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### Freezing fertility: Oocyte cryopreservation and the gender politics of ageing

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## *Ex Ovo Omnia*

When I imagine my eggs, I think of them as grey and shiny, like slippery helium balloons clustering in the thousands within organs lit-up and awake. I think of eggs enfolded in follicular cavities, folding again and again into a sponge of cells and yellow bodies, pulsing patiently with only an occasional burst: membrane breaking at the touch of engorged fimbriae, fallopian fingers brushing the ovarian skin. After stories and statistics, after computer animations and camera registrations of organs shining against surgical light, my eggs become palpable within two pulsing opals, shielded by hipbones, roused with embodied symbolism. Hypnagogic, I dream them into being—a fiction of the body.

Celebrated as empowerment and criticised as exploitation of women, egg freezing (oocyte cryopreservation) is a contested new reproductive technology that has brought the egg into the public eye with renewed prominence. The technology, and the eggs and bodies it pertains to, have been widely featured in public debates and popular culture. I began writing this research in 2011, just after the conclusion of a two-year parliamentary debate on egg freezing in the Netherlands. Politicians, journalists, medical professionals and members of the public spoke out about whether or not women should (be allowed to) freeze their eggs, and at what ages that would be appropriate. In the media coverage of egg freezing, including that of these discussions, eggs became some of the most culturally-determined cells in the body, represented in declining fertility statistics, visualised in photomicrography and referenced in tropes of the “biological clock” and “ticking ovaries.” Dutch documentary maker Marieke Schellart garnered widespread attention for egg freezing with her film *Eggs for Later* (2010), while 3.57 million US viewers watched celebrity Kim Kardashian freeze her eggs in the season finale of the popular reality show *Keeping up with the Kardashians* (Seacrest and Goldberg 2012; Bibel 2012). A large egg floated above the dancing nurses and gynaecologists on the “*donorboot*” [donor boat] at the annual floating canal parade of the 2014 Amsterdam Gay Pride, which promoted the Academic Medical Centre’s (AMC) new frozen egg bank. Whereas media coverage and public debates initially primarily focused on the novelty and permissibility of the practice, the discourse around egg freezing quickly developed as later developments such as egg freezing cocktail parties promoting the “empowering” technology or its inclusion as a “perk” in the health care benefits of certain Apple and Facebook employees triggered international media hypes (Eggbanxx 2015). As women began freezing their eggs in increasing numbers, they encountered them through medical imaging techniques like ultrasound and photomicrography, while extending their reproductive decision-making about the

extracted cells in contracts of informed consent. In each of these ways, and many more, eggs are brought into discourse in ways that affect not only the women who freeze them, but the public at large.

Of course eggs have been recognised cultural entities from the 17<sup>th</sup> century onwards, when William Harvey (1578-1657) postulated that all animals are conceived from eggs in his famous dictum “*ex ovo omnia*” [everything from the egg], which was later confirmed—at least where mammals were concerned—by Karl Ernst von Baer’s observation of the mammalian ovum in 1826 (Lopata 2009, 5; Gosden and Lee 2010, 973). Harvey’s frontispiece to his treatise *Exercitationes* (1651), a drawing of Zeus holding an egg with the inscription “*Ex Ovo Omnia*,” references the myth in which the deity, disguised as a swan, rapes Leda, who bears two eggs from which the demigod Helen and a twin hatch (Maguire 2009, 3). This reference points to a rich and long cultural history of the egg, in which it served as a symbol of life, death and regeneration in many civilisations around the world long before human eggs were identified within the tradition of European biology.

The oldest written reference to the egg was found on Egyptian papyrus of the New Kingdom period, where the author, probably referencing Thoth, god of the moon, addresses the “Egg of the water,” writing: “I came forth with thee from the water; I came forth with thee from thy rest” (Newall 1967, 4).<sup>1</sup> The understanding of the egg as the origin of the world, of deities or of the first humans occurs in many creation myths in the Balto-Finnic region, the Eastern Mediterranean lands, South Asia (China, Tibet, Indo-China, India), the Malay Archipelago, Oceania, and Australia (Valk 2000, 148; Leeming 2005, 82).<sup>2</sup> Egg creation myths from the ancient Greek Orphic tradition re-emerged in medieval Europe, notably in Hildegard of Bingen’s (1098-1179) vision of the universe as “Cosmic Egg” in the collection of 26 mystical visions *Liber Scivias* (1151) (Fox 2002, 48).<sup>3</sup> Eggs also appear in Italian Renaissance paintings above the head of the Virgin and have been interpreted as symbols of immaculate conception (Alcock 2007, 22). In Europe eggs were recognised as tools for witchcraft; as the egg embodied the creation of

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<sup>1</sup> Thoth was believed to have hatched the world egg at Hermopolis. Foreshadowing Harvey’s dictum, Petosiris, priest of Hermopolis, writes of this sacred site: “Part of the Egg was buried in this place, and here were found all beings who came forth from the Egg” (Newall 1967, 4).

<sup>2</sup> For example, in Pre-Buddhist China, the 3rd-century text *Sanwu Liji* describes egg from which the being P’an-Ku was born, who separated the heavy yin element of earth and lighter yang element of sky (Leeming 2005, 74). In Vedic mythology, the *Rig Veda Samhitā* and *Śatapatha-Brāhmaṇa* describe how the deity Prajapati, later replaced by Brahma, emerged from the “golden egg” in 15<sup>th</sup>-12<sup>th</sup> and 8<sup>th</sup>-6<sup>th</sup> centuries BC respectively (Valk 2000, 150–1). Finnish folklore recorded in the *Kalevala* tells the story of Luonnotar, Daughter of Nature, who receives three eggs in her lap, which break into the skies, earth, sun and moon once they fall from her knees. Numerous legends in Oceania ascribe the birth of the first human to birds’ eggs (Newall 1967, 6).

<sup>3</sup> This vision is accompanied by miniature illustration of the universe in the shape of the egg and a description by Hildegard of Bingen: “By this supreme instrument in the figure of an egg, and which is the universe, invisible and eternal things are manifested” (qtd. in Fox 2002, 48).

life, its destruction was thought to bring about death—as recently as 1904, a British woman was accused of causing the death of her neighbour’s infant by boiling and mashing eggs (Newall 1967, 10). Associated with vitality, fertility and regeneration, eggs have been exchanged, gifted and thrown in courtship, wedding and funeral rituals in Russia, China and across Western, Central and Eastern Europe (Newall 1967, 12–14). This custom finds its current incarnation in the Easter egg, after the Christian church adopted the egg—sometimes painted red to reference blood—as a symbol of Jesus’ resurrection from the tomb (Alcock 2007, 24).<sup>4</sup>

The frozen eggs that emerge with oocyte cryopreservation (OC) are enriched with this symbolic history and may also be regarded as novel cultural entities in a long line of biomedical reinventions of the female gamete. After Von Baer removed and observed the mammalian egg in 1826, it became lodged in the anatomical model of the female body in the Western biomedical paradigm. About a century later, as the practice of tissue culturing developed, cells could be dislodged from the body and continue living *in vitro*, thereby redistributing living matter from the body to the laboratory (Landecker 2007, 1, 14). At this time, the idea that cells could live and reproduce outside of the body raised popular interest in the speculative idea of the “*in vitro* cultivation of humans” (D. Wilson 2005, 241). Both in interwar journalism and literature, stories about “babies in bottles” or “chemical babies” proliferated, most famously in Aldous Huxley’s dystopian *Brave New World*, which opens with a description of “racks upon racks of test-tubes” in which “the detached and ripened eggs were kept” after being extracted from an “excised ovary alive and actively developing” (D. Wilson 2005, 240–1; Squier 1994; Huxley [1932] 2007, 2–3).

Whereas tissue culturing had externalised human cells, the 1978 birth of Louise Brown, the first baby conceived through *in vitro* fertilisation (IVF), solidified the notion that the egg could also be fertilised outside of the woman’s body. After that first controversial birth, a further 5 million have followed and IVF has become routine practice.<sup>5</sup> The popularity of IVF has brought the egg into vision; first to gynaecologists, many of whom, until the extraction of eggs became familiar clinical practice in the early 1980s, had never seen a living human female gamete (Gosden and Lee 2010, 973). Later, particularly with the advent of the cell’s micromanipulation in ICSI (intracytoplasmic sperm injection), the visual of a needle inserting a single sperm into the egg became ubiquitous as a stock image of IVF, and reproductive technologies more broadly, in news

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<sup>4</sup> In England, the exchange of eggs at Easter was mostly discontinued after the Reformation as it was considered to be a “papal trapping.” The custom regained popularity in the 19<sup>th</sup> century when Cadbury introduced chocolate eggs (Alcock 2007, 26).

<sup>5</sup> A further 20 million attempted cycles of IVF did not result in the birth of a child (ESHRE 2014).

media, documentaries, advertising and films.<sup>6</sup> This image conveys at once the egg's externalisation from the body and the possibility of its fertilisation, resulting from its manipulability by "hand held tools" representing human volition (Franklin 2013a, 246–50). Much like genes became "an increasingly prominent iconic vocabulary in turn-of-the-millennium public culture *because there is a rapidly expanding range of things that can be done to them*," eggs have become the subject of public awareness as their particular existence in time and space can be manipulated in new ways with IVF and, as shall become clear, with egg freezing (Franklin 2000, 189; emphasis in text).

As the 20<sup>th</sup> century witnessed the advent of the extracorporeal egg's fertilisation, its cryopreservation has been hailed as the harbinger of a 21<sup>st</sup>-century "reproductive revolution" on a par with the introduction of the contraceptive pill (Groskop 2006; Nowak 2007). As a fertility treatment, egg freezing is effectively an IVF procedure with a prolonged period of cryostorage after the eggs' extraction from the woman's body, but before its fertilisation. While the eggs are in the freezer, stored at -196 °C in liquid nitrogen tanks, they are thought to be unaffected by the passage of time (Kuwayama et al. 2005, 75; Porcu et al. 2004, S16).<sup>7</sup> Those eggs that survive the freeze-thaw process may be used for fertilisation when a woman intends to become pregnant. Originally developed as a technique to aid women with malignant diseases who were confronted with imminent fertility loss, egg freezing may also be used to circumvent the effects of age-related infertility—and it is this application that is the focus of this study.<sup>8</sup>

*Freezing Fertility* critically examines the technology of oocyte cryopreservation, and its discursive construction in public discourses, in relation to a notion that is relatively undertheorised in the study of culture: ageing. As a reproductive technology that is employed for so-called "fertility preservation" rather than immediate childbearing, the possibility of oocyte cryopreservation both triggers the articulation of existing age normativities and reconfigures the temporal logic of reproductive ageing. I investigate the implications of oocyte cryopreservation for contemporary thinking on bodily temporality by analysing a selection of cultural objects—varying from documentaries and newspaper coverage to informed consent contracts and medical photography—which are emblematic for each stage of the egg freezing procedure.

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<sup>6</sup> In conventional IVF, egg and sperm cells are combined in a petri dish to allow spontaneous fertilisation. ICSI may be used if there is reduced sperm quality or quantity or if the egg no longer allows fertilisation. The latter is the case for previously frozen eggs because cryopreservation affects the zona pellucida, a protein layer surrounding the outer cell's membrane, in a way that impairs sperm-egg interaction (Kazem et al. 1995).

<sup>7</sup> Several pregnancies have occurred after numerous years of cryostorage (Porcu et al. 2004, S16).

<sup>8</sup> For the sake of clarity, I use the term "women" without specification throughout. I do acknowledge that not all women experience age-related infertility; some were never fertile, lose their reproductive ability due to causes that are not age-related or do not live long enough. Also some people who do not identify as women may experience pregnancy, birth and age-related infertility.

Accordingly, *Freezing Fertility* follows the journey of the egg: starting from the initial anticipation of reproductive ageing in relation to *in vivo* eggs, followed by the visual mediation of *in vitro* eggs after extraction, the selection of fertilised eggs with time-lapse embryo imaging, the novel forms of older motherhood following the implantation of fertilised frozen eggs, and, finally, the global impact of egg freezing as a condition of possibility for the transnational flows of eggs that can emerge once cryopreservation renders the egg newly mobile. At each stage of the procedure, the relation between reproductivity and bodily temporality is problematised to give insight into broader cultural ideas about ageing and their intersection with the politics of gender.

The central aim of this study is to analyse how the 21<sup>st</sup>-century introduction of egg freezing shifts cultural constructions of the relation between reproductivity and ageing.<sup>9</sup> OC presents a situation in which bodies age while frozen eggs, and the reproductive potential they embody, are understood to assume a latent mode of living unaffected by the passage of time. In *Freezing Fertility*, I explore what is at stake in the confrontation between these two modes of living in time. The starting point of the analysis is that egg freezing is not only significant as a medical intervention for those interested in fertility preservation, but also as a material-semiotic practice and discursively-mediated phenomenon that both transforms and is transformed by the meanings ascribed to reproductive decision-making, (in)fertility and ageing in broader cultural discourses.

Through these discourses, the introduction of OC instigates a reconsideration of the temporal logic of reproduction, in which existing age norms pertaining to the timing of childbearing may be both explicitly reaffirmed in the face of their potential transgression or rethought as operating by a different rationale when eggs may be “frozen in time.” Following from this, this study firstly explores how the relation between reproductivity and ageing is organised by *normativities* that may be expressed, naturalised and rethought through the figure of the frozen egg. Secondly, with the possibility of OC drawing attention to the role of the eggs in reproduction, the *visual mediation* of these cells through medical imagery offers an occasion for reflection on the relation between bodily and cellular time. Thirdly, I explore the temporal orientation of *anticipation* and its role in redistributing responsibility for future health and fertility when new reproductive technologies like OC become available. In keeping with the approach to OC as a discursively-mediated phenomenon, I consider these three focus

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<sup>9</sup> I use the generic term “reproductivity” to refer to the state of being reproductive, which may apply to bodies, embryos and cells alike. It functions as an umbrella term for fertility, fecundity or reproductive embodiment in bodies and viability or reproductive potential in cells. Ageing is also an umbrella term which here denotes various socio-cultural, political and technological interpretations of the passage of time in and through bodies and cells. The different chapters include a reconsideration of these terms and their relation in the context of OC.

points through a series of case studies of selected cultural objects which may be seen as emblematic for each stage of the OC procedure.

With the method of cultural analysis, I analyse these cultural objects as instances of the discursive practices through which egg freezing, and the concomitant emergence of the frozen egg, become meaningful to the wider public. The possibility of freezing eggs affects the discursive production of female gametes as they live inside and outside the body, in freezers or photographs, in glass or as glass, in time or out of time. Likewise, as Squier describes how the notion of the “baby in the bottle” entailed the “imaginative reconstruction of sex, gender, kinship and reproduction,” so the frozen egg becomes the occasion for the imaginative reconstruction of the reproductive body and its existence in time (qtd. in Franklin 2013a, 246). In order to gain insight into the subject positions, broader cultural systems and discursive practices through which these frozen eggs and reproductive bodies become meaningful, I will bring critical readings of selected cultural objects that circulate in public discourses in dialogue with scholarship on concepts that pertain to ageing and reproductivity. In *Freezing Fertility*, then, I approach egg freezing as an opportunity to gain insight into cultural ideas about the relation between reproductivity and ageing that may both transform and solidify as the OC practice reshuffles the ways in which reproductive cells and bodies are understood to live in time.

In this introduction, I will first consider the historical emergence of Western European egg freezing practices in the early 21<sup>st</sup> century, the discussion of which leads up to a further specification of the research questions guiding this study. I will subsequently present some key notions pertaining to the gender politics of ageing that inform egg freezing. After a brief discussion of non-human applications of OC and their relevance for thinking through questions of finality, I will present the study’s methods in more detail and offer an outline of the chapters. This lays the foundation for *Freezing Fertility’s* consideration of how the clinical possibility of OC and the concomitant emergence of frozen eggs that retain their reproductive potential over time provide the occasion for contemporary reconsiderations of fertility, finitude and regeneration that have been associated with eggs for millennia.

## The Emergence of the Frozen Egg

Described as the “holy grail in fertility medicine,” egg freezing technology has been a long time in the making (Richards 2013, 74). Sperm and embryos have been routinely frozen for decades, but the cryopreservation of eggs has proved challenging. The use of human frozen-and-thawed sperm first led to a live birth in the early 1950s; three decades later, the first birth from previously cryopreserved embryos occurred (Bunge, Keettel, and Sherman 1954; Parkes 1957, 208; Zeilmaker et al. 1984; Gook 2011, 281–3).

Although OC only gained popularity as a fertility treatment after the turn of the millennium, the first babies—they were twins—created from frozen eggs were born in Australia as early as 1986, only a couple of years after the first frozen-embryo baby (C. Chen 1986). While embryo and sperm freezing soon became routine clinical practice, Chen’s results were not easily reproduced and further attempts to use frozen eggs for human reproduction were largely suspended “as if cast under a voluntary moratorium” (Gosden 2011, 266).<sup>10</sup> Egg freezing proved challenging in part because of the relatively large liquid volume of the egg—the largest cell in the human body at 0,1mm—which is sensitive to freezing damage from ice crystal formation and the toxicity of cryoprotectant chemicals. Moreover, after cryopreservation, the zona pellucida, a layer surrounding the egg’s outer membrane, hardened and complicated the egg’s fertilisation.

There was nevertheless much interest in developing OC as a technology for “fertility preservation.” Embryo cryopreservation was available but resulted in moral objections, legal disputes between intended parents and the need for a partner or donor sperm. As an alternative to the more contentious embryo cryopreservation, the development of egg freezing technology occurred in interaction with state regulations on existing fertility treatments. Italy is a case in point as a country that, in the late 1980s, had one of the “most cutting-edge” fertility industries in the world. It came to be known as the “wild west” of the European fertility industry and developed “the beginning of an industry intended for career women who had delayed conception into their 40s and beyond” (Inhorn et al. 2010, 850). In 1997, doctors in Bologna resumed working with frozen eggs and used ICSI to bypass the hardened zona pellucida (Gosden 2011, 266). The Italian legal restrictions on embryo cryopreservation and egg donation in its prohibitive 2004 IVF Law were anticipated and followed by an intensification of research into egg freezing (Benagiano and Gianaroli 2004, 118; Gook 2011, 284; L. J. Martin 2010, 527). Indeed the first live birth after OC with the vitrification technique occurred in an Italian clinic: on 20 June 1999, a girl was born to a 47-year-old mother who had used vitrified donor eggs (Kuleshova et al. 1999).

Vitrification provided an alternative to conventional slow-freezing methods by freezing the eggs so rapidly that the liquid in the cells does not form ice crystals, but transforms into a glass-like state. These vitrified eggs then do not exist *in vitro*, in glass, but rather are *vitreum*, as glass, within the liquid nitrogen tanks. In fact, no longer held by the glass referenced in IVF (*in vitro* fertilisation), it was the development of an alternative container, the Japanese Cryotop system, that proved pivotal in raising the egg

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<sup>10</sup> One exception is a report in the following year of another birth after cryopreservation of unfertilised eggs (Van Uem et al. 1987).

post-thaw survival rates to 90% (Kuwayama et al. 2005, 76).<sup>11</sup> These high survival rates, and their reproducibility in clinics across the world as both vitrification and slow-freezing protocols improved, has transformed egg freezing into a technology that is not only useful for women with malignant diseases, but also for the purpose that is central in this study: the circumventing of age-related infertility.

These developments were the backdrop for the Amsterdam Academic Medical Centre's (AMC) 2009 proposal to offer egg freezing not only to women with imminent fertility loss due to diagnosed pathologies and their treatment, but also to healthy women who wish to anticipate age-related infertility.<sup>12</sup> A majority in the Dutch parliament initially objected to the AMC's plan, including all parties of the coalition government *Balkenende IV*, and a two-year highly mediatised public debate ensued until so-called "social" egg freezing was formally permitted in 2011 (Schippers 2011b).<sup>13</sup> This decision followed the publication of a report by The Dutch Association of Obstetrics and Gynaecology (NVOG) and the Association of Clinical Embryology (KLEM), which recommended permitting the procedure, but lowering the maximum age of implanting the embryos from the 50 years the AMC had initially proposed to the customary 45-year age limit in conventional IVF (NVOG 2010; Sheldon 2010).<sup>14</sup>

Twenty years prior, the United Kingdom had already drawn up egg storing regulations in the 1990 Human Fertilisation and Embryology Act. At least 50 women froze their eggs in the following decade, but the Human Fertilisation and Embryology Authority (HFEA), the national body licensing and monitoring UK fertility clinics, did not permit the use of these eggs for fear of chromosomal defects (Boseley 2000). At the request of Carolyn Neill, one of these women, and her doctor Mohammed Taranissi, the HFEA commissioned Dr Sharon Paynter to write a report on the safety of egg freezing.<sup>15</sup> Following the resulting report's positive, albeit cautious, recommendations, the HFEA lifted the ban on using frozen eggs for fertilisation and subsequent implantation at the

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<sup>11</sup> The Cryotop system consists of a plastic handle and a thin film strip onto which the egg could be laid in only a minimal volume of fluid. The Cryotop system is now in use for oocyte and embryo cryopreservation at 1600 IVF centres in 70 countries (Kitazato and Dibimed 2015).

<sup>12</sup> The AMC had already offered egg freezing for "medical" reasons since 2006.

<sup>13</sup> The *Balkenende IV* government, led by prime minister Jan-Peter Balkenende, consisted of the *PvdA* [Labour], *CDA* [Christian Democratic Appeal] and *ChristenUnie* [Christian Union] parties.

<sup>14</sup> Along with the Dutch NVOG and KLEM, the major medical regulatory bodies in the UK and Europe (British Fertility Society, Association of Clinical Embryologists, European Society of Human Reproduction and Embryology Task Force on Ethics and Law) still consider egg freezing and vitrification "experimental" due to its uncertain success rates and potential health risks to women and children (Shkedi-Rafid and Hashiloni-Dolev 2011, 293; Baldwin et al. 2014, 170–1). In 2013, the US Practice Committees American Society of Reproductive Medicine and the Society for Assisted Reproductive Technology, did, however, lift the "experimental" label for women who are "facing infertility due to chemotherapy or other gonadotoxic therapies," but not for circumventing age-related fertility (ASRM 2013, 42).

<sup>15</sup> Taranissi worked at the Assisted Reproduction and Gynaecology Centre in London, one of the two UK fertility clinics licensed to freeze eggs at the time.

turn of the millennium (Boseley 2000; HFEA 2000a). The first British frozen egg baby, Emily Perry, was born in June 2002. Unlike the Dutch equivalent, the UK HFEA regulations make no distinction between “social” and “medical” egg freezing, and there are no national age limits prohibiting treatment after 45 years.<sup>16</sup> This study and the cultural objects it discusses primarily focus on these two national contexts of the Netherlands and the United Kingdom.<sup>17</sup> Notwithstanding their differences, both national contexts are characterised by a high degree of national state regulation of reproductive health care, significant popularity of OC as a clinical practice and ample media attention for the possibility of egg freezing (Melchior 2011; HFEA 2014b).

Both in the Dutch and UK contexts, the emergence of OC is not simply matter of technological development, but reflects a cultural, political and regulatory climate in which the technologisation of certain aspects of reproduction is considered acceptable and that of others less so. The 21<sup>st</sup>-century responses to OC are informed by earlier public debates on fertility treatment about issues that have now become normalised or, conversely, are revived with renewed vigour. In its current incarnation in the Netherlands and United Kingdom, egg freezing is primarily framed as a treatment for women without a partner, or at least without one with whom they want to reproduce at present. The normalisation of fertility treatment for *single women* follows the heated debates about this issue in the early 1990s, epitomised in the 1991 so-called Virgin Birth scandal over a 20-year single woman who was not sexually active but underwent intra-uterine insemination (IUI) at a Birmingham clinic (Shore 1992, 295). In my analysis of OC media coverage, I will point to its multiple constructions of singlehood, in which the treatment of some women is seen to symbolise their commitment to the nuclear family ideal, while in others it is taken to signify frivolity, pickiness and a refusal to grow up. The debates on OC also follow in the wake of controversies about *older motherhood*—and celebrations where celebrities are concerned—made attainable by IVF, sometimes in combination with egg donation (Shaw and Giles 2009). With OC emerge novel forms of older motherhood that become meaningful in relation to the revival of these debates under new circumstances, offering an opportunity to analyse the cultural production of age norms for timing reproduction.

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<sup>16</sup> There are, however, NHS regulations and insurance policies that identify maximum ages for coverage of fertility treatment as well as clinical guidelines that distinguish between cancer-related and other motivations for egg freezing, see for example National Institute for Health and Clinical Excellence (2013).

<sup>17</sup> The Netherlands has no independent regulator of fertility clinics equivalent to the HFEA. The Ministry of Health, Welfare and Sport licenses the 13 Dutch IVF clinics, the great majority of which are non-profit and closely affiliated with a hospital. This contrasts with the 76 licensed IVF clinics, of which a significant proportion is private, in the UK (HFEA 2014c). While the HFEA gathers relatively large data sets on IVF treatments in the UK, in the Netherlands the NVOG keeps a limited overview of IVF outcomes. The HFEA keeps track of the number of eggs frozen for future use; although this is in development, there is currently no official national data available on the number of egg freezing treatments in the Netherlands.

Combining these two aspects, OC practices present a (non-)reproductive choice that women can make without, or independent of, a partner and that anticipates both future age-related infertility and intended motherhood later in life. The choice to freeze one's eggs may benefit women and their partners at different life stages. Yet the financial and cultural capital, time investment, health and legal status, and favourable regulatory and medical context required for undergoing the procedure means that such choices are not equally accessible, and may therefore contribute to further stratification of reproduction in general, and of older motherhood in particular. The nature of a choice to freeze one's eggs also requires gauging the reproductive potential of the frozen eggs against health and financial risks, all of which are mediated through discourses that may themselves be contested and informed by third-party interests.<sup>18</sup> The availability of a reproductive choice may also entail assuming responsibility for *not* making that choice, thereby potentially reframing certain situations, such as experienced age-related infertility, as its outcome. Similarly, a normalisation of egg freezing may inflect the meaning of childbearing at ages at which eggs could have been frozen instead, as critics of Facebook's and Apple's health coverage of OC fear. This could have negative effects on labour rights like maternity leave and flexible work policies as well as hinder insurance coverage of infertility (Mohapatra 2014). While greater availability of information on age-related infertility, and measures to counteract it through egg freezing, are important in informed reproductive-decision making (Everywoman 2013), it may equally further medicalise women's reproductive capacity and raise anxiety about ageing while increasing the valuation of technologised models of reproduction and, where commercial parties are concerned, the profits of the fertility industry.

Some feminist and bioethics scholars have advocated the availability of egg freezing because it offers women benefits in making reproductive choices and improves equality between the sexes in timing childbearing (Goold and Savulescu 2009, 33–4; Savulescu and Goold 2008), sometimes even encouraging women to freeze their eggs so they can “choose when to become a mother” (Inhorn 2013). Others have argued that a focus on egg freezing as an individual choice may detract attention from the socio-cultural factors that contribute to a situation in which childbearing becomes problematic and egg freezing appears as a solution, including the (temporal) organisation of education, labour, relationship patterns, demographic ageing changes and their

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<sup>18</sup> Prior to egg extraction, hormone injections are to be administered for one to two weeks, which can cause discomfort and side effects. This hormonal stimulation can result in ovarian hyperstimulation syndrome, a potentially serious condition that may cause pain, inflammation and has been fatal; it may have as yet unknown long-term risks for later reproductive and hormonal health. Once matured, the eggs are surgically removed, which causes internal bleeding or infection in 1% of cases (Waldby 2008, 20–1; NVOG 2010). Given that the chances of a frozen egg resulting in a live birth are estimated at 5% (D. Stoop et al. 2012, 2032), women are commonly advised to freeze at least 20 eggs per intended child and may therefore undergo several cycles.

intersection with race, class and sexuality (Carbone and Cahn 2013). The framing of egg freezing as an individual choice, Lisa Ikemoto argues, suggests a concern with reproductive rights, when in fact its “empowerment” functions to “fuel demand” within a logic of free market individualism (2015, 114). Instead of an “expensive and physiologically risky procedure that offers an individualist solution to social reasons for delayed childbearing,” critics have called for addressing the structural inequalities underlying these social reasons through such measures as parental leave, child care, wage equality and comprehensive health insurance (Cattapan et al. 2014, 239). Another structural inequality is the disproportionate burden on women’s bodies for the treatment of both male and female infertility and the attendant medicalisation of female reproductive bodies, to which egg freezing may contribute (Shkedi-Rafid and Hashiloni-Dolev 2011; L. J. Martin 2010). Irene Daly and Susan Bewley also address this concern and suggest that, “in absence of other societal compensation for biological inequity[,] the application of assisted reproduction needs to be extended to men.” Following Shulamith Firestone’s assertion that gender oppression and reproduction are linked, and therefore require not only a social but a biological revolution, they advocate “the use of reproductive science to pursue male pregnancy, artificial gametes and artificial wombs” rather than intensifying the reproductive burden on women with fertility treatments like egg freezing (Firestone [1970] 2015; Daly and Bewley 2013, 727–8).

In this study, I am interested in the underlying ideas about female reproductive ageing that inform discourses of OC and understand the construction of age-related infertility as itself a politically relevant moment requiring critical reflection. This project does not challenge the widely-observed phenomenon that women’s ability to become pregnant and birth children is finite and age-contingent.<sup>19</sup> I also advocate the widespread availability of information on female fertility and its age-related contingencies, especially given that significant contingents of women and men remain under-informed on these matters and overestimate the success rates of technologically-assisted reproduction.<sup>20</sup> However, rather than investigating *whether* people are informed about age-related infertility, my main interest lies with *how* the relation between reproductivity and ageing becomes legible as bodily truth in public discourses of egg freezing. Rather than endorsing or condemning egg freezing, I focus on examining OC as a material-semiotic practice that both reflects and transforms what it means to age, and to be (in)fertile.

From the study’s central aim of analysing cultural constructions of the relation between ageing and reproductivity follows a set of more specific research concerns. I will discuss how the discourses surrounding OC give insight into gender-specific age

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<sup>19</sup> See Hanson (2003) for a challenge to the association between maternal age and infertility.

<sup>20</sup> See (Lampic et al. 2006; Bretherick et al. 2010; Daniluk, Koert, and Cheung 2012; Daniluk and Koert 2013; Daly and Bewley 2013).

normativities that affect not only women who freeze their eggs, but a much broader public. They moreover offer an opportunity to analyse the historical specificity of localising reproductive ageing in specific body parts that become mediated through the medical gaze—whether imbalanced hormones, atrophied organs, plethoric blood, shortening DNA, or, as is commonly the case in discourses of OC, the eggs.<sup>21</sup> Throughout the study, I ask what relation between the age of the body and the age of the embodied, frozen, fertilised or travelling egg is construed at each stage of the OC procedure. In turn, I consider how the concomitant conceptualisations of bodily or cellular reproductivity are employed to resist, naturalise or transform age normativities. I will investigate how the relation between reproductivity and ageing becomes legible through both textual and visual mediation of cellular prenatal life. I further explore the defamiliarised relation of reproductivity to time in OC as it is organised by various temporal orientations such as anticipation, retrospection, anterior futurity, acceleration and deceleration through which constructions of (non-)reproductive futures and (in)fertile pasts come to bear on the present moment. In doing so, I suggest that the advent of egg freezing not only repoliticises the timing of reproductive decision-making, but more broadly, the relation between reproductivity and bodily temporality. Oocyte cryopreservation, then, pertains not only to lengthening the fertile life course, but to a broader reshaping of the gender politics of ageing as frozen eggs travel across time and space, across bodies and borders, with far-reaching effects.

### Time, Chrononormativity and the Gender Politics of Ageing

The gender politics of ageing relevant to this study of egg freezing pertains to the intersection of gender and age in organising bodies as sites of the political. The political here denotes a “web of power relations that situate, saturate, and constitute bodies differentially” with reference to these two systems of separation (Coole 2013, 167). Whether an ever-growing female-oriented market in anti-ageing cosmetics, worth 1.15 billion dollars in the US alone, the medicalisation of female midlife, or the double standards of ageing in popular visual media, examples of contemporary phenomena that affect ageing men and women differently are numerous (Vincent 2009; Lock 1995; Segal 2013). While feminist scholars of the 1970s have distinguished the different categories of gender and sex, an equivalent distinction does not exist for the category of age. A later generation of poststructuralist scholars criticised the gender-sex distinction as producing the very differences it intended to criticise. Thus, Judith Butler argued that the notion of sex was itself “constituted through discursively constrained performative acts that

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<sup>21</sup> I use the term “medical gaze” here with reference to the Foucaultian concept, which I discuss in Chapter 2.

produce the body through and within the categories of sex” with reference to gender normativity (1990, x). Without denying “the material foundation of bodies,” but nevertheless “insist[ing] that an analysis of the body is necessarily mediated by the context in which it is conceived,” the production and naturalisation of age differences similarly requires critical reflection (Sturm 2014, 19–20). So rather than reading the discursive production of reproductive age and age-related infertility as the logical result of a body in decline, I am interested in how norms of ageing and organising time produce categorisations, affects, subject positions and conceptualisations of the female (non-)reproductive ageing body as their effect.

The notion of age normativity differs from gender normativity as it is unstable throughout the subject’s lifetime, while normative gender is presumed to be fixed for life. This is not to say that gender *is* a constant throughout life, but rather that its normative construction tends towards a production of a consistent categorisation as “male” or “female” throughout the life course. A performative understanding of gender purports that the notion of its static nature is produced by a repeated enactment of norms, thereby “freezing’ masculinity and femininity into timeless truths of being” (Freeman 2010, 4; Butler 1997a, 14). Age identities can similarly be considered as performatively constituted (Biggs 2004, 49; Basting 1998, 174), but whereas gender normativity entails the maintenance of a stable category of “female” or “male” throughout the lifetime, age normativity necessitates timely changes in accordance with such age-related categories as childhood, puberty, middle age. At their intersection, normative expressions of “female” or “male” differ at various life courses, as, vice versa, those of any particular age are inflected by gender norms. Such gender-specific age normativity may pertain to any aspect of social and physical life, whether clothing (Twigg 2007), sexual fitness (Katz and Marshall 2002), embodied appearance (L. H. Clarke 2011), or economic independence (Russell 2010).

Traditionally, at least from the mid-19th century onwards, age normativities specific to women have been predicated on reproductive changes in the female body. As I will develop in Chapter 2, there is a gender-specific history of naturalising age-appropriate acts—such as when to have a partner, when to reproduce, when to care—with reference to (non)reproductive physical phenomena such as menstruation, fertility and menopause. The anticipation and arrival of age-related infertility is a contemporary equivalent of a body-based moment in the female life span that becomes a reference point in validating or resisting a set of age- and gender-related norms pertaining to what Elizabeth Freeman calls “repronormative time,” governing when to have children, when (in-)fertility may be assumed, when infertility ought to be anticipated, when medical interventions are appropriate and how the passage of time may be recognised in the body (2010, xv). In discourses of OC, age normativities may be expressed in institutional

regulations prohibiting fertility treatment after 45, mediated medical advice on when to pick Mr. Good Enough over Mr. Right, women's public accounts of the anxiety experienced at turning 35, the proposition to offer OC as a graduation gift and in the recognition of "frozen time" in photographs of eggs to name but a few examples that I will analyse in this study.

In *Encounters with Ageing*, Margaret Lock points to the gender-specificity of foregrounding reproductive ability in conceptualising the life cycle: "normality means youth and vigor, regardless of gender," but "among women, normal means to be of reproductive age" (1995, 377). In her cross-cultural analysis of menopause, she highlights the pivotal role ascribed to the cessation of menses in popular and scientific conceptualisations of the female life span at large. She criticises the fact that books and articles on menopause frequently reference both the popular myth that women rarely lived past middle age before the 20<sup>th</sup> century and the notion that humans are the only primates to live beyond the end of their reproductive capacity. The implicit ideological position in this presentation of menopause, she argues, is that it is an anomaly following from something "inherently contrary to nature's purpose [that] has happened over the past one hundred years"—a position founded in the assumption that "reproduction of the species is what female life is all about" (1995, xxvii). Such implicit ideologies, along with the well-documented association of fertility with gender identity (Sandelowski 1990), may also underlie attitudes towards age-related infertility that inform OC.

Lock's example points to a clash between contrasting organisations of time: the accelerated time of scientific progress, associated with extended longevity, human exceptionalism and postmenopausal nonreproductivity, is contrasted with the slow evolutionary time of "nature's purpose," other primates and premenopausal reproductivity. The relatively stable length of the female reproductive life span in the face of increased longevity has similarly been politicised in debates around older motherhood and delayed parenthood, particularly with reference to the notion that "the public domain, organized around paid labor, interferes and competes with a woman's fertile years" (Friese et al. 2006, 1551). While reproductive technologies like IVF and egg donation have opened up possibilities for older motherhood, egg freezing in particular is an intervention that is conceptualised as shifting this previously stable length of the reproductive life span. Here, a contrast similar to Lock's opposition between the time of scientific progress and that of "natural" evolution becomes relevant in the framing of OC. Advocates of the technology laud it as a method for matching women's reproductive ability with their extended longevity, while critics may understand OC as either a false hope for or an undesirable development towards counteracting natural temporal limits to fertility.

These different approaches to interpreting the temporal limits of the body are significant in thinking about the relation between reproductivity and ageing because they propose a relationality between the female reproductive body and the cultural organisation of time in what Freeman calls “chrononormativities:” “technique[s] by which institutional forces come to seem like somatic facts.” She offers examples of chrononormativities as the “hidden rhythms” of “schedules, calendars, time zones” that “seem natural to those whom they privilege” (2010, 3). Freeman’s definition of chrononormativity as “the use of time to organize individual human bodies toward maximum productivity” points to an industrialised organisation of time, which was first standardised in England (1847) and highly gendered within the “separate spheres” system (2010, 3). In contrast with an industrialised time of standardised scheduling, women’s space of the home was idealised within a discourse of domesticity that “validated a set of feelings—love, security, harmony [...] motherly instincts—in part by figuring them as timeless” (Heath 2009, 15; Freeman 2010, 5). This domestic maternal space was associated with a cyclicity of a feminine “corporealized time” attendant to the “human tides” which was rhetorically opposed to the “linear time of history” and wage time of industrial capitalism (Luciano 2007, 125–7). What emerged was a cultural logic in which a non-linear time seen to belong to the female reproductive body lay at the foundation for the reification of the gender binary in distinct “spheres” that became separated not only in space, but in the particular chrononormativities that organised their temporal schemes.

The naturalisation of this feminised chrononormativity was challenged in the 20<sup>th</sup> century not only by women’s increased participation in the industrialised time of the public sphere and wage labour, but also by the entrance of linear scientific time into the female reproductive body, primarily through the advent of reproductive technologies offering increased agency over the timing of menstruation and maternity. Hormonal contraceptives (the pill) introduced standardised time into the cyclical rhythms of menstruation. *In vitro* fertilisation techniques decoupled attempts at childbearing from cyclical ovulatory patterns and synchronised them with the time schedules of fertility clinics through precisely timed hormonal stimulation. These developments do not necessarily entail a conceptual severing of femininity and fertility with cyclical rhythms—in fact, they can reinforce a notion of “the natural cycle” in contradistinction with these interventions. Also, the discovery of sexual hormone production reinforced the temporal gender binary as the female reproductive body became “characterised by its cyclic hormonal regulation and the male body by its stable” counterpart (Oudshoorn

1994, 146–7).<sup>22</sup> Nevertheless, these reproductive technologies did posit the timing of menstruation and ovulation as manipulable by chemical hormones and allowed for the popular reconceptualisation of childbearing within linear temporalities as “family planning.” In this way, the chrononormative temporal regulation of the female reproductive body in relation to standardised treatment protocols, mass-produced hormone strips and clinical time schedules exemplifies Freeman’s definition of chrononormativity as, this time more literally, becoming recognisable as “somatic facts” (2010, 3).<sup>23</sup>

With this increased technologically-mediated agency over timing childbearing, the end of the female reproductive cycle gained cultural significance as a temporal limit to “family planning.” Friese et al. describe public concern with a female reproductive “deadline” following the increasing availability of contraceptive and abortion services, which centred on the notion that “the public domain, organized around paid labor, interferes and competes with a woman’s fertile years” (2006, 1551). The widespread preoccupation with this deadline, often referred to as the biological clock, also emerged in relation to a burgeoning fertility industry, a cultural context “conducive to public discussion about reproductive issues” and the positioning of age-related infertility as “the price women pay” for increased participation in paid labour, politics and higher education (Harter et al. 2005, 84). In the 1980s widely-cited studies based on contemporary and historical data began to emerge that held that “female fecundity [is] a function of age” (Schwartz and Mayaux 1982; Menken, Trussell, and Larsen 1986). Along with the advent of new reproductive technologies like IVF and egg donation, the popularisation of such findings displaced the common conceptualisation of menopause as the end of the reproductive life span and menstruation as an affirmation of fertility towards an understanding of “ovarian reserve” and the age of the eggs as determinants of reproductive capacity (Friese et al. 2006, 1550–1). This shift entails a move away from the easily observable and cyclical indicator of presumed fertility in menses to a more elusive notion of the age of the eggs that may be assessed through medical interventions

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<sup>22</sup> The understanding of sex differences in terms of “cyclicality versus stability” became further popularised after the 1960s with the introduction of the Premenstrual Syndrome, which posited the female reproductive system as the basis for the association between femininity and “instability and unreliability” (Oudshoorn 1994, 146, 172–3n10)

<sup>23</sup> This foregrounding of the egg as locus of fertility and reproductive ageing in the context of OC is historically specific. Femininity and fertility were previously quintessentially located in the womb, and later in the ovaries, in the anatomical model of the 19<sup>th</sup> century (Oudshoorn 1994, 145). With the advent of sex endocrinology in the early 20<sup>th</sup> century emerged a “chemical model of sex,” which located it in the hormones. As sex became quantifiable as chemical substances, of which there could be “too much or too little” in a body, so female fertility became recognisable as hormonal balance and menopause as an “imbalance” that could be supplemented with chemical supplements to remain, as the infamous Dr Robert Wilson recommended in his bestseller “feminine forever” (1966; Oudshoorn 1994, 144–5).

like hormonal blood tests or ovarian ultrasound scans—or deduced from one’s age in years since birth.

Rather than a cyclical conceptualisation of women’s reproductive embodiment, characterised by monthly recurrences of menses and generational rhythms of procreation, the dominant presentation of the temporality of the female body in discourses of OC is characterised by a life-long decline of egg quantity and quality.<sup>24</sup> Instead of adopting an idealised position outside of standardised time, the female reproductive body becomes itself synonymous with clock time in tropes of “ticking ovaries” and the “biological clock.” In this linear loss model of reproductive ageing, eggs may begin to function as themselves measurements of time. As eggs may be “banked” as a means of “fertility insurance,” they somatise an economy of time, in which time is understood to be quantifiable and delimited—a “‘thing’ that can be ‘spent,’ ‘saved,’ and ‘lost’; indeed, it is frequently ‘invested’”(Stephenson 2010, 11). The female body characterised by the biological clock then represents the basis for examining a chrononormative logic that is verified by the “somatic facts” of fertility decline. The meanings ascribed to the figure of the frozen egg, in turn, will give insight into the reconceptualisation of (in)fertility, reproductive ageing and finitude in the context of OC.

### Finitude and the Frozen Egg

Frozen cells, Hannah Landecker suggests in *Culturing Life*, offer an occasion to reconsider “how biotechnology, with its characteristic interventions in plasticity and temporality, changes what [...] it means at any given moment [...] to be cellular living matter” (2007, 233). She specifically invites a reflection on the state of being “cellular” before “leaping straight into how biotechnology changes what it is to be human” (2007, 233). Although this study focuses on human oocyte cryopreservation, suspending this species-specificity momentarily gives insight into other ways in which ageing and bodily temporality may be rethought in relation to cryopreservation, given that the technology also affects the lives and bodies of non-human animals.<sup>25</sup> The advent of reproductive technologies in the 20<sup>th</sup> century has been mobilised to increase the efficiency of the mass reproduction of animals in agricultural industries (Cooper and Waldby 2014, 113). Egg

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<sup>24</sup> This decline model fits within a broader developments of a medicalisation of ageing and the influence of anti-ageing ideologies and industries (Tulle 2008).

<sup>25</sup> For the vast majority of vertebrates on Earth, only male gametes may be preserved; because of interspecies oocyte differences, the OC technique cannot simply be translated but requires unique protocols and methods for different types of animals. Eggs have nevertheless been frozen in approximately 40 species, including laboratory animals—primarily rodents—non-human primates, horses, dogs, cats and farm animals (Andrabi and Maxwell 2007, 232; Saragusty and Arav 2011, 3–5).

freezing is similarly a tool in accelerating the time of reproduction and creating “genetic improvement” or “biodiversity” in the breeding of valuable domestic animals and agricultural livestock like cows, pig and sheep (Luvoni 2006; Mullen and Fahy 2012, 1710; Taylor-Robinson et al. 2014). By contrast, OC is also employed in the slowing down of time in the temporality of species extension, in which it functions to maintain endangered life in cellular latency. Oriented towards a future moment of “reanimat[ion]” in “de-extinction” efforts, frozen cells—including eggs—may supplant actual living animals, instead preserving their parts in “frozen zoos” (Kowal and Radin 2015, 70; Friese 2013, 34, 111). In animal conservation purposes, egg freezing is instrumental in the preservation of genetic diversity and biomaterial of rare wild animals (Leibo and Songsasen 2002, 303; Pereira and Marques 2008; Prentice and Anzar 2010).

Needless to say, non-human animals are implicated in human egg freezing as model species for experimentation as well as through the use of animal products in cell culturing—notably fetal bovine serum (FBS), which is commonly sourced from the beating hearts of unanaesthetised fetuses taken from slaughtered cows’ uteri and is used in some OC protocols, as well as in tissue culturing more broadly, as a growth medium (Yoon et al. 2003; Jochems et al. 2002, 4; Van der Valk et al. 2004, 2). In these “always asymmetrical” cross-species relations of oocyte cryopreservation, the “incomplete death” of the frozen egg becomes instrumental in the organisation of “living and dying, and nurturing and killing” (Haraway 2010; Kowal and Radin 2015, 70).

The reversal of the metonymic logic of supplanting animals with cryopreserved cells imbues the deathless frozen egg with the promissory value of latent life. So one direction in which an answer to Landecker’s meta-species query of what it means to be “cellular living matter” points is the reimagination of death and finitude after cryopreservation. Throughout *Freezing Fertility*, I will address how the figure of the frozen egg is enlisted in confronting and counteracting the end of the (reproductive) life span. Discursive practices pertaining to the frozen egg and its “ontogenic and teleological potential” then give insight into broader concepts like (im)mortality, kinship and regeneration (Cooper and Waldby 2014, 113). Conversely, the reproductive youth that the egg symbolises is also foregrounded in this inquiry. By following the egg’s journey from the body and beyond, I examine how the reproductive youth attributed to the cell propels it across time and space in trajectories that reflect economic, regulatory and ethical asymmetries. As different aspects of this journey garner public attention, egg freezing occasions the reimagination even of those eggs that remain enclosed in the body.

## The Egg's Journey: Outline

*Freezing Fertility* presents a cultural analysis of the early 21<sup>st</sup>-century practice of egg freezing and its relation to reproductivity and ageing. Through an interdisciplinary analysis of egg freezing as a multifaceted material-semiotic practice, I highlight the many ways in which reproductivity and bodily temporality are rethought, reconfigured and repoliticised through the figure of the cryopreservable egg. In keeping with this focus, the analysis is primarily concerned with OC for age-related infertility in autologous donation, ie. egg freezing for one's own reproductive use later in life.<sup>26</sup> The study is roughly divided in two parts. The first consists of a media and a historical analysis that lay the foundation for understanding the terms of the debate and the historical grounding of egg freezing in relation to reproductive ageing. The second part follows the journey of the egg in the OC procedure; the analyses focus on the egg in the body, its frozen existence in the freezer, its time-lapse visualisation after fertilisation, its subsequent return to the womb and the implications of its unprecedented movement in global flows of eggs.<sup>27</sup>

In organising this study according to the journey of the egg, I draw attention to the fact that OC is not a single procedure, but a set of consecutive interventions. Similarly, in this approach the egg emerges as an unstable referent, which may undergo various transformations: immature eggs in the ovaries become mature during hormonal stimulation; extracted eggs are cryopreserved and stored in the freezer; eggs may be fertilised, incubated and implanted; frozen eggs may become mobile, traveling through various institutional and national contexts in portable freezers. I therefore approach egg freezing as a set of procedures and transformations governed by a chronology of their own. The title of this study hints at the entanglement of this temporally-specific technology of egg freezing and the cultural construction of the time of fertility as both finite and freezable. *Freezing Fertility*, in keeping with the chronology of OC, follows the journey of the egg and in a series of analyses that give insight into the shifting

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<sup>26</sup> In popular and professional publications, this is frequently characterised as “social” egg freezing, in contrast with “medical” egg freezing in cases of imminent disease- or treatment-related infertility. Alternative qualifying terms are “elective,” “lifestyle” or the acronym AGE for “anticipated gamete exhaustion” (Dominic Stoop et al. 2014). In the final chapters I expand the discussion of OC to heterologous egg donation for reproductive and research purposes in contexts that are relevant to a consideration of ageing.

<sup>27</sup> The journey is a familiar metaphor in discourses of fertility clinics, in which the experience of undergoing a set of treatments may be referenced as one's “IVF journey” and procedures like time-lapse embryo imaging for embryo selection as “your embryo's journey” (Auxogyn 2012). *In vivo* conception is conventionally presented as the sperm's journey through the female reproductive tract towards an egg waiting in the fallopian tube. By structuring the chapters according to the egg's journey, I intend to draw attention to the egg's mobility in OC and the site-specificity of the meanings ascribed to the cell and its movements at the various stages of the egg freezing procedure.

reconfigurations of the relation between reproductivity and ageing at each stage of the procedure.

An interdisciplinary project, *Freezing Fertility* integrates insights from cultural analysis, feminist science and technology studies, medical anthropology, media theory, reproductive studies and critical gerontology to analyse a corpus of textual and visual material within the cultural imaginary of oocyte cryopreservation. Rather than offering an exhaustive overview of one dimension of the OC practice, I offer a series of critical readings of cultural objects that are pertinent to understanding the situatedness and implications of egg freezing in relation to a broader gender politics of ageing. Given that each chapter in the second part addresses a successive stage in the egg's journey, I have selected cultural objects that were emblematic for each step of the procedure and that shed light on how the relation between reproductivity and ageing is reconfigured with reference to eggs that are in the body, in the freezer, in the incubator, in the womb or in global transit. Some of the selected objects, such as newspapers and documentaries, are indicative of egg freezing's prominence in public debates and popular culture, which impacts a much wider contingent of people than only the women who freeze their eggs. Other objects, such as cellular photographs or informed consent contracts, present a novel aspect of OC that distinguishes it from other reproductive technologies and informs its relation to questions of temporality and ageing.<sup>28</sup>

My methods include close readings, visual and discourse analyses of this corpus, combined with contextual, historical and theoretical research. My reading of the objects adopts the analytical approach of "cultural analysis." This is an interdisciplinary research practice in which the analyst purposively does not apply a single method to understand an object, but rather "conduct[s] a meeting between several [methods], a meeting in which the object participates, so that, together, objects and methods can become a new, not firmly delineated field" (Bal 2002, 4). Cultural analysis adopts a technique of close reading that is sensitive to the "interplay between the text and [its] context" (Peeren 2007, 3). In this way, "the various objects gleaned from the cultural world for closer scrutiny are analysed *in view* of their existence in culture"(Bal 2002, 9; emphasis in text). In dialogue with an interdisciplinary selection of scholarship, I read the cultural objects in relation to concepts such as temporality, the medical gaze, willfulness and finitude in order to gain a more complex understanding of the shifting meanings

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<sup>28</sup> This selection of objects for the chapters' case studies also reflects that I write about a recently-introduced technology, in which the first phase of egg extraction and freezing grew in popularity throughout the research period, while at this point in history there are still few public accounts of children being born from frozen eggs and the shipping of frozen eggs is still in its infancy. Accordingly, the earlier chapters focus on widely-circulated cultural objects that present egg freezing in mainstream media and the later chapters also include cultural objects that give insight into the conditions of possibility for developments like posthumous motherhood and transnational egg transfers.

attributed to the relation between reproductivity and ageing in the context of oocyte cryopreservation.

*Freezing Fertility* is indebted to the major body of work in feminist science and technology studies that has mapped how “technoscientific and biomedical knowledges and practices describe and, indeed, produce material differences between women and men” as well as male and female cells, including Clarke et al. (2010), Martin (2001a), Oudshoorn (1994), Haraway (1991; 2010) (McNeil and Roberts 2012, 30). I build on scholarship in the cultural and social study of reproductive technologies (Thompson 2005; Almeling 2011; Franklin 2013a; Waldby and Mitchell 2006), theories of medicalisation (Foucault 1977; A. E. Clarke et al. 2010) and work focusing on the knowledge production, visualisation and cultural mediation of interior and cellular bodies (E. Martin 2001a; Van Dijck 2005b; Lie 2012; Landecker 2007). Critical gerontology and medical anthropology inform the analyses of ageing (Lock 1995; Vincent 2006; Gilleard and Higgs 2000). In discussions of medical and documentary imagery I draw on cultural theories of visual culture (Barthes 1981; Jones 2006; Van Dijck 2005a). In my research I have also studied a wide array of biomedical publications on assisted reproduction, regenerative medicine and cellular ageing, which have informed my thinking on egg freezing in relation to technoscientific constructions of temporality, mortality, fertility and ageing.

