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SELECTIVE REPRODUCTIVE TECHNOLOGIES

Tine M. Gammeltoft and Ayo Wahlberg

Department of Anthropology, University of Copenhagen, 1353 Copenhagen, Denmark; email: tine.gammeltoft@anthro.ku.dk, ayo.wahlberg@anthro.ku.dk

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■ **Abstract** From a historical perspective, selective reproduction is nothing new. Infanticide, abandonment, and selective neglect of children have a long history, and the widespread deployment of sterilization and forced abortion in the twentieth century has been well documented. Yet in recent decades selective reproduction has been placed under the aegis of science and expertise in novel ways. New laboratory and clinical techniques allow for the selective fertilization of gametes, implantation of embryos, or abortion of fetuses. Although they will often overlap with assisted reproductive technologies (ARTs), what we term selective reproductive technologies (SRTs) are of a more specific nature: Rather than aiming to overcome infertility, they are used to prevent or allow the birth of certain kinds of children. This review highlights anthropological research into SRTs in different parts of the world, discussing how selective reproduction engages with issues of long-standing theoretical concern in anthropology, such as politics, kinship, gender, religion, globalization, and inequality.

INTRODUCTION

Throughout human history, people have tried to influence reproductive outcomes. Ethnographic accounts of religious rituals and medical practices that aim to guarantee healthy pregnancies and births abound; people have always, it seems, handled the

contingency that characterizes reproduction through active interventions, seeking to enhance their chances of desired pregnancy outcomes. The Trobriand islanders studied by Malinowski (1987) in the early twentieth century, for instance, conducted ceremonies of ritual bathing of pregnant women that sought to guarantee "the proper formation of the fetus" (p. 190). Based on ethnographic fieldwork conducted in the 1920s, Mead (2001) has described how pregnant women in Samoa are "surrounded by a multitude of taboos…[as] any wrong deed committed by the expectant mother will injure the child" (pp. 130--31). Yet, when efforts to control reproductive processes falter, and unwanted, fragile, or anomalous children are born, people have often turned to infanticide, abandonment, and selective neglect. LaFleur (1992) reports that infanticide was a routine kind of family planning in early modern Japan, a practice that amounted to deliberate selection of new family members; Sargent (1987) has described how, among the Bariba in Benin, abnormal infants were held to be "witch babies" and abandoned or killed at birth; and Scheper-Hughes (1993) has documented how impoverished mothers in a Brazilian shanty-town classified weak or sickly infants and toddlers as "angel babies," selectively withdrawing care for children that they thought were unlikely to survive. Indeed, until quite recently, reproductive selection could only take place after birth: the moment when sex, birthmarks, or physical constitutions were revealed.

In the twenty-first century, the possibilities people can enlist to choose the children they want to enter this world have expanded dramatically. Starting in the 1960s, obstetrical ultrasonography has grown into a routinized part of pregnancy care worldwide. By rendering the fetus visible, this technology makes it possible to select certain children-to-be for life, rejecting others before they are born. In countries where son preference prevails, the routinization of prenatal ultrasound has been accompanied by a significant surge in sex-selective abortion of female fetuses and an attendant demographic masculinization, most notably in China and India (UNFPA 2012). Ultrasound scans are also used to detect fetal anomalies, sometimes in combination with maternal serum screening, an examination of levels of alpha-feto protein (AFP) in the mother's blood. Since the 1970s, new genetic testing technologies have brought dramatic changes to conventional prenatal care: Procedures such as amniocentesis and chorionic villus sampling have made it possible to test the fetus for genetic problems,

and abortion legislation in many countries allows for pregnancy terminations in the event that a fetal anomaly is detected. Moreover, the invention of in-vitro fertilization (IVF) in the late 1970s signaled the introduction of a range of new technologies used to assist human reproduction (Inhorn & Birenbaum-Carmeli 2008). Assisted reproductive technologies (ARTs) originally aimed to help would-be parents to overcome infertility, but the act of fertilizing gametes in a dish also provides clinicians with access to a potential child's genetic material prior to implantation and gestation (Wahlberg 2008). More recently, since the 1990s, techniques for preimplantation genetic diagnosis (PGD) have become increasingly routinized: As a supplement to IVF procedures, embryos can be biopsied and tested for genetic problems and/or sex and those considered appropriate can then be selected for implantation (Franklin & Roberts 2006, Bhatia 2010). If a couple is found to be at high risk of having children who will suffer from a hereditary disease, PGD is increasingly seen as the solution---a way to select that does not involve termination of a pregnancy. At the same time, over the past decades, genetic carrier testing has become increasingly routinized, particularly in populations considered at high risk for certain genetic diseases. In most countries, carrier screening and testing are presented as voluntary options, but some countries---such as Cyprus, Saudi Arabia, and Iran---have launched mandatory programs (Cousens et al. 2010). Finally, at the time of writing, some countries (such as the United Kingdom) are preparing to legalize mitochondrial replacement therapy, a new form of IVF treatment that involves replacing the nucleus of a donor egg with the nucleus from an intended mother's egg, thereby allowing for the birth of a child with three genetic parents; this process would prevent the child from inheriting a mitochondrial disease that runs in the family (Collins 2013).

At present, researchers are further developing existing technologies for selective reproduction. Sex selection can now take place through microsorting of sperm prior to fertilization, and the improvement of cryopreservation techniques allows eggs, sperm, and embryos to be frozen and stored, thereby facilitating the development of procurement-storage-distribution networks that can be global in scope. Gamete banks and brokers allow customers to browse through donor catalogs that provide detailed information about donor traits and personalities (Kroløkke 2009). Also, through PGD and embryo selection, it has become possible to produce "savior siblings" who can serve

as cord blood or bone marrow donors to siblings with certain otherwise-fatal genetic conditions (Hashiloni-Dolev & Shkedi 2007, Sui & Sleeboom-Faulkner 2010a). In other words, selective reproductive technologies (SRTs) are not only used to prevent certain kinds of children from being born; they can also help bring specific kinds of children into the world through the selective fertilization of gametes, implantation of embryos, or abortion of fetuses.

In this review, we show how ethnographic engagement with SRTs has provided important insights into the politics, pressures, expectations, anxieties, and constraints that shape novel practices of selection in reproduction. For anthropology, the development and routinization of increasingly sophisticated biomedical technologies that aim to prevent or promote the birth of particular kinds of children raise a myriad of questions: questions about how these biomedical technologies are used, regulated, and commercialized; about how public concern and criticism have shaped their deployment; about the roles they play in personal and political deliberations and imaginings; about how individuals and couples live with and use them; about how new technologies interact with long-standing distributions of power and privilege; and about their consequences for the ways we think about individuality and collectivity, responsibility and choice.

SELECTIVE REPRODUCTIVE TECHNOLOGIES AS POLITICAL TOOLS

In modern states, childbearing is a vital political issue; attempts to control women's fertility and to regulate the size and character of populations are at the heart of state politics worldwide (Ginsburg & Rapp 1991, 1995; Browner & Sargent 2011). The twentieth century witnessed dramatic government-led interventions into human reproduction: Some countries introduced population policies aiming to restrict or enhance fertility; others pursued reproductive agendas that were overtly eugenic. Eugenics was taken to extremes in Hitler's Germany; however, throughout much of the twentieth century, ideas of better breeding proliferated across the world. While encouraging the "fit" to bear children, many governments tried to hinder the "unfit" from reproducing, performing forced sterilizations on individuals deemed incapable of or unsuitable for parenting. Anthropologists and historians have documented how

eugenic policies were designed and implemented in settings as diverse as Europe, the United States, Latin America, and East Asia (Stepan 1991, Dikötter 1998, Robertson 2002, Frühstück 2003, Broberg & Roll-Hansen 2005, Stern 2005). These studies show that in many cases eugenic practices were supported by feminists and social reformers, constituting integrated elements of social welfare policies such as those carried out by Scandinavian social democratic governments in the 1930s through the 1970s.

Contemporary policies and practices of selective reproduction are often interpreted on the background of this sinister history of worldwide eugenics (Erikson 2003, Koch 2004). Numerous anthropologists have claimed that the expanding options for reproductive selection constitute a refined version of twentieth-century eugenics: a "laissez-faire," "back door," "private," "liberal," "voluntary," "soft," "neo," or "flexible" eugenics (Duster 2003; Taussig et al. 2003; Lock 2007, 2009; Raz 2009; Gupta 2010b). Disability rights scholars have set forth sharp critiques of SRTs, arguing that these technologies entail implicit value judgments, signaling that the lives of people with disabilities are worth less than other lives. Such messages, they note, are in line with the long and unsettling history of discrimination against people with disabilities in many parts of the world (Shakespeare 1998, Parens & Asch 2000, Saxton 2006). Yet the situation is quite heterogeneous: In present-day Japan, for example, anthropologists have found, public opposition to the eugenic policies that prevailed in the twentieth century tends to delegitimize prenatal screening and testing, pushing such technologies to a "back-stage" realm of biomedical care (Ivry 2006, Kato 2010a).

Yet a key difference between past and present selective reproductive practices, many scholars have noted, is that whereas twentieth-century eugenics was led by national governments, twenty-first-century selective reproduction is most often defined as a matter of individual volition and choice (Lippman 1999a, Rapp 1999, Lock 2007, Rose 2007). To distance themselves from a eugenic past, health care authorities often emphasize reproductive self-determination, seeking to place decisions regarding whether and how to use SRTs in the hands of prospective parents themselves. This tendency has turned "nondirective counseling" into a primary principle in clinical practice in many countries: When SRTs are deployed, health care providers are expected to offer neutral information and then leave the decision making to their patients (Getz & Kirkengen

2003, Meskus 2009). This privileging of individual autonomy and choice is, however, neither consistently applied nor globally universal. Numerous studies have found that health care professionals often bend principles of nondirectiveness, finding them difficult to implement in practice (Williams et al. 2002, Schwennesen et al. 2010). The character of counseling often depends on how "neutral information" is selected, made accessible, and presented, e.g., whether references are made to support groups for parents whose children are successfully living with a given condition. An emergent literature suggests, moreover, that the dominant ethics of nondirectiveness, choice, and autonomy often coexists with an alternative, yet more subdued, ethics of care, engagement, and responsibility (Kerr 2003, Mol 2008). Ethnographic research conducted in Danish pregnancy care settings, for instance, has found that health care providers often express professional moral ideals that emphasize more active forms of care and intervention (Schwennesen & Koch 2012, p. 295); similarly, in Japanese medical worlds, health care professionals strive to take active responsibility for the well-being of antenatal care clients rather than representing themselves as "providers of information for autonomous patients who are expected to make informed decisions" (Ivry 2006, p. 461).

In some settings, such a reproductive ethos of responsibility and intervention is not only quietly practiced, but also officially pronounced. In present-day China and Vietnam, for instance, SRTs are explicitly drawn into governance as key elements in party-state efforts to enhance national population quality (*renkou suzhi* in China; *chất lượng dân số* in Vietnam) (Anagnost 1995, Greenhalgh & Winckler 2005, Gammeltoft 2007a, 2008; Leshkowich 2012). Reproductive selection is officially framed in terms of collective responsibilities and obligations, and insistent demands are placed on women to submit their pregnancies to technological surveillance for the sake of children, families, and the nation (Handwerker 2002, Sleeboom-Faulkner 2010a, Gammeltoft 2013, Zhu 2013). In some regions, SRTs are explicitly deployed as political tools, mobilized as elements in government efforts to build families, communities, and nations of particular kinds and qualities. Rather than as a matter of individual preference and choice, in these political terrains selective reproduction is represented as a collective

endeavor, as a matter of each person's belonging to larger familial and national communities.

GENDER AND KINSHIP: BUILDING FAMILIES THROUGH REPRODUCTIVE SELECTION

New technologies for reproductive selection offer people novel means to form families. To date, the most dramatic way in which these new possibilities for family formation have been taken up is through sex selection. Across the globe, the expanding use of obstetrical ultrasonography in combination with induced abortion has enabled prospective parents to select against fetuses of a given sex. Although parents in some societies strive to attain "balanced" families with an equal number of male and female children (van Balen & Inhorn 2003, Bhatia 2010), in practice, when sex selection is performed, the preference is nearly always for sons (Miller 2001, Patel 2007). In some countries, therefore---such as in China, India, and Vietnam---boys now significantly outnumber girls. Son preference is embedded in long-standing patriarchal ideologies of gender and kinship, which hold that only sons can undertake vital family functions such as the continuation of family lines, the provision of support for aging parents, and the performance of kinship rituals (Renteln 1992, Gammeltoft 1999, Croll 2000, Bharadwaj 2003). Although such gender ideologies are often challenged by people's everyday experiences (Fong 2002), these traditions remain socially pervasive and symbolically powerful in many Asian societies. The consequences of this widespread and deliberate elimination of girls for female lives, self-images, and identities remain underinvestigated, but some observers expect that the demographic masculinization occurring across Asia will be associated with deepening daughter discrimination and escalations of gender-based violence (UNFPA 2012).

The kinds of children that SRTs prevent from being born are, however, not only female children but also children with disabilities or diseases. In today's middle- and high-income societies, SRTs such as ultrasounds and genetic tests are routinely used in antenatal care, aiming---explicitly or implicitly---to build families that are free from the suffering that disability and sickness are assumed to entail. Although the selective purposes of these technologies are often downplayed in clinical care, induced abortion

remains, as Rapp (1999) observes, "the barely hidden interlocutor of all prenatal testing" (p. 129). Numerous anthropological studies have examined the decisions that pregnant women---"moral pioneers" in Rapp's idiom---confront in this new clinical landscape, investigating what compels women to either refuse or accept prenatal screening (Browner & Press 1995; Lippman 1999b; Rapp 1999; Remennick 2006; Gupta 2010a,b; Kato 2010a,b; Tsuge 2010). When women refuse, these studies indicate, they are motivated by a diversity of reasons, including fears of miscarriage or other risks to mother or child-to-be; religious beliefs; and skepticism regarding the accuracy of results or regarding technological approaches to pregnancy (Rapp 1998; Markens et al. 1999, 2010; McCoyd 2010; Ivry et al. 2011). But across all societies, ethnographic studies show, the vast majority of women are inclined to accept the new possibilities for pregnancy surveillance that they are offered. Press & Browner (1997, p. 987), for instance, found that among Californian women, new technologies for prenatal screening were relatively effortlessly absorbed "under the rubric of an older, and noncontroversial, medical practice---routine prenatal care."

A large and growing body of research has investigated the social crises that occur when prospective parents have to decide for or against continuation of the pregnancy in cases where prenatal examinations detect a fetal anomaly. When parents-to-be find themselves in this situation, ethnographic studies show, questions of care are centrally placed (Brookes 2001, Rapp & Ginsburg 2001, McCoyd 2008, Gupta 2010a, Kato 2010b). How much care will a disabled child require, prospective parents ask, and who will support them to provide this care? When a decision is made not to continue an affected pregnancy, it is usually based on the woman's or the couple's expectation that the potential child's needs for support will exceed the care that they can realistically provide (Rapp 1999, Sandelowski & Barroso 2005, Wahlberg 2009, Pilnick & Zayts 2012, Gammeltoft 2014). In their deliberations, families will often invoke expectations about what it will be like for loved ones to care for a child living with a certain disease; as such, the "serious diseases" for which pregnancy termination is advised come to be imagined as "kinds of living," not only for the affected child but also for her or his carers (Wahlberg 2009). Decisions about whether to continue a pregnancy reveal, as Rapp & Ginsburg (2001, p. 542) point out, "how close to the edge many parents feel

when they imagine the juggling of work and family obligations should disability enter an already tight domestic economy." They also reveal the moral agonizing that families who encounter "spoiled pregnancies" endure (Rothman 1998, p. 186).

Gendered moral expectations, these studies show, play prominent roles not only when SRTs are used to select against sex, but also when they are used to select against disability. Even though men too are involved in pregnancy care and parenthood (Markens et al. 2003, Hallowell et al. 2006, Ivry & Teman 2008, Reed 2009, Inhorn 2012), people across cultures tend to place the primary responsibilities for childbearing and family well-being on the shoulders of women (Inhorn 1995, Morgan 1997, Paxson 2004, Ivry 2007, Trần 2010). If a pregnancy goes awry, therefore, prospective mothers are often blamed. Their awareness of the demands that are placed on them, and the sense of obligation that this produces, seems (seem?) to play key roles in women's uptake of new technologies of pregnancy. Prenatal screening serves to "test women" as much as to test the fetus (Rapp 1999, Landsman 2009).

The availability of personal genetic information, ethnographic studies have shown, tends to reinforce this sense of reproductive responsibility, generating "burdens of genealogy" (Konrad 2003; see also Lippman 1991, Hallowell 1999, Svendsen 2006). In some settings, individuals whose family histories indicate that they may carry the disposition for a genetic disease that would have serious implications for their future health and lives, such as thalassemia, fragile X syndrome, Tay-Sachs disease, or Huntington's disease, are offered genetic carrier testing. People who are found to be at high risk of having affected children often express deep ambivalence: They want to have children, but not any children (Kelly 2009, Sui & Sleeboom-Faulkner 2010b, Raspberry & Skinner 2011). In this situation, some couples opt not to have biological children, some rely on prenatal diagnosis followed up by abortion if necessary, and some turn to PGD, hoping to produce a biologically related child who is unaffected by the condition (Franklin & Roberts 2006, Hershberger et al. 2012). Research carried out in the United Kingdom has found that the very existence of PGD places pressure on couples to use this technology: Only in this way can they live up to normative expectations regarding "normal" family building while also protecting their child against the suffering that a

severe genetic disease would entail. As a consequence, many couples feel that PGD is their "only choice" (Franklin & Roberts 2006).

But selection of prospective family members may take place even earlier than at the embryonic state at which PGD is performed: The increasing use of sperm and ova donation presents new possibilities for reproductive selection. Donor gametes are used by couples with infertility problems, single women, lesbian and gay couples, and individuals who carry genetic dispositions for severe diseases. These forms of reproductive selection, ethnographic research shows, have significant gender implications: Some studies have shown how sperm donation becomes a terrain in which masculinities are asserted or contested (Inhorn 2006, Wu 2011); others have shown how ova donation becomes the ground for enactments of relatedness and/or affirmations of female alliances (Konrad 1998, Thompson 2001, Roberts 2009). Social scientists have also explored whether prospective parents try to enhance their offspring by selecting donors who possess superior physical or intellectual qualities. Most studies conclude, however, that what people seek is resemblance and conventionality rather than perfection even when medical screening of donors is valued; when using donor gametes, parents-to-be usually strive to reproduce the values that characterize "ordinary" or "natural" families within their societies (Carmeli & Birenbaum-Carmeli 2000, Hanson 2001, Mamo 2005, Nordqvist 2012).

In sum, throughout the contemporary world, SRTs have become integral and routinized parts of family-building processes. Yet the ethnographic evidence indicates that rather than revolutionizing family relations, these technologies tend to reinforce the hierarchies and inequalities that already characterize gender and kinship arrangements. When used to select against sex, SRTs tend to affirm dominant kinship ideals, continuing long-standing practices of discrimination against women and girls; when used to select against disability, SRTs are woven into the moral expectations placed on couples to uphold conventional family ideals and norms of normality, thereby also reaffirming gender-specific reproductive responsibilities. In both cases, SRTs play critical roles in consolidating normative expectations regarding parenting and family formation.

ANXIETY AND AMBIVALENCE: SELECTIVE REPRODUCTION AS HUMAN EXPERIENCE

In a pioneering study, Rothman (1986) suggested that prenatal screening changes the experience of motherhood fundamentally, rendering pregnancies tentative and placing choice at the center of the maternal role. Through the routine offer of these technologies, Rothman argued, the hypothetical possibility of childhood disability becomes something that all pregnant women must confront. Numerous subsequent studies have documented the anxieties and ambivalences that new options for reproductive selection entail. Pregnancy has, as ethnographic studies worldwide suggest, probably always been fraught with uncertainty, a liminal passage "replete with unknown dangers and possibilities" (Rapp 1999, p. 104); however, in the current era of selective interventions, the anxieties that suffuse pregnancies seem to intensify (Browner & Press 1995, Lauritzen et al. 2007, Helén 2004). Research conducted in the United States, for instance, has pointed to the contradictory nature of prenatal ultrasounds: At the same time that they render the child-to-be "real," sonographic images also remind women that this pregnancy may come to an abrupt and unfortunate end (Taylor 2008). As experienced, therefore, prenatal screening is suffused by ambivalence: hope, joy, and anticipation merging with dread, fear, and anxiety.

In social settings where past or present experiences of violence suffuse people's day-to-day lives, pregnancy anxieties tend to be particularly intense. In Israel, for instance, prospects of reproductive disaster loom large, as a generalized "politics of threatened life" reminds people of military and existential threats to their existence (Ivry 2009). In Vietnam, too, memories of warfare shape present-day pregnancy experiences. The country's citizens are intimately familiar with unsettling images of children who have been born severely disabled and whose disabilities are assumed to stem from parental or grandparental exposure to the herbicide dioxins nicknamed "Agent Orange," which were sprayed over Vietnam during the Second Indochina War. When ultrasounds are performed, therefore, such images often form the grounds of women's imaginings of their own pregnancy outcomes (Luong 2007, Gammeltoft 2014). But even under less dramatic circumstances, prenatal screening and testing often seem to produce "iatro-

genic anxiety" (Lippman 1991), reminding people of the possibility of less fortunate pregnancy outcomes.

Particularly acute anxieties seem to surround selective reproduction in societies where sons are deemed essential to social survival and kinship continuity. In such societies, women who fail to produce male offspring place themselves at risk of social ostracism, exclusion, and violence. Because a woman's value in her own eyes as well as those of others tends to hinge on her capacity to produce at least one male heir, the social, moral, and existential risks associated with not having sons are overwhelming (Patel 2007, Khanna 2010, Trần 2010, Unnithan-Kumar 2010). Producing a son, by contrast, secures women's social belonging, helping them to achieve a socially recognized position in family and community. At issue are, as Sangren (2013) observes in the context of China, "mothers' attempts to realize in their families of procreation what was denied in their natal families: stable and enduring recognition of personhood, albeit by means of vicarious identification with sons" (p. 288). Sex-selective abortions sought by women, therefore, must be seen as efforts to attain fundamental existential security and social belonging, as struggles for social survival in societies where women's integration into family and community hinges on their fulfillment of reproductive duties.

When sex selection is undertaken, the knowledge produced by SRTs is often relatively unambiguous; the new child-to-be is categorized as either male or female. But when fetuses are screened or tested for disability, profound doubts often reign. Because the information offered by ultrasound images or genetic tests is often difficult to interpret, prenatal diagnoses are inherently ambiguous (Rapp 1999, Gammeltoft & Nguyễn 2007). Even a relatively conclusive biomedical diagnosis does not tell people what their own child would be like. Much is, therefore, left to the imagination, and in deciding how to act on the basis of a prenatal diagnosis, parents-to-be must grapple with deep uncertainties, often shadowed by old stereotypes of what a particular disability, such as Down syndrome, portends. Research conducted in Europe and North America suggests that in maneuvering within this terrain of uncertainty, pregnant women are often compelled to make very lonely and very individualized choices (Sandelowski & Jones 1996, Rapp 1999, McCoyd 2008). Studies from South and East Asia, in contrast, have found that women seem to handle the uncertainties they face by placing themselves

in the hands of others, turning choice into enactment of belonging (Gammeltoft 2007a, 2014; Gupta 2010a, Kato 2010b).

Because options for medical treatment of the fetus are limited, a prenatal diagnosis usually presents prospective parents with only two options: either to keep the pregnancy or to terminate it. Some researchers have documented how this limitation places people in a painful "therapeutic gap," not least in settings with restricted access to induced abortion (Novaes 2000, Simpson 2007); others have examined how women cope with heart-wrenching affective and bodily experiences of selective pregnancy terminations (Rapp 1999, Sandelowski & Barroso 2005, McCoyd 2009, Kato 2010b, Gammeltoft 2014). Deep ambivalence, these studies have found, lies at the heart of this experience; because these pregnancies were usually wanted, the mixed feelings---of love, grief, guilt, and relief---that often suffuse "ordinary" abortion experiences seem to intensify when selective pregnancy terminations are performed. Couples who undergo PGD will often do so exactly to avoid having to make such heart-wrenching decisions about termination. Still, as Franklin & Roberts (2006) found, considerable emotional resources are nevertheless required to get through PGD as "decreased fertility is the cost of increased genetic control" (p. 160).

In short, SRTs promise to provide new knowledge and enhanced control of reproductive processes, offering novel pathways to intervene in the making of new children. Yet as practiced and experienced, ethnographic evidence indicates, these strivings for control tend to generate new doubts and unknowns. Rather than producing a brave new world of reproductive mastery, SRTs throw their users into social worlds of contingency, ambivalence, and disorientation, worlds in which they must grapple with new and perhaps intensified reproductive anxieties and uncertainties.

ACCOUNTING FOR SELECTIVE REPRODUCTION: SCIENCE, COSMOLOGY, AND ETHICS

As shown by ethnographic studies, to gain a foothold in a particular social setting SRTs must be accounted for by those who introduce and use them (García et al. 2008, Teman et al. 2011). In taking up SRTs, people locate the medical tests, risk assessments, and

diagnoses on which these technologies rely within already existing cultural logics and cosmologies.

One such logic is that of science. SRTs are very often organized around scientific notions of heredity and transmission, and the language of counseling is often statistical. One of the most difficult tasks in genetic counseling, therefore, relates to the communication of risk. Differences between popular and scientific understandings of heredity can shape how clinicians and pregnant women communicate, as genetic counselors attempt to make scientific meanings accessible to patients who can then act upon them. Numerous studies have explored how people interpret what physicians and other counselors tell them, "turning authoritative information into their own understandings of the likelihood and meaning of having a healthy child" (Pilnick 1999, p. 266; Rapp 1995; Lippman 1999b; Svendsen 2006; Shaw 2011). Individuals make sense of scientific facts, these studies show, by placing what they convey within wider social frameworks and experiences.

The status of SRTs is also often affected by specific national histories that can be mobilized to either constrain or promote their use. In Germany, for instance, genetic counselors and obstetricians are relatively less likely to provide induced abortions when fetal abnormalities are detected in comparison with their colleagues in Israel (Hashiloni-Dolev 2006). In Israel, an idea of "the chosen body" springs from both the Zionist movement and Jewish religious tradition (Hashiloni-Dolev 2006, p. 481), whereas Germany's traumatic Nazi history has deep implications for today's ethical sensibilities in the realm of reproduction (Erikson 2003). In Japan, SRTs are only hesitantly taken up, as past eugenic practices continue to haunt today's health care provision (Ivry 2006). In Vietnam, in contrast, SRTs are eagerly embraced, partly in response to fears that the country's wartime exposure to herbicide dioxins has caused lasting genetic damage (Gammeltoft 2014).

The fact that SRTs intervene in early human life intimately links these technologies to religious forms of reasoning. Both health professionals and parents(-to-be) place new technologies of reproduction within an interpretive space where different ontologies of fetal existence and human coming-into-being compete. In countries such as Sri Lanka and Vietnam, long-standing Buddhist, Confucian, and Taoist cosmologies that define

infant integrity as a sign of cosmic harmony play significant roles in present-day uptake of SRTs (Simpson 2007, 2009; Gammeltoft 2008, 2010). In Argentina, a predominantly Catholic country, variability in definitions of human life translates into differences in actual laboratory practices; some clinics provide PGD while others refrain (Raspberry 2009).

In short, the ways in which people engage with SRTs are always socially forged through shared frameworks of meaning and institutional regulation. As medical technologies, SRTs are founded on scientific forms of reasoning, yet a nation's history, religious orientations, and dominant cultural conceptions play significant roles when accounting for SRT use. As SRTs become routinized, they also become embedded in the collective imaginings and memories of a nation just as they are made to accord with prevailing forms of ethical reasoning.

HEALTH SYSTEMS AS/AND MARKETS: COMMODIFICATION AND INEQUALITY

One of the effects of an increased medicalization and indeed molecularization of human reproduction, which has separated reproduction from sex, has been the possibility of parceling out the reproductive process. Gamete retrieval, fertilization, implantation, gestation, abortion, and birth have each become specialized fields of laboratory-clinical practice. This specialization coupled with ongoing commercialization of health care throughout the world have led to an emerging bioeconomy involving sperm banks, egg donor agencies, clinical genetics units, IVF labs, ultrasound clinics, and prenatal clinics. Because the global spread of SRTs has been taking place in a time when health sectors in many countries are being liberalized and commercialized, each field of specialization has brought with it novel prospects for selection and profit. Who can afford to resort to SRTs, and what is the quality of services received by those who seek out these technologies?

The relatively low cost of ultrasonography has ensured that prenatal screening has become the most ubiquitous form of selective reproduction globally. However, the global diffusion of prenatal screening has been uneven in terms of both availability and quality of services. In some countries, prenatal screening has been rolled out through

state-funded health-delivery systems, whereas in others couples must pay for these services out of pocket (Müller-Rockstroh 2007, Gammeltoft 2008, Schwennesen & Koch 2009, UNFPA 2011). Denmark and Finland are among the first countries in the world to implement a government-funded prenatal screening program covering all pregnant women regardless of their risk status (Schwennesen & Koch 2012). In countries such as China, India, and Vietnam, on the other hand, where national health care coverage is not universal and most services are funded through user fees, a "street corner sonography" has emerged in many cities and towns and the services are advertised on billboards and at clinic gates. The revenue provided by ultrasounds constitutes an important part of health-provider incomes, and some women are willing to pay for up to 10, if not 20, ultrasound scans per pregnancy to ensure that their fetus develops as hoped for (Gammeltoft 2007b, Khanna 2010, Zhu 2013). In her ethnography of a town in Northern India, Khanna (2010) found that ultrasound was synonymous with sex identification much more so than with prenatal diagnosis and that paying for ultrasound scans was considered a "small investment to ensure long-term prosperity and security of the family" (p. 89). In China, commercial producers of assay kits market maternal serum screening directly to both clinicians and pregnant women (Zhu 2013). In both cases, advertising points to the role of medical technologies in shaping and attaining reproductive dreams and desires. Yet, growing availability of SRTs through commercialized provision does not necessarily ensure high-quality services. Ethnographic studies have shown how provision of prenatal screening and diagnostic services in poorly resourced medical settings can intensify the uncertainties that risk assessments and prenatal diagnoses are known to generate (Gammeltoft & Nguyễn 2007, Müller-Rockstroh 2007, Khanna 2010).

Not only have SRTs themselves become commercialized over the past decades; improvements in cryopreservation techniques have meant that eggs, sperm, and embryos can be frozen and stored, enabling the establishment of procurement-storage-distribution infrastructures. In such gamete networks, selection works through the recruitment and screening procedures of sperm banks and egg donor agencies on the one hand and selection of desired traits by prospective parents on the other. Ethnographic studies of reproductive trade and travel involving donor gametes have shown how patterns of

commodification in the fertility industry have tended to reinforce structures of inequality. Almeling (2009) has shown in a study of sperm banks and egg agencies in North America that businesses explicitly seek to recruit "sellable" donors who provide "high quality" gametes to recipients (see also Mamo 2005, Inhorn 2011). University students are prime targets of recruitment campaigns; white "Ivy League" women are able to secure much higher fees for their eggs than are other students (Pollock 2003). In some countries, PGD alongside the microsorting of sperm are offered as sex-selection techniques. Costly as they are, these techniques have been marketed mostly to more affluent couples as a means to avoid having to abort a fetus of the "wrong" sex because embryos of the preferred sex are created (in the case of microsorting) or selected (through PGD) in vitro prior to implantation (van Balen & Inhorn 2003, Bhatia 2010).

In sum, as specific techniques such as ultrasound scanning, maternal serum screening, or PGD become specialized, they also become amenable to commercialization in the form of street corner sonography, marketable assay kits, or laboratory packages. Moreover, once isolated, the bodily substances that enable reproduction have become commodities, tradable across national borders and time. As a consequence, the patterns of inequality that are so visible in all forms of health care are reproduced in the realm of SRTs, affecting patterns and forms of accessibility and use as well as quality of care.

CONCLUSION

When prenatal diagnosis was first introduced, critics argued that despite the rhetorical emphasis on self-determination, selective reproductive choices would be far from free; the mere offer of technologies for prenatal screening, they claimed, is likely to push women to take up these technologies and to terminate their pregnancies if a problem is found (Lippman 1991). The ethnographic work conducted to date largely supports this criticism. Because women tend to be held responsible for child care and family welfare, and because normative expectations regarding family formation hold considerable power in most societies, anxieties regarding reproductive outcomes often run deep. At the same time, the increasing availability of SRTs has made them all but obligatory points of passage on the road to parenthood, as pregnancy surveillance has become a

routine part of prenatal care. Consequently, choices are, more often than not, experienced as obligations, whether to family members, communities, or the state.

In today's world, the accelerating use of SRTs has changed the conditions for human reproduction in fundamental ways. New technologies have brought with them new decisions and demands, confronting prospective parents with decisions about which gametes to use, which embryos to implant, and/or which fetuses to keep. Yet, however new such technologies might be, this article has shown that the social, cultural, and technological changes that they have induced are embedded in and often reinforce already-existing cultural patterns and preferences, engaging with long-standing moral sensibilities, social aspirations and biases, and political ideologies. The rapid routinization of these technologies generates processes of acculturation and adjustment as existing cosmologies and frameworks are consulted to either accommodate or reject particular reproductive possibilities. Just as technical conditions must be in place for SRTs to gain a foothold, so too must these technologies be accounted for by policy makers, clinicians, embryologists, parents, and parents-to-be. As the use of SRTs continues to spread, involving the global movement of technologies and forms of expertise, we need continued anthropological attention to the various ways that individuals and societies envision, embrace, or resist these advancing technologies.

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