they do carry some risks to the female user and potential offspring. The risks associated with egg freezing reflect those seen in 'traditional' IVF as several of the procedures are the same. One of the most common complications of IVF treatment is ovarian hyper stimulation syndrome (OHSS). OHSS is an iatrogenic consequence of the ovarian simulation process and in its mildest form, which results in abdominal discomfort and bloating, occurs in 20%–30% of women undergoing IVF (Saumet et al., 2018). Moderate OHSS is estimated to occur between 3% and 8% of cycles and includes moderate abdominal pain, nausea and vomiting (Delvigne & Rozenberg, 2002). In its most severe form, however, OHSS is associated with life-threatening complications such as renal failure, respiratory distress and haemorrhage from ovarian rupture (Binder et al., 2007; Saumet et al., 2018). However, severe OHSS is only estimated to occur in up to 0.2%–3% of all cycles (Binder et al., 2007; Vloeberghs, Peeraer, Pexsters, & D'Hooghe, 2009). Additional risks of the egg freezing process include bleeding and infection following injury to the intra-peritoneal structures during egg retrieval as well as bladder, bowel or vessel perforation, and in extremely rare circumstances, the risk of ovarian torsion from enlarged ovaries (Saumet et al., 2018). These risks, however, remain low at less than 1% (Maxwell, Cholst, & Rosenwaks, 2008). Some studies have identified a possible link between ovarian stimulation and ovarian or breast cancer, though this has been challenged in recent years and the evidence remains inconclusive (van den Belt-Dusebout, Alexandra, van Leeuwen, & Burger, 2016).

Should women want to use their eggs in an attempt to conceive in the future, they will need to undergo IVF treatment using ICSI which also poses further physical and emotional risks to the woman. Indeed, a significant body of evidence has shown that pregnant women aged 35 and older are at increased risk of pregnancy and birth-related complications compared to younger women, including an elevated risk of hypertension, gestational diabetes and preterm birth (Saumet et al., 2018). These risks are not eradicated or significantly reduced by attempting conception with genetic material from a younger 'donor' but are instead linked to the age of the woman carrying the pregnancy (Sauer, 2015). One of the most significant risks of fertility treatment more broadly, but which also applies to users of egg freezing, is the chance of a multiple pregnancy and birth in the future. Multiple pregnancies are associated with sometimes significant maternal and perinatal complications including gestational diabetes, foetal growth restrictions, pre-eclampsia and premature birth (Kamphuis et al., 2014). However, policies such as the 'One at a time' campaign in the United Kingdom has reduced the number of multiple embryo transfers taking place in UK fertility clinics, which have seen a substantial decrease in the number of multiple IVF births in the intervening years (HFEA, 2015). Nevertheless, the risk of multiple birth remains in all cycles of IVF.

Data on the long-term safety of egg freezing continue to be somewhat incomplete partly because egg vitrification was only adopted and used widely (at least in the United Kingdom) in the last 8–10 years. Furthermore, only small numbers of women have returned to use their eggs and their offspring are still growing up (Daar et al., 2018). However, early data indicate that the use of thawed eggs shows no increased risk of chromosomal abnormalities or developmental deficits in babies compared to other IVF or general population births (Cobo et al., 2015; Noyes, Porcu, & Borini, 2009). However, there remains some scientific unknowns concerning long-term or transgenerational offspring health linked not only to practices of cryopreservation but also the embryo culture medium used and the ICSI procedure adopted to fertilise thawed eggs (Belva et al., 2016; Bouillon et al., 2016).

A further, potentially significant, risk associated with the technology which is sometimes overlooked is that women may overestimate the chance of future success with their eggs which may not ultimately result in a live birth in the future (Saumet et al., 2018). Furthermore, it is important to bear in mind the substantial emotional toll that fertility treatment of any kind can have on an individual as well as couple relationship (Boivin & Takefnan, 1996; Van Der Merwe & Greeff, 2015). Thus, social egg freezing is a novel technology which is currently only seeing modest success rates in the United Kingdom; it is also a costly process which isn't without risks. However, despite this, growing numbers of women are still considering putting their fertility 'on ice'.

1.6. Overview of the Book

The phenomenon of social egg freezing has only recently emerged as a new social practice related to the timing of parenthood, and as such there remain many unanswered questions about women's perceptions and use of this novel technology. This book is derived from an exploratory sociological research study which examined how 31 women, who were in many ways pioneering users of this technology, constructed, understood and experienced the phenomenon of social egg freezing in the context of debates surrounding reproductive choice and delayed motherhood. This research also explored how women made the decision to engage with social egg freezing, how they perceived the risks and benefits of the procedure, and how they experienced the 'medical' encounter in the clinic. As part of this investigation and analysis this research project also examined some of the broader sociological questions raised by this technology in relation to the (gendered) burden of appropriately timed parenthood, the medicalisation of women's bodies in the reproductive domain, the further entrenchment of the geneticisation of society, and the way in which reproductive and parenting ideals, values and expectations can come into conflict with the biological and relational realities of women's lives.

