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Assisted Reproductive Technologies and Culture Change

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Abstract

In 1978, the world's first "test-tube" baby was born via in vitro fertilization (IVF). The past 30 years have seen the rapid evolution of many other assisted reproductive technologies (ARTs)—some are simple variants of IVF, whereas others bridge the fields of assisted reproduction and human genomics. As ARTs have evolved over time, so have social, cultural, legal, and ethical responses to them. Indeed, ARTs are a key symbol of our times, representing the growing prominence of biotechnologies in the configuration of individual, familial, and collective identities around the globe. This review highlights the scholarship of more than 50 anthropologists who are studying the effects of ARTs in many areas of social life, including the traditional anthropological domains of kinship, marriage, and the family, gender, religion, and biomedicine. Their research bespeaks both the destabilizing and the generative impacts of ARTs at the interface between science and society.

In vitro fertilization (IVF): a technique whereby sperm and eggs are fertilized outside the body, then transferred as embryos to a woman's uterus

ARTs: assisted reproductive technologies

Intrauterine insemination (IUI) (i.e., artificial insemination): a technique whereby sperm (male partner's or donor's) are injected directly into the uterus, sometimes following sperm-sorting for sex selection

DI: donor insemination

INTRODUCTION

In 1978, the world's first "test-tube" baby—England's Louise Brown—was born via in vitro fertilization (IVF), a technique whereby sperm and eggs are retrieved from bodies, allowed to fertilize in a petri dish, and then transferred as fertilized embryos back to the woman's uterus. The past 30 years have seen the rapid evolution of many other assisted reproductive technologies (ARTs), which have evoked a variety of social, cultural, legal, and ethical responses. As we show below, assisted reproduction has diversified, globalized, and denaturalized the taken-for-granted binaries of, *inter alia*, sex/procreation, nature/culture, gift/commodity, informal/formal labor, biology/sociality, heterosexuality/homosexuality, local/global, secular/sacred, and human/nonhuman. Such challenges suggest that there is much to consider in thinking through what is "new" about these so-called new reproductive technologies.

At the present time, more than 50 anthropologists around the globe are producing a rich body of ART scholarship, which is cited in this review and comprehensive bibliography. Their work is concerned primarily with key anthropological debates surrounding kinship and gender in Euro-America. However, in recent years, ART ethnography has also flourished outside Euro-America, particularly in Israel and the Muslim countries, where anthropologists have made significant contributions to the understanding of local moral economies. With the exception of HIV/AIDS scholarship, no single topic seems to have attracted so much attention in medical anthropology, particularly over the past decade. Why are anthropologists so fascinated by the ARTs?

First, ARTs ramify in many areas of social life, including the traditional anthropological domains of kinship, marriage, and the family, religion, and biomedicine (Becker 1990, Franklin 2006a, Franklin & Ragoné 1998). As Rapp (2001) has also noted, the feminist anthropological concern with gender and the body has "dragged" reproduction, including assisted

reproduction, into the center of social theory in anthropology. Second, the ARTs might be described as "mutating technologies": Namely, emerging variants of older technological forms have led to significant new practices, new dilemmas, and new realms of anthropological research. In short, technological innovation has led to anthropological proliferation. Finally, the concern with ARTs at this particular historical juncture signifies medical anthropology's millennial intersection with science and technology studies (STS) (Inhorn 2006a, 2007a) and the development of a newer generation of anthropological scholars who are well versed in STS perspectives. Indeed, ARTs provide a key lens through which to view the relationship between science and society.