In order to introduce the primary terms of debate through which egg freezing is politicised in public discourses, Chapter 1 offers a media analysis of OC’s coverage in two Dutch and UK newspapers. One important element in these public narratives is the categorisation of “medical” versus “social” and “single” versus “lifestyle” freezing in pairings that function as rhetorical tools in either condoning or criticising OC practices. I will explore how media narratives around these divisions create a set of new subject positions through which women’s reproductive decision-making becomes subject to public scrutiny and medical authority becomes extended into new parts of social life. Similarly, the trope of the “biological clock” and the egg-focused conceptualisations of age-specific (non-)reproductive bodies both shape the need for and the nature of the reproductive choice associated with OC. With a critical reading I will argue that the news coverage of OC reveals a gendered politics of ageing, predicated on reproductive ability as the organising principle for the temporal structuring of life, which both interpellates a contingent of women who may want to reproduce later in life and positions their reproductive decision-making as a public concern.

In order to understand the historical specificity of these conceptualisations of female reproductive body, their relation to time and the cultural implications thereof, OC’s advent needs to be positioned in a longer history of medicalising women’s reproductive ageing. In Chapter 2 I do so by discussing a critical juncture in this history:

the mid 19<sup>th</sup>-century discursive construction of menopause as pathology. Through a close reading of the first English book-length medical treatises on menopause alongside Michel Foucault's *The Birth of the Clinic*, I discuss how normative ideas about aging and reproductive embodiment became conceptually linked in the medicalisation of female midlife. I analyse different approaches to observing, conceptualising, and treating the body in relation to time and discuss their function in affirming and reworking social norms of age and gender. In doing so, I highlight the political work implicit in contesting medical conceptualisations of female reproductive bodies, their age-specific pathologies, and directives of (self-)surveillance employed in discourses surrounding women's reproductive health. From this analysis emerge three mechanisms concerning the naturalisation of age normativity, the visualisation of physical ageing and the disciplinary effects of bodily futurity, all of which have continued relevance in the study of 21<sup>st</sup>-century egg freezing and reproductive ageing.

The disciplinary effects of bodily futurity in particular play a key role in Chapter 3, which focuses on the *in vivo* egg and the new cultural and clinical practices of anticipating bodily futurity that emerge with OC. The Dutch documentary *Eggs for Later* (Schellart, 2010), which features diverse medical, political and personal discourses on egg freezing, gives insight into the anticipatory terms and affective states through which women's future age-related infertility is conceptualised in relation to the medical possibility of cryopreserving eggs. My analysis of the documentary draws attention to the contesting interpretations of egg freezing as postponement of motherhood, extension of fertility and biopreparedness for future infertility. What is at stake is the potential of various modes of anticipating bodily futurity to reconfigure ideas and practices of what constitutes healthy embodiment, the reproductive process and responsible ageing. The analysis explores how egg freezing may function not only to potentially achieve future reproduction, but also to resolve anticipatory anxiety by maintaining the futurity of potential motherhood.

Once extracted and frozen, the emergent cultural entity of the cryopreserved egg becomes meaningful through its visual and textual mediations. Now that frozen eggs may continue to exist for extended periods of time outside of the body, photomicrography of the cells becomes a means for relating to them while they remain in the freezer. In Chapter 4 I discuss this phenomenon in a case study of the public presentation of a frozen egg by a woman who underwent OC. With the online alias "Eggfreezer," she uses the Blogspot platform to offer an account of her experience that features a photograph of her cryopreserved egg. In my analysis of this cellular portrait, I reflect on what cultural ideas about reproductive ageing are expressed in the image, its textual framing and its online distribution. Positioning this photomicrography of the egg in a visual history of reproductive medical imaging, I will discuss how the image of the

cryopreserved egg is used to affirm and reimagine both existing understandings of reproductive embodiment and linear models of bodily ageing. In dialogue with theorists like Roland Barthes and Amelia Jones, I discuss constructions of temporality in the “frozen moment” of the photographic image in relation to the egg “frozen in time.” The cellular portrait then offers the occasion to consider a contemporary moment in which the manipulation of biological time changes what it means to age as much as culturally specific ideas about ageing—in this case mobilised by the photographic image of the egg—change what it means to manipulate biological time.

After the eggs are fertilised *in vitro*, it has to be decided which of them will be implanted in the womb in a process called embryo selection. At this stage of the procedure, the now fertilised eggs can once more be visualised, this time in videos produced through time-lapse embryo imaging. This selection method, which became available as a routine option in UK clinics in 2013, foregrounds cellular temporality as a determining factor in anticipating the embryos’ future viability. In keeping with this study’s focus on ageing, in Chapter 5 I draw attention to the visualisation and instrumentalisation of embryonic ageing in time-lapse embryo imaging by analysing the production of a new set of images of fertilised eggs and their division into embryos that circulate beyond the laboratory in the clinic, the intended parents’ private sphere and public discourses. Emerging in the wake of an increasingly visual interface with prenatal life, such as the iconic imagery of micro-injection and fetal ultrasound, both of which have had a profound impact on the public and private imagination of the reproductive process, time-lapse embryo videos add yet another visual dimension to the encounter with early human life on screen (Duden 1993; Van Dijck 2001; Franklin 2013a). The instrumentalisation of these images in the clinical context and in patenting procedures generates new risks and “biovalue” as a result of the temporalisation of embryo selection (Waldby 2002). This method of embryo selection then may not just result in more or less “IVF success,” but also affects the conceptualisation, representation and commercialisation of ageing at an embryonic level.

If selected, the egg’s—now embryo’s—journey proceeds to implantation into the intended mother’s womb in what is described as the second phase of OC. Chapter 6 focuses on this stage and explores how the introduction of egg freezing is indebted to and shifts existing cultural constructions of “older motherhood.” I distinguish three new forms of technologically-mediated older motherhood that co-emerge with OC: willful, genetically related and posthumous motherhood. These three configurations of motherhood become meaningful within gendered cultural systems of ageing and their intersections with contemporary constructions of the “reproductive will,” kinship and mortality (Ahmed 2014, 112).

However, given that only a very limited percentage of cryopreserved oocytes result in live births, motherhood—older or not—is not a self-evident endpoint of either the egg’s journey or this study on egg freezing. Consequently, Chapter 7 zooms out to offer a reflection on the spatial trajectories of frozen eggs that become feasible as cryopreservation renders the egg newly mobile. Once frozen, the eggs become as portable as the liquid nitrogen tanks that contain them; egg freezing is thus a key condition for the development of global flows of eggs propelled by reproductive and research needs in egg donation networks. The US-based World Egg Bank ships frozen eggs to clinics worldwide and provides a case study for this chapter’s consideration of the implications of the transnational mobility of frozen eggs for reproductive egg donation and concomitant reconceptualisations of reproductive ageing. The possibility of shipping and banking eggs moreover becomes relevant as the question of research egg procurement is revived by long-awaited successes in human stem cell research (SCNT) in 2013. Given the potential clinical applications, financialisation and regulation of stem cell research, and its dependence on large amounts of oocytes provided by young women, the egg adopts a pivotal position within a broader global biopolitics of ageing. As the egg travels across bodies and geopolitical boundaries, as it is instrumentalised to halt, counteract or regenerate age, OC’s emergence radically transforms how the passage of time becomes meaningful, visible and political in bodies and eggs alike.