In drawing on this research and wider scholarship and investigation, this book joins a rich field of sociological research that applies qualitative methods to explore contemporary developments in assisted reproduction (Dimond & Stephens, 2018; Nash, 2014; Nordqvist & Smart, 2014; Wahlberg & Gammeltoft, 2018). This book aims to offer a nuanced, detailed and critical examination and analysis of social egg freezing by investigating the way in which users of this technology determine and negotiate their mothering desires which are mediated and constrained not only by wider socio-political and market contexts but also by their intimate encounters with (non)reproductive partners. It also aims to demonstrate the sometimes significant pressures and burdens new biomedical developments in reproductive technology can place upon women to draw upon and navigate these technologies in the pursuit of greater reproductive choice and control and in the process of family building. This text seeks to be the first of its kind to bring together rigorous academic research, detailed accounts from egg freezing users, and wider social science scholarship and theorising to explore the phenomenon of social egg freezing in qualitative depth. This book is therefore written not only for an academic audience but also for informed publics, users and potential users of social egg freezing, as well as those involved in the provision, delivery, management or regulation of assisted reproductive technologies. As such, I have sought for the tone and structure of this book to be sufficiently inclusive, accessible and engaging for specialist and non-specialist audiences alike.

Whilst remaining conscious of the way in which social egg freezing plays into and shapes broader debates and practices in a wider Western context, this research provides a uniquely British-American perspective on this technology.

This chapter has situated the practice of egg freezing within its specific social, economic and technological context. It has drawn on wider demographic and medical literature to help understand the emergence of this technology and has identified and explored a number of complex issues relating to the 'success rates' being achieved with this technology and the risks the procedure poses to potential users. This chapter has also provided a discussion of and rationale for the precise nomenclature that is adopted throughout this book. Chapter 2 of this book draws on wider scholarship across the social sciences but also bioethics and law to provide a considered analysis and discussion of several contemporary debates in social egg freezing. This chapter explores how, via a process of medicalisation, age-related fertility decline has become reconstructed not as a natural and inevitable process of ageing but as something pathological and in need of a technological fix. It furthermore observes how this pathologising of ovarian ageing has given rise to new anxieties and responsibilities on behalf of women to anticipate their own infertility and consider drawing on new biomedical interventions. This chapter also examines how egg freezing technology has become highly commercialised not only as a tool of fertility extension but as a key mechanism in the wider 'tissue economy' by enabling the storage and transportation of eggs across geographic as well as temporal borders with greater frequency and ease. It then concludes by exploring the highly contentious issue of company-sponsored egg freezing and asks important questions about whose reproductive and mothering horizons are being broadened by social egg freezing and whose are being left on the sideline. Drawing critically on concepts and tools from lifecourse theory and wider social scientific research, as well as on the findings of interviews with users of social egg freezing, Chapter 3 explores the complex issue of reproductive timing. In this chapter the socio-cultural context of delayed parenthood is unpacked in greater detail, including the factors shaping the timing of motherhood and perceptions of the 'right time' to have a child. This chapter also explores perceptions and representation of older motherhood and problematises the way in which women are often presented as 'choosing' to delay pregnancy. Chapter 4 of this book draws on theories and concepts from the sociology of the family and parenting culture studies, alongside a discussion of the accounts of the research participants to explore how ideologies of parenthood can shape women's perceptions of their readiness to parent. It explores how intentions to mother 'intensively' can produce anxieties about the performance of parenthood and how as a result some women in this research disclosed some ambivalence about becoming a mother in the future. This chapter also explores the other ways in which women considered going about performing parenthood beyond the 'traditional' two-parent family and examines their attitudes towards single motherhood via sperm donation. The fifth chapter of this book explores in detail the factors motivating women to undergo social egg freezing and presents the findings of this research in context with other quantitative and qualitative data on this topic which has emerged in recent years. This chapter demonstrates how women's use of the technology was shaped by a fear of running out of time to find a suitable partner, a fear of engaging in panic partnering, as well as a fear of future regret and blame. This chapter also shows how concerns about career advancement did not play a significant role in women's use of this technology but demonstrates how workplace issues related to maternity leave and fears of discrimination shaped the timing of motherhood and thus women's use of egg freezing technology. In the absence of any other in-depth and nuanced account of the egg freezing process which presents the experiences of multiple users of this technology, Chapter 6 provides a thorough and detailed examination of the experience of social egg freezing from the perspective of the user. Organised chronologically, this chapter prioritises the participants' voices and accounts and explores their initial thoughts and opinions of the technology, their experience of the egg freezing process, and their reflections on the procedure and future reproductive intentions. This chapter may be of particular interest to users and potential users of social egg freezing who are looking for detailed unbiased accounts of what it is like to freeze eggs for social reasons. Chapter 7 explores how women's reproductive intentions and actions are intimately entangled with the procreative consciousness and impulses of potential and actual male partners. In exploring the sexual politics of social egg freezing, this chapter highlights the unequal power relations at play in the process of relationship formation and progression in large cities where many of the participants were based and shows how this works to disadvantage women as they age. This chapter also explores how the participants managed the disclosure of egg freezing and shows how some women mobilised their frozen reserve as a tool to communicate enduring reproductive capacities to potential partners and thereby increase their value in the marketplace of marriage. In the final chapter of this book I draw together some of the discussion which has spanned several chapters of this book and lay bare how the decision to undergo social egg freezing and women's experience of reproductive delay were shaped by powerful factors beyond women's control as individuals. I also consider the new opportunities presented by social egg freezing but also the highly gendered burdens and responsibilities this technology generates, and close with some reflections and considerations about future research directions.