Given this medical anthropology–STS nexus, our broad theoretical assumption in this article is that technologies are socio-technical products, which are shaped by human and non-human factors, including the technical features of the ARTs themselves, as well as by the economic, political, cultural, and moral environs in which they unfold. This assumption implies that technologies are deeply culturally embedded, intimately linked with power relations, and eventually accepted by professionals and potential recipients only when perceived as reasonable in the context of existing social relations, cultural norms, and knowledge systems (Webster 2002). Within this general perspective, society/technology relations become both pivotal and mutually constitutive, with each being at once a source and a consequence of the other (Ong & Collier 2005). By situating technologies within networks of power/knowledge, as well as the surrounding cultural and social order, we can begin to unpack the multifaceted repercussions and cultural transformations currently being induced by ARTs around the world.

GLOBALIZATION AND INEQUALITIES

ARTs were initially developed to overcome intractable infertility—i.e., intrauterine insemination (IUI) and donor insemination (DI) for

cases of male infertility and in vitro fertilization (IVF) for infertile women with blocked fallopian tubes. It is always important to keep the problem of infertility in clear view when discussing ARTs. Infertility affects more than 15% of all reproductive-aged couples worldwide at some point in their lives (Vayena et al. 2002). The scope and gravity of the infertility problem is much more severe in the non-Western world, owing largely to the problem of untreated reproductive tract infections (RTIs) (Bentley & Mascie-Taylor 2000; Brady 2003; Inhorn 2003a,b; Nachtigall 2006; Van Balen & Inhorn 2002). Infertility affects ~80 million women and men worldwide (Vayena et al. 2002), with the highest prevalence being in central and southern Africa, where the presence of an “Infertility Belt” has been repeatedly reaffirmed in cross-national studies (Feldman-Savelsberg 2002, Leonard 2002a, Van Balen & Inhorn 2002). Unfortunately, effective infertility treatments and ARTs are generally inaccessible in these poor and mostly rural nations, leading to a grim scenario of untreated and intractable infertility across large portions of the non-Western world (Bhatti et al. 1999, Leonard 2002b, Nahar et al. 2000, Richards 2002, Sundby 2002, Unisa 1999, Van Balen & Gerrits 2001). The nonexistence of IVF and other ARTs in these countries is often rationalized in terms of population control, scarcity of health care resources, and the heavy burden of other life-threatening diseases such as HIV/AIDS and maternal mortality (Macklin 1995, Okonofua 1996). Although these concerns raise major questions about prioritizing infertility as a global reproductive health problem (Inhorn 2003b), the silence surrounding infertility in resource-poor countries may also reflect a tacit eugenic view that the infertile poor are unworthy of treatment; thus, overcoming their infertility problems, including through provision of ARTs, contradicts Western interests in global population control (Greenhalgh 1995).

Nonetheless, studies consistently show that the social consequences of infertility in non-Western countries lead to profound human

suffering, particularly on the part of women (Boerma & Mgalla 2001, Feldman-Savelsberg 1999, Hollos 2003, Pearce 1999). Strong pronatalist norms frequently translate into blaming women for reproductive failure, to the point of divorce and social ostracism in some cases (Inhorn 1994, 1996; Inhorn & Bharadwaj 2007). Life-long childlessness also implies severe difficulties in achieving old-age security in a majority of countries that lack strong social safety nets (Inhorn 2000, Inhorn & Van Balen 2002). Thus, the provision of ARTs to infertile women in pronatalist settings may lead to social empowerment and the alleviation of gender-based suffering and violence.

Even in the Western world, access to ARTs reflects pronounced class- and race-based inequalities (Inhorn et al. 2008, Spar 2006). In the United States, relatively few states mandate full or even partial insurance coverage for ARTs, meaning that infertile American couples must pay for ARTs out of pocket, at the average cost of \$12,400 per IVF cycle as of 2003 (Spar 2006). As a result, only 36% of infertile women in the United States seek any form of medical assistance, and only 1% resort to any form of ART (Spar 2006). Low-income ethnic minority populations, be they African American (Ceballos 1999), Latino (Becker et al. 2006, Nachtigall et al. 2009), Native American (Quiroga 2007), Arab American (Inhorn & Fakih 2006), or South Asian (Culley et al. 2006, Culley & Hudson 2005/2006), may be unable to access these technologies. All Western health care systems—both public and private—set restrictive eligibility criteria that limit consumers’ access, despite some state subsidization in most of the countries of Western Europe (Melhuus 2005, Vanderlinden 2009, Yebey 2000).

The financial burden of ARTs is even heavier in non-Western countries, where state subsidization rarely exists (Inhorn 2001, Nachtigall 2006). ARTs provide a prime example of stratified reproduction (Colen 1995, Ginsburg & Rapp 1995): Namely, technologically assisted reproduction is largely restricted to global elites, whereas the infertile poor, who are at highest risk of infertility, are devalued

and even despised as reproducers (Inhorn 2003a, Spar 2006). Numerous “arenas of constraint,” or structural, ideological, and practical obstacles and apprehensions, serve to limit access to these technologies (Inhorn 2003a–c). Nonetheless, ART services are gradually reaching larger populations in some non-Western countries. Anthropologists have documented the globalization of ARTs to China (Handwerker 2002), Ecuador (Roberts 2006), Egypt (Inhorn 1994; 2002a,b; 2003a,b), India (Bharadwaj 2000, Gupta 2006), Iran (Tremayne 2006), Lebanon (Clarke 2007, Inhorn 2007a), Mali (Horbst 2006), and Vietnam (Pashigian 2009).

By ethnographic interrogation of the varied reception and practice of ARTs in these diverse non-Western settings, anthropologists have elucidated some of the cross-cultural similarities as well as differences that arise when a technology travels along multiple pathways and trajectories. The transformations and innovations that ARTs undergo in their global travel enable us to test our assumptions about biotechnological Eurocentrism, namely, that technologies always develop in the West then travel elsewhere (Birenbaum-Carmeli & Inhorn 2009). Although controversial, the first IVF pregnancies were actually reported in India (Bharadwaj 2000, 2002), with China, Russia, Israel, and Australia also playing leading roles in ART development. In non-Western settings such as Egypt, located on the “receiving” end of ART globalization (Inhorn 2003a,b), ARTs may translate into a collective symbol of the technological know-how shared by the advanced, wealthy nations of the world. By providing and deploying ARTs, both practitioners and consumers in non-Western countries may come to pride themselves on keeping pace with the “modern,” industrialized world (Blyth & Landau 2004). In this sense, then, ARTs not only reflect, but contribute to, the construction of global power relations and new notions of local modernity (Bharadwaj 2006a, Kanaanah 2002, Paxson 2006, Raspberry 2009, Roberts 2008, Tremayne 2006).

GENDER, EMBODIMENT, AND SUBJECTIVITIES

Among those who are able to access ARTs, gender identities are often deeply implicated in the process of ART utilization (Becker & Nachtigall 1994, Haelyon 2006, Inhorn 2002a, Nachtigall et al. 1992, Throsby 2004). ARTs themselves are gendered technologies, with highly specific and differentiated applications on men’s and women’s bodies (Konrad 1998). Generally speaking, ARTs are applied more invasively to women’s bodies, for example, by inducing superovulation with powerful oral and injectable hormones and in invasive procedures to harvest oocytes and transfer embryos back to the uterus. The enactment of ARTs on the female body may facilitate the mistaken view that women bear the responsibility for reproductive problems (Inhorn 2003a, Van Balen & Inhorn 2002). As an unintended consequence, the very existence of ARTs may serve to reinforce cultural “motherhood mandates” for women in many societies, mandates that have been challenged by generations of Western feminist scholars (Thompson 2002).

Women’s heightened embodiment of ARTs also manifests in men being treated as “the second sex” in ART practices and discourses (Inhorn et al. 2009) despite the fact that more than half of all infertility cases around the world involve a so-called male factor (Inhorn 2003d, 2004; Vayena et al. 2002). Although their experience is marginalized, infertile men also experience embodied suffering via powerful hormonal medications and genital surgeries (Inