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Where has the quest for conception taken us? Lessons from anthropology and sociology

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Abstract Louise Brown, the world's first test-tube baby, was born more than 40 years ago in England. For Louise Brown's infertile mother, Lesley, in-vitro fertilization (IVF) was the 'hope technology' which allowed her to overcome her tubal infertility after 9 years of heart-breaking involuntary childlessness. Since then, IVF has travelled to diverse global locations, where millions of individuals and couples have embarked on technologically assisted 'quests for conception'. After 40 years of IVF, where has the quest for conception taken us? This article outlines seven major global trajectories – namely, that the quest for conception has become more: (i) technological, because of a profusion of IVF-based innovations; (ii) masculine, because of men's eager uptake of intracytoplasmic sperm injection, their own 'masculine hope technology'; (iii) stratified, due to persistent race- and class-based barriers in IVF access; (iv) transnational, as infertile and other involuntarily childless people search across borders to overcome restrictions in their home countries; (v) selective, as IVF-based reproductively technologies eliminate genetic disease while exacerbating sex selection; (vi) moral, as religious sensibilities both accommodate and curtail the possibilities and outcomes of assisted reproductive technology (ART); and (vii) extended, as new cryopreservation technologies prolong the reproductive lifespan and extend reproduction to the transgender community. The article concludes with thoughts on where future quests for conception might take us, and why IVF and other reproductive technologies are 'good to think with' in both the anthropology and sociology of reproduction.

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Introduction: the quest for conception

Louise Brown, the world's first test-tube baby, was born more than 40 years ago in England. For Louise Brown's infertile mother, Lesley, in-vitro fertilization (IVF) – developed at the University of Cambridge – was a 'hope technology' (Franklin, 1997), allowing Lesley to overcome her tubal factor infertility and 9 years of heart-breaking involuntary childlessness. Lesley's story involved a complex reproductive quest, in which she travelled with her working-class husband John from their home in Bristol to Oldham General Hospital to undergo the IVF procedures (Elder and Johnson, 2015). Due to intense media scrutiny and religious opposition (Dow, 2019), the delivery of baby Louise by caesarean section on 25 July 1978 was carried out under conditions of secrecy.

Less than 2 years after Louise Brown's birth, the first IVF 'fatwa' (i.e. authoritative religious decree) was delivered on 23 March 1980 by the Grand Shaykh of Egypt's renowned Al Azhar University. He deemed IVF acceptable for infertile Muslim couples, as long as the couple's own gametes were being used within the realm of lawful marriage. By 1986, the region's first IVF clinic had opened in Egypt, followed later that year with clinic openings in Jordan and Saudi Arabia. Two years later, I arrived in Alexandria, Egypt, to conduct my doctoral research on the stigma and suffering of infertility among the Egyptian poor. By that time, Alexandria's public maternity hospital had announced a low-cost IVF programme, causing hundreds of poor infertile women to pour into Alexandria from all over the Egyptian Delta region. These women told me they were 'searching for children' – in this case, a 'tifl l-anabib' (i.e. 'baby of the tubes') (Inhorn, 1994).

Attempting to understand these poor Egyptian women's 'quests for conception' marked the beginning of my scholarly career. My first book, *Quest for Conception: Gender, Infertility, and Egyptian Medical Traditions* (Inhorn, 1994) – with the iconic main title suggested by my University of Pennsylvania Press editor, Patricia Smith – represented the earliest ethnographic examination of IVF in a non-Western setting. Three subsequent decades of 'travelling with IVF' across the Arab world – in Egypt (Inhorn, 1994, 1996, 2003), Lebanon (Inhorn, 2012a), the United Arab Emirates (Inhorn, 2015) and Arab America (Inhorn, 2018) – has led me to reflect on the state of this field. Using examples from my own Middle Eastern research, as well as state-of-the-art literature in the growing scholarly corpus on this subject, I hope to spell out why assisted reproductive technology (ART) is 'good to think with'. As I will attempt to show in this article, ART provides an exceptional 'reprolens' into multiple domains of social life, including gender, sexuality and family making; aging and the reproductive life course; the intersectionality of race and class stratification in technological access; globalization and transnationalism; religion and bioethics; state–society relations; and the overall human response to technological innovation.

Given the multiple social effects of ART, the past four decades have generated a rich field of scholarship, including in the disciplines of anthropology and sociology. Although anthropology and sociology are distinct fields with separate

and storied histories, theories and methodologies, they are the two social sciences most committed to qualitative research, including in-depth, person-centred ethnography (Hollan, 2001). Both anthropologists and sociologists have made significant contributions to the study of reproduction in general and the ethnography of ART more specifically. Indeed, the first important theoretical work on the relationship between anthropology, kinship and ART was published by renowned University of Cambridge anthropologist Strathern, 1992. Since then, anthropologists and sociologists have gone on to publish 20 book-length ethnographies on IVF in countries ranging from Mexico to India to Thailand (Becker, 2000; Bharadwaj, 2016; Bonaccorso, 2008; Clarke, 2009; Franklin, 1997; Franklin and Roberts, 2006; Gerrits, 2016; Gökner, 2015; Gonzáles-Santos, 2019; Inhorn, 2003, 2012a, 2015, 2018; Kahn, 2000; Kanaaneh, 2002; Konrad, 2005; Roberts, 2012; Sandelowski, 1993; Thompson, 2005; Whittaker, 2015).

However, there are also some important scholarly omissions. In what follows, I attempt to examine the lessons learned from research on ART in the anthropology and sociology of reproduction. I highlight areas where much research has already been conducted and those areas where future potentials have yet to be realized. I also cite some alternative trajectories for these technologies that could and should be explored.

In answering the question of where the quest for conception has taken us, I outline seven global trajectories that are clear from the extant literature. To wit, the quest for conception has become more: (i) technological, because of a profusion of IVF-based innovations; (ii) masculine, because of men's eager uptake of intracytoplasmic sperm injection (ICSI), their own 'masculine hope technology' (Inhorn, 2012a); (iii) stratified, due to persistent race- and class-based barriers in IVF access; (iv) transnational, as infertile and other involuntarily childless people search across borders to overcome restrictions in their home countries; (v) selective, as IVF-based reproductively technologies eliminate genetic disease while exacerbating sex selection; (vi) moral, as religious sensibilities both accommodate and curtail the possibilities and outcomes of ART; and (vii) extended, as new cryopreservation technologies prolong the reproductive lifespan and extend reproduction to the transgender community.

It is also important to note that this article is part of a special issue on reproductive technologies, featuring the ethnographic fieldwork of anthropologists and sociologists in France and the USA. I pay particular attention to research conducted in these two countries, including the findings of my own most recent ethnographic projects in the USA. As should become apparent, stark national differences between France and the USA have been highly influential in shaping what Franklin and Inhorn (2016, p. 4) have called 'repro-national histories', or the particular national events that have moulded IVF provision differently from one country to the next. As we will see, Catholicism coupled with strict ART legislation and state subsidization in France have led to quite different ART provision protocols there than in the USA, where the ART industry is characterized by 'laissez-faire' regulation and neoliberal fee-for-service treatments, which are rarely covered by either the state or health insurance.

Finally, in this article, I will also draw upon my long-term fieldwork in the Middle East to show how reprobational histories can vary considerably based on local cultural sensibilities and religious moralities. Indeed, the so-called 'Eastern' religions (e.g. Hinduism, Islam) have embraced ART and visions of technoscientific modernity in ways that some 'Western' religions (e.g. Catholicism, Evangelical Protestantism) have not (Lotfalian, 2004). Thus, by employing an implicit comparative perspective in this article, I hope to question simplistic binaries and untested assumptions about Islam versus Christianity, ayatollahs versus priests, Muslims versus Christians, and the 'East' versus the 'West'. Such multisited, global ethnographic comparison is part and parcel of the anthropological tradition in which I am trained.

Technological quests

The first lesson that should be emphasized after four decades of ART research is that IVF has changed the world for the better. This is the proposition underlying the current project funded by the Wellcome Trust on 'Changing (In) Fertilities', directed by Sarah Franklin at the University of Cambridge, co-directed by me at Yale University, and bringing together the world's IVF ethnographers. In her own early path-breaking ethnography, *Embodied Progress: a Cultural Account of Assisted Conception*, Franklin (1997) coined the term 'hope technology' to refer to the promise of IVF among the first generation of British users. Since then, IVF has brought great hope and promise to the parents of more than 8 million IVF babies now born worldwide (De Geyter, 2018). Some of these parents are infertile couples, while others are single women (Hertz, 2018; Tober, 2018), lesbian couples (Luce, 2010; Mamo, 2007) and gay men whose reproduction has been made possible through IVF and surrogacy [Pralat, 2018; see also Smietana et al., 2018, whose 2018 guest-edited symposium in *Reproductive Bio-Medicine & Society Online* Volume 7, focuses on 'Making Families: Transnational Surrogacy, Queer Kinship, and Reproductive Justice'].

As Franklin (2013) has argued in her more recent book, *Biological Relatives: IVF, Stem Cells, and the Future of Kinship*, IVF has spawned something of a technological revolution, becoming a 'platform' technology for a multitude of other interventions designed to overcome intractable reproductive barriers. These 'second-generation' IVF technologies include: (i) ICSI to overcome male infertility; (ii) third-party reproductive assistance (with donor oocytes, sperm and embryos) to overcome problems of poor gamete and embryo quality; (iii) gestational surrogacy to help women who are unable to carry a pregnancy in their own uterus, as well as gay men who employ surrogates to become fathers; (iv) cryopreservation (freezing) and storage of unused sperm, embryos, oocytes and ovaries to preserve fertility for those facing cancer or the threat of age-related decline in fertility; (v) mitochondrial transfer from a healthy human oocyte to the diseased oocyte of another woman to prevent the birth of offspring with fatal mitochondrial diseases; (vi) preimplantation genetic diagnosis (PGD) of IVF embryos to prevent the birth of offspring with heritable disorders; (vii) preimplantation genetic screening (PGS) to

select embryos of a specific quality or sex, or to select embryos that can grow into 'saviour siblings' through the donation of their umbilical cord blood; (viii) human embryonic stem cell research on unused embryos for the purposes of therapeutic intervention; and (ix) the future possibility of human reproductive cloning or asexual, autonomous reproduction, which has already occurred in other mammals (e.g. Dolly the sheep) (Franklin, 2007; Waldby, 2019).

With only a few exceptions, these technologies are now widespread throughout the USA and Europe. Their continual evolution and refinement are celebrated annually at major IVF conferences held by the European Society for Human Reproduction and Embryology (ESHRE) and the American Society for Reproductive Medicine (ASRM). However, interestingly, relatively few anthropologists or sociologists participate in these conferences, either as presenters of their own work or as researchers of the IVF scientific community itself.

Understanding ART laboratory science, technological innovation and clinical translation is key to revealing the sometimes profound social implications, both positive and negative, of these various technological transformations. For example, mitochondrial replacement therapy – in which mutated mitochondria are removed from a woman's diseased oocytes and replaced with healthy mitochondrial DNA from a donor – means that IVF babies will now be born free of lethal mitochondrial diseases. However, such children will inherit three forms of parental DNA ('two mums, one dad'), an outcome that has made this technology controversial (Waldby, 2019).

Furthermore, the minute-by-minute development of IVF embryos can now be watched by embryologists – and recorded for patients themselves – through the technique of time-lapse embryo monitoring, which can aid in the evaluative process of embryo selection (Merleau-Ponty, 2018). However, time-lapse embryo monitoring can represent an expensive 'add on' to patients' clinic bills and create psychological attachments to non-viable embryos; thus, its clinical value has yet to be proven by solid evidence (Wilkinson et al., 2019). Furthermore, new work on in-vitro gametogenesis – or the possibility of making gametes (oocytes and sperm) from human stem cells (Bourne et al., 2012) – may open up possibilities for parenthood among individuals who face otherwise absolute sterility. However, this may also create unrealistic hopes, especially among azoospermic men who do not produce any spermatozoa at all and are waiting for this type of 'miracle cure' (Inhorn, 2012b). In addition, new forms of reproductive biobanking are shaping a global world of clinical science and resource sharing between countries, but not all partners, especially those from the global South, benefit equally (Merleau-Ponty et al., 2018).

In short, the reproscientific world of technological conception is ever-changing, bringing with it new hopes and new ethical conundrums (Thompson, 2013). Today more than ever, we need anthropologists and sociologists with science and technology studies backgrounds to use their dual scientific and ethnographic training to study these emerging worlds of ART reproscience. Only by entering the IVF laboratories, biobanks, clinics, operating theatres and conference spaces can we begin to observe and trace these

new technological trajectories. This was one of the major contributions of Rayna Rapp in her ground-breaking ethnography, *Testing Women, Testing the Fetus: the Social Impact of Amniocentesis in America* (1999), in which she entered genetics laboratories as an ethnographer to study the science of chromosome testing. As Guest Editor of this special issue of *Reproductive BioMedicine & Society Online*, Rapp's legacy carries on, as seen in the type of feminist technoscience research on reproduction being published in this journal.

Masculine quests

The second lesson to be learned is about the importance of men in reproduction – an area of research that has been sorely neglected. As argued in our edited volume, *Reconceiving the Second Sex: Men, Masculinity, and Reproduction* (Inhorn et al., 2009), we need more scholars to follow masculine quests for conception as part of our research agenda. Why? Following upon the initial success of IVF, one of the first variations was ICSI, a technology to overcome male infertility that was introduced in Belgium in 1991. Until the 1990s, the only known solution for male infertility was donor insemination, the oldest infertility technology, but one that was socially and religiously unaccepted by many men and women (Becker, 2002; Eisenberg et al., 2010). The introduction of ICSI was thus a watershed event. A variant of IVF, ICSI solves the problem of male infertility in a way that IVF cannot. Through microscopic manipulation of 'weak' sperm (i.e. low numbers, poor movement or misshapen) under a high-powered microscope, these sperm can be injected directly into human oocytes, effectively 'forcing' fertilization to occur. With the invention of ICSI, otherwise 'sterile' men may now father biogenetic offspring. This includes azoospermic men, who produce no sperm in their ejaculate and must therefore have their testicles painfully aspirated or biopsied in the search for sperm.

The importance of ICSI in the world today cannot be underestimated, given that male infertility contributes to more than half of all cases of involuntary childlessness worldwide (Inhorn and Patrizio, 2015). Male infertility is also one of the most stigmatizing male health conditions (Goldberg, 2009; Inhorn, 2004), as it is often mistakenly conflated with impotency (i.e. erectile dysfunction). This 'fertility–virility linkage' (Lloyd, 1996) means that men who are infertile are assumed to be impotent, although most are not. This sexual misattribution also means that male infertility problems are deeply hidden, with women often being blamed for what, in fact, are problems of infertility in their husbands.

The high prevalence of male infertility, its stigma and secrecy, and its potential solution through ICSI are major issues to be studied by social scientists. However, to date, only two ethnographies have devoted significant attention to this topic (Barnes, 2014; Inhorn, 2012a). My own book, entitled *The New Arab Man: Emergent Masculinities, Technologies, and Islam in the Middle East* (2012a), is the only one to focus on ICSI and infertile men's eager embrace of this masculine hope technology. In the book, I argue that ICSI provides an interesting case study of how medicalization – or the recasting

of male infertility from a problem of manhood into a problem of health (i.e. 'a disease like any other') – has led to a 'coming out' of this condition from behind its veil of secrecy.

Given the significance of male infertility problems, new anthropological and sociological studies on the role of fertile sperm donors in the USA (Almeling, 2011), Denmark (Mohr, 2018) and China (Wahlberg, 2018) are important, because the global demand for donor sperm appears to be growing among lesbian and single women (Agigian, 2004; Hertz, 2008, 2018; Mamo, 2007; Tober, 2018), as well as among the burgeoning population of men with male infertility problems (Inhorn, 2012a, 2012b; Wahlberg, 2018). In the world today, many countries are reporting significant declines in sperm count – a so-called 'big drop' (Daniels, 2006) – that likely indicates increased levels of environmental contamination (Wahlberg, 2018). In France, for example, an Institute for Health Surveillance (Roland et al., 2012) report shows a 'significant' drop (32%) in sperm parameters over the 17-year period from 1989 to 2005. Although it is not known if these decreasing sperm counts are associated with reduced fertility at the population level, such decreasing numbers could signal trouble for European countries such as France with below-replacement fertility levels (Inhorn and Smith-Hefner, 2020). This entanglement between male fertility, population demography and environmental toxicity is surely one of the key trajectories that needs to be followed well into the future.

Stratified quests

The third lesson to be learned is that both infertile men and infertile women may face significant barriers to ART access based on gender, race, class, sexual orientation and other forms of difference. However, as with the study of male infertility, anthropologists and sociologists have not attended well enough to these varied forms of social stratification. Among the six ethnographies devoted to infertility and ART in the USA (Barnes, 2014; Becker, 1997, 2000; Bell, 2014; Sandelowski, 1993; Thompson, 2005), only one, *Misconception: Social Class and Infertility in America* (Bell, 2014), is specifically devoted to the struggles of poor women, including poor women of colour. In most of Euro-America, including France, ethnic minorities' experiences of infertility, as well as their attempts to seek ART treatment (Mathieu, 2013), are almost entirely missing from the anthropological and sociological record.

Such an omission is especially egregious in this day and age, for minority infertility represents a case 'par excellence' of 'stratified reproduction' – the term coined by anthropologist Shellee Colen (1995) and made famous by Faye Ginsburg and Rayna Rapp in their seminal volume, *Conceiving the New World Order: the Global Politics of Reproduction* (1995a, 1995b). Stratified reproduction is still one of the most important concepts in the anthropology of reproduction. As described so eloquently by Ginsburg and Rapp (1995a, b, p. 3), stratified reproduction bespeaks 'the arrangements by which some reproductive futures are valued while others are despised'.

Stratified reproduction still plagues the world of assisted conception, where barriers to ART access and various forms of subtle and not-so-subtle racism are abundantly apparent.

Barriers to access are perhaps especially true in the USA, where a single cycle of IVF or ICSI can cost well over \$12,000 – about four times the global average (Inhorn and Patrizio, 2015). In the USA, only a handful of so-called ‘mandate states’, mostly on the East Coast, provide any form of mandatory insurance coverage for IVF services. Most Americans must pay out-of-pocket for IVF, as relatively few employers provide fertility benefits as part of their insurance policies.

As a result, many American couples find it very difficult, even impossible, to afford IVF, including those coming from the middle class. High unmet need for IVF, however, is most apparent among disadvantaged minority populations, who often have higher rates of infertility but much lower rates of IVF utilization.

I examine this highly stratified ART landscape in my recent book, *America’s Arab Refugees: Vulnerability and Health on the Margins* (Inhorn, 2018). Basing my study in ‘Arab Detroit’ – the largest Arab ethnic enclave in North America, located on the margins of America’s poorest large city – I met nearly 100 infertile men and women, most of whom had fled as refugees from war-torn Iraq and Lebanon. I came to think of these poor infertile refugees as ‘reproductive exiles’. On the one hand, they were forced to leave their home countries because of war, including the two US-led wars in Iraq. However, once they arrived in the USA as refugees, they found themselves stranded, unable to return to their home country because of ongoing violence and shattered healthcare systems, and unable to access infertility services due to their structural vulnerability within the healthcare system in the USA. Exile, thus, had two meanings for this population: first, the forced removal from their home countries, with little hope of return; and second, the feeling of being forced out of an inaccessible healthcare system, where they would never be able to afford IVF or ICSI.

Even passage of the Affordable Care Act – also known as ‘Obamacare’ – did little to ameliorate ethnic and racial disparities in IVF access. Under Obamacare, IVF and all related ART are considered ineligible for insurance coverage, given that they are deemed ‘elective’ procedures for the non-life-threatening condition of infertility. Thus, under Obamacare, infertile minority couples’ dreams of parenthood have not been met. This is sadly ironic given that the first Black President of the USA clearly cherished his fatherhood role. Furthermore, in her new book *Becoming* by Michelle Obama (2018), we learn that Michelle and Barack struggled over their own infertility problems and that Michelle eventually gave birth to two IVF daughters. Perhaps the importance of this book will be in opening up a conversation about minority infertility.

Sadly, even today, minority couples may still be faced with frank ‘reproductive racism’ (Inhorn, 2018) – an issue that is currently being addressed by a new generation of critical race studies scholars (e.g. Bridges, 2011; Davis, 2019; Gurr, 2014). For example, many of the Middle Eastern Muslim refugee couples with whom I worked reported subtle and not-so-subtle questioning of their childbearing intentions and desires, as well as clear-cut cases of iatrogenesis (i.e. physician-induced harm). Such discrimination, iatrogenesis and barriers to ART access produce profound forms of suffering and additional flight. Indeed, in Arab Detroit, I met refugees who had travelled across state borders to find

a sympathetic, trustworthy and charitable Muslim ART physician – one who would not judge them and who actually might help them to make an IVF baby safely, affordably and effectively.

Transnational quests

A fourth lesson then is that ART trajectories involve movement, which is increasingly global in nature (Inhorn, 2015; Nahman, 2013; Speier, 2016; Whittaker et al., 2019). Given the profound barriers to ART access of the type described above, it is not surprising that individuals and couples are ‘reprotravelling’ (Inhorn, 2015) across regional, national and international borders in their quests for conception. Much of the anthropological work on transnational reproduction has focused on Euro-American travel to the global South, especially for access to commercial gestational surrogacy (Deomampo, 2016; Majumdar, 2017; Pande, 2014; Rudrappa, 2015; Whittaker, 2018). However, among Euro-Americans, most transnational travel is closer to home (e.g. France to Belgium, Canada to the USA), and is also more mundane (e.g. for IVF and ICSI).

In European countries such as France, ART may be state subsidized but the barriers to its access are often legal. Such divergent laws between countries have caused a legal ‘patchwork’ or ‘mosaic’ of ART services across Europe (Pennings, 2004). Within this variable legal landscape, France has gained the notorious reputation as a ‘progressive’ country with nonetheless ‘restrictive’ ART legislation (Pennings, 2002). To wit, France restricts ART for multiple categories of people, including older women seeking IVF or oocyte cryopreservation for age-related decline in fertility, single men seeking to become IVF fathers, and gay male couples who want to become parents of biogenetically related offspring, including through surrogacy. Most of these individuals are not technically ‘infertile’, but face involuntary childlessness because of their exclusion from state-subsidized treatment, even if they are willing and able to pay for it.

Given this scenario, French individuals and couples are increasingly travelling abroad to seek ART services. A study of 128 French patients who sought cross-border reproductive care between 2010 and 2012 found that Belgium, Greece and Spain were their three most common travel destinations. Most of these French travellers were same-sex couples, single women not eligible for assisted reproduction in France, and heterosexual couples seeking oocyte donation due to French shortages of donor oocytes (Rozée Gomez and de la Rochebrochard, 2013). Among those seeking surrogacy services abroad, many struggled to have their children legally recognized as their own offspring and to be granted French citizenship (Courduriers, 2018).

In Europe more generally, a large empirical study was undertaken involving 46 IVF clinics in six countries (Belgium, Czech Republic, Denmark, Slovenia, Spain and Switzerland) (Shenfield et al., 2010). Based on a survey of 1230 patients, the study estimated a minimum of 24,000–30,000 cross-border cycles in Europe each year, involving between 11,000 and 14,000 patients. In another major study from North America, it was estimated that approximately 4% of patients treated with IVF in the USA were from other countries

(Hughes et al., 2016; Hughes and DeJean, 2010), and that 6% of Canadian IVF patients left their country for treatment, including to the USA, mostly for donor oocytes (80%). A recent detailed analysis of the extent and scope of reproductive travel to the USA shows a doubling of incoming patients over the 7-year reporting period from 2006 to 2013 (Levine et al., 2017). Using data from the US Centers for Disease Control and Prevention's National ART Surveillance System, the study shows that 1.2% of all ART cycles performed in 2006 were for non-US residents, but that the number increased to 2.8% of all ART cycles in 2013. Compared with US residents, non-US residents made greater use of oocyte donation (10.6% versus 42.6%), gestational surrogacy (1.6% versus 12.4%), and PGD or PGS (5.3% versus 19.1%). In other words, reproductive travel to the USA not only increased substantially over time, but also involved more specialized ART services.

Taken together, these studies speak to the four major reasons why people are travelling for ART: (i) legal and religious prohibitions; (ii) resource constraints; (iii) quality and safety concerns; and (iv) personal preferences (Gürtin and Inhorn, 2011). For instance, a recent survey by the International Federation of Fertility Societies (2016) showed that reproductive travellers from 64 different countries reported that lack of access, higher quality and safety, and lower costs (83%, 80% and 73%, respectively) were their major motivations for travel. Fewer respondents reported travelling to other countries for oocyte, sperm or embryo donation (52%, 45% and 43%, respectively) or for gestational or traditional surrogacy arrangements (22% and 9%, respectively).

This important study suggests that most reproductive travellers are seeking standard infertility services, such as IVF, ICSI and intrauterine insemination, but are hampered in their home countries by legal restrictions, high costs and low-quality care (Hudson et al., 2011). Differences in costs per cycle between countries are indeed a major factor in reproductive travel, particularly for those without any form of public or employer health insurance coverage. It is important to note that many reproductive travellers suggest that they would prefer to stay home if safe, accessible, affordable and effective ART services were available in their own countries (Culley et al., 2011; Inhorn, 2015; Inhorn and Shrivastav, 2010). Thus, transnational reproduction rarely constitutes a 'fertility holiday' (Speier, 2016). Rather, it is done out of perceived need and, sometimes, feelings of desperation (Inhorn, 2015).

Such tortuous reproductive journeys need to be studied by anthropologists and sociologists of reproduction, as increasing numbers of infertile couples, gay couples and single individuals embark on their transnational quests for conception. With new borders and barriers to reproductive travel being erected around the world (Whittaker, 2018; Whittaker et al., 2019), this area of scholarship is now especially critical.

Selective quests

A fifth lesson coming into focus is about selective reproduction, or the use of ART to select for and against certain types of embryos and offspring. Selective quests for conception –

with their dystopian potential for Gattaca-like societies of designer babies – represent one of the most pressing bioethical issues in today's reproductive world. This has been forcefully argued by Scandinavian anthropologists Wahlberg and Gammeltoft, 2018 in their recent edited volume *Selective Reproduction in the 21st Century*. Wahlberg and Gammeltoft define the new category of 'selective reproductive technologies' (SRT) as follows: 'Rather than aiming to overcome infertility, they are used to prevent or allow the birth of certain kinds of children' (Gammeltoft and Wahlberg, 2014, p. 201).

PGD is a prime example of an SRT. Introduced in IVF laboratories in the mid-1980s, PGD was designed to diagnose severe genetic disorders in eight-cell IVF embryos, thereby preventing intrauterine transfer of genetically abnormal embryos, and hence, the birth of IVF offspring with life-threatening heritable diseases (Franklin and Roberts, 2006). However, over time, genetic testing via PGD has increasingly morphed into PGS, in which IVF embryos can be assessed for both overall 'quality' and sex.

As shown in Rajani Bhatia's (2018) incisive social history, *Gender Before Birth: Sex Selection in a Transnational Context*, the introduction of PGD-cum-PGS has led to new possibilities for selective reproduction, particularly the use of PGS for 'family balancing' (Bhatia, 2018). Transnational quests for sex-selective PGS are increasing, although the extent of such reproductive travel is still unknown. Some locales are nonetheless beginning to advertise their PGS services for 'family balancing' and 'enhancement', bringing travellers from far and wide for PGS-assisted sex selection.

Dubai is becoming one of these new international PGS 'reprohubs' (Inhorn, 2015), using subtle and not-so-subtle 'pink and blue' advertising schemes to market their gender selection services on websites (Kroløkke and Kotsi, 2019). As I have argued in my book, *Cosmopolitan Conceptions: IVF Sojourns in Global Dubai* (2015), Dubai's role in this 'new sex trade' (Whittaker, 2011) is inherently problematic, especially given that PGS is re-invigorating patterns of son preference and daughter discrimination that were once waning across the region (Inhorn, 2012a; Obermeyer, 1999; Van Balen and Inhorn, 2003). Furthermore, Islam explicitly prohibits female infanticide (Ahmed, 2006). Thus, PGS-assisted culling of female embryos would seem to be anathema to Islamic moral principles. However, some contemporary Islamic religious authorities have condoned so-called 'gender selection' (Shabana, 2017). Egypt's famed Al Azhar University issued a 'fatwa' permitting gender selection at the 'individual level' (as long as it does not harm the fetus, now or in the future), but cautioning against the effects of gender selection at the 'community level' (given the potential to disturb 'the male-female ratio which is an important element for human life and existence').

This Egyptian 'fatwa' speaks to an important outcome of selective reproduction – namely, its effects on population demography, particularly through disruption of male–female sex ratios. Selective reproduction also has eugenic potential. As seen in a number of recent ethnographies from Asia, discourses of 'population quality' are being invoked in PGS-assisted sex selection (Bhatia, 2018), ultrasound-assisted feticide (Gammeltoft, 2014) and selective

recruitment of educated sperm donors for sperm banking (Wahlberg, 2018).

In Euro-America, attitudes towards and practices of selective reproduction are variable. For example, the USA has become a global hub for sex selection because the practice is forbidden in Canada, Australia, New Zealand and the vast majority of European countries (including France). In those countries, sex selection of embryos is only allowed for the elimination of certain sex-linked genetic diseases. In the USA, however, PGS is being used for 'family balancing' under the justification that many Euro-American couples will use this technology to ensure the birth of a daughter (Bhatia, 2018). Whether these sex-selective quests will increase over time and whether they will alter male–female sex ratios are issues of concern.

Bioethicists have engaged in active debates about selective reproduction; some have argued that PGS-abetted selection of the 'best' children is a form of 'procreative beneficence' (Savulescu, 2001, 2007), while others have objected to the very principle of procreative beneficence, particularly as it places lower moral value on the disabled (Harris, 2005). Anthropologists and sociologists of reproduction, particularly those with interests in disability studies, must enter into these discussions. Furthermore, through our empirical dedication to ethnography, we must begin to study new sites of selective reproduction (e.g. the emerging sex-selective reprohubs of the USA and Dubai), as well as the people (e.g. clerics, practitioners and parents themselves) who support or engage in sex-selective quests for conception.

Moral quests

The sixth major lesson for anthropologists and sociologists is that we must continue to take religion seriously in our studies of ART. The global spread of new sex-selective and eugenic SRT in diverse national settings – from Muslim Egypt to Communist China to Hindu India – is but one example of how moral sensibilities and religious mandates can shape individuals' modern quests for conception.

The study of religion and ART has always been an interest of anthropologists and sociologists (Bharadwaj, 2006a, 2006b; Birenbaum-Carmeli, 2016; Clarke, 2009; Inhorn, 2003; Kahn, 2000; Kanaaneh, 2002), and this religious studies scholarship continues to be enduring (Bharadwaj, 2016; Gürtin, 2016; Roberts, 2012; Taragin-Zeller, 2019a, 2019b; Zanini, 2019). Most of the world's major religions have taken a stance on ART, with permission being granted in many cases. For example, in the predominantly Muslim Arab nations in which I have worked, ART was permitted early on through the issuance of 'fatwas'; these, in turn, have provided important sources of moral support for IVF patients, who, in the Muslim world, are necessarily heterosexual and married.

Furthermore, as shown in our edited volume on *Islam and Assisted Reproductive Technologies: Sunni and Shia Perspectives* (Inhorn and Tremayne, 2012), Islam has embraced ART in ways that some other religions have not. This is especially true of Catholicism, with the Vatican continuing to reject all forms of ART (Zanini, 2019). As a result, Catholic-dominant European countries, such as France, Italy

and Spain, must openly flaunt the Catholic Church in order to practice ART on national soil (Inhorn et al., 2010; Zanini, 2019).

In France – where the first IVF baby, Amandine, was born in 1984, despite the concerns of the Catholic Church – ART has subsequently been legislated, resulting in one of the most ART-restrictive legal regimes in Europe. France is a secular state, but Catholicism continues to play an influential role in shaping these restrictions. The restrictions, however, have been challenged recently. For example, on 27 September 2019, the French assembly voted to give lesbian couples and single women the same access to ART as married couples. Reflecting the internal diversity and religious pluralism of French Catholicism, some Catholic clergy supported this legislative revision.

In the USA, on the other hand, neither religion nor law has played a definitive role in shaping ART sensibilities. As the USA does not have ART law, ART practice is largely guided by state mandates, guidelines issued by professional associations, and clinical consensus, with most IVF clinics offering a wide range of reproductive services. Although the USA has gained a reputation as the 'Wild West' of ART treatment, it is also viewed as the land of reproductive opportunity – a fertility tourism destination – for thousands of individuals and couples on their global quests for conception. However, even in the USA, religion still matters greatly in the world of ART, informing the 'local moral worlds' (Kleinman, 2006) of both patients and practitioners. For example, research among American Protestant evangelicals shows how deeply they care about 'saving' frozen IVF embryos, and enacting programmes of embryo 'adoption', even across racial lines (Cromer, 2018, 2019). In other words, understanding the intersection of religion and reproduction – even in the so-called 'secular' states of Euro-America – continues to be critical, particularly as newer ART trajectories emerge.

Extended quests

The seventh lesson for anthropologists and sociologists is that we must study the new ART among new communities of users. In this ever-changing world of ART, one of the newest innovations is oocyte cryopreservation, which allows human oocytes to be frozen and stored in oocyte banks, thereby potentially extending a woman's reproductive lifespan. First tried in the early 1980s, with the first reported baby born from a frozen oocyte in 1986 (Lockwood, 2011), oocyte cryopreservation 'took off' in the early 2000s through a method of flash freezing called 'vitrification' (Mertes and Pennings, 2012).

A clear-cut need for vitrification was first seen in the world of clinical oncology. Namely, women at risk of losing their reproductive ability due to cancer chemotherapy or other fertility-threatening medical conditions could freeze their oocytes, potentially preserving their future ability to conceive a genetically related child (Inhorn et al., 2018a, 2018b). Oocyte cryopreservation thus allowed female cancer patients to gain the psychic relief that sperm cryopreservation had provided to generations of young men facing sterilizing cancer treatments. Oocyte cryopreservation also opened up the possibility of posthumous reproduction in the case of cancer death, with partners and family members

tasked with deciding upon ultimate oocyte disposition (Inhorn et al., 2017; Katz and Hashiloni-Dolev, 2019).

Given the success of oocyte cryopreservation in clinical trials with cancer patients, as well as with healthy volunteers, on 19 October 2012, ASRM lifted its experimental ban, allowing oocyte cryopreservation to be performed clinically in the USA in IVF clinics for both medical patients and healthy women. Since then, most US IVF centres have created their own oocyte cryopreservation programmes, and several commercial oocyte banks and stand-alone clinics have opened in major urban areas, especially New York City, where a growing number of oocyte cryopreservation centres are now located (Van de Wiel, 2020).

The response to oocyte cryopreservation on the part of American women was almost immediate. Within the first year of clinical acceptance (i.e. 2013), approximately 5000 oocyte cryopreservation cycles were undertaken in the USA. Five years later (i.e. 2018), that number more than doubled to 11,000 cycles, according to the Society for Assisted Reproductive Technology.

In Europe, the ESHRE Task Force on Ethics and Law (2012) approved oocyte cryopreservation for clinical use in 2012, and several European countries quickly followed suit. By 2015, ESHRE reported that six out of 34 European countries surveyed were employing oocyte cryopreservation for fertility preservation among otherwise healthy women (Shenfield, 2016). These 'early adopter' countries included Bulgaria, Finland, Germany, Italy, the Netherlands and the Ukraine; the number increased steadily to include countries such as Belgium, Denmark, Sweden and the UK. However, at the time of writing, many European countries, including France, Austria, Norway and Malta, disallow the practice of oocyte cryopreservation for non-medical purposes. Other countries, such as Denmark and the UK, have imposed strict storage limits (5 and 10 years, respectively), which have put intense time pressure on women to 'use or lose' their frozen oocytes. Perhaps most significantly, to date, no country provides state funding for elective oocyte cryopreservation. In this regard, European women, who may have come to expect state subsidization for ART services, are forced to pay the high prices for oocyte cryopreservation that are endured by American women. Oocyte cryopreservation is expensive – nearly as much as a full IVF cycle and with annual storage fees that can become prohibitive over time.

Most media coverage of oocyte cryopreservation has suggested that women are willing to pay for this new ART treatment to intentionally 'delay,' 'defer' or 'postpone' their fertility, especially for educational and career purposes, thereby achieving reproductive autonomy (Goldman and Grifo, 2016) and forestalling age-related decline in fertility (Argyle et al., 2016). However, recent surveys and ethnographic studies carried out among diverse women in the USA (Brown and Patrick, 2018; Carroll and Kroløkke, 2018; Greenwood et al., 2018; Hodes-Wertz et al., 2014), UK (Baldwin, 2017, 2018; Baldwin et al., 2015, 2019; Gürtin et al., 2019; Waldby, 2015, 2019), Belgium (Stoop et al., 2015), Australia (Hammarberg et al., 2017; Pritchard et al., 2017) and Turkey (Göçmen and Kiliç, 2018; Kiliç and Göçmen, 2018) show that 'lack of a partner' is cited as the primary reason for oocyte cryopreservation among more than 80% of women across all studies.

In our own recent study of oocyte cryopreservation – carried out with 150 American and Israeli women who had completed at least one cycle of cryopreservation during the 2014–2016 period – 85% had turned to oocyte cryopreservation at an average age of 36 years because they were unable to find a committed partner with whom to pursue childbearing (Inhorn et al., 2018c, 2018d). This dearth of male partners reflects growing educational disparities between men and women, which is leaving highly educated professional women without equally educated partners to marry (Birger, 2015). In our own study of highly educated women, we concluded that oocyte cryopreservation was not being used for planned fertility postponement (i.e. to achieve educational or career goals among women in their 20s or early 30s), but rather for unplanned fertility preservation (among women in their late 30s and early 40s) who were facing the end of their reproductive lifespans and their chances of biological motherhood.

Harking back to an earlier point, we need to study men's reproductive intentions as well as women's in order to understand the full story of why both men and women are engaging in reproductive delay, and whether such delays are by choice, especially for women (Inhorn and Smith-Hefner, 2020). Although oocyte cryopreservation has been heralded as a way to 'rewind the biological clock' (Goold and Savulescu, 2009; Lockwood, 2011), it is still much too early to say whether oocyte cryopreservation will be a 'reproductive revolution' for women, equivalent to the introduction of the birth control pill (Gibbs, 2010; McDonald et al., 2011). To date, most studies have shown that women are not returning in large numbers to use their frozen oocytes, many frozen oocytes do not survive the 'thaw', and thus the success rate of oocyte cryopreservation in terms of live-birth outcomes is still negligible (Argyle et al., 2016). Although this may change over time as younger generations of women take up oocyte cryopreservation, the 'revolutionary' potential of this new and costly ART certainly has yet to be realized.

Having said that, the truly revolutionary potential of oocyte cryopreservation may be in extending reproduction to transgender men. With the growing social acceptance of gender assignment technologies and techniques, individuals assigned female at birth can now preserve their oocytes before initiating testosterone therapy on the transition to manhood. In our own study of oocyte cryopreservation in the USA and Israel, we began to see the use of this ART in the gender assignment process, with two transgender men (one in the USA, one in Israel) volunteering to participate in our study (Birenbaum-Carmeli et al., in press). These men are not alone. A recent international survey of fertility preservation providers in nine countries (Tishelman et al., 2019) showed that oocyte cryopreservation is increasing in the transgender community, as transgender men work to preserve their potential for future fatherhood.

Given that oocyte cryopreservation has introduced exciting possibilities for transgender men, reproductive imaginaries for transgender women are likely to follow. For example, uterine transplantation – once a utopian fantasy – has become a reality for women born without a uterus. Initially perfected in Sweden, uterine transplantation has come to the USA, where the first IVF baby was born in November 2017 from a uterus transplanted from one woman

to another in a Texas hospital (Sifferlin, 2019). In the coming decade, uterine transplantation for transgender women could become technically feasible, extending reproduction to the transgender female community through uterine transplantation and IVF conception. At the 2018 University of Cambridge conference on 'Remaking Reproduction: the Global Politics of Reproductive Technologies,' the final plenary 'Trans Roundtable' explored this and other possibilities for future quests for conception.

Future quests for conception

As seen in these developments, the future of reproduction is here and now. Anthropologists and sociologists must be part of these futures, exploring the social and cultural impacts of the newest ART as it makes its way around the globe. As shown in this article, ART produces effects well beyond the laboratory and clinic, and well beyond the borders of Euro-America. Thus, anthropologists and sociologists must keep exploring the outcomes of ART reproduction – not in terms of fertilization and pregnancy success rates, but in the many vital domains of human social life where its most important effects are found. These include, among others, subjective experiences of personhood and infertile embodiment; gender and sexuality; kinship and family life; religion, law and bioethics; race, class and stratification; globalization and transnationalism; and the role of the state in determining particular reproductive histories. ART impacts, and is impacted by, all of these domains.

Among social scientists, anthropologists and sociologists are best situated to study these long-term impacts. We have undertaken substantial work already, as shown in the seven trajectories outlined in this article. As a group, we have made great progress in examining the quest for conception from three of these vantage points (e.g. technological, transnational and moral). However, two aspects of the conceptive quest remain decidedly underdeveloped – masculine and stratified. Two other aspects are new and waiting to be discovered – selective and extended. As new ART continues to come down the pipeline (or, in this case, the pipette), it behooves us to keep following the technological quests of ART reproscientists, and to understand the meaning of new reprotechnologies for the patients and practitioners who will eventually use them.

It is always important to bear in mind that the goal of these technologies is to 'make parents' out of those whose chances of biological conception are otherwise thwarted. In her seminal volume *Making Parents: the Ontological Choreography of Reproductive Technologies*, Charis Thompson (2005) reminded us that men and women around the globe will willingly engage in complex 'ontological choreographies' in their often herculean efforts to become parents of IVF offspring. As feminist ethnographers, we must always attempt to understand why these technologies are so important to people, and what potential benefits and rewards are offered by ART (Thompson, 2002).

Indeed, in our scholarship as anthropologists and sociologists of reproduction, we must attempt to make sense of the human desires, motivations, investments, struggles, joys and subjectivities of the women and men – both cis and transgender – who willingly engage in often difficult

journeys to and through ART. More than 40 years after the birth of Louise Brown, it is still important to remember what is at stake – that it is the babies born with the help of ART that make parents' arduous quests for conception well worth the struggle.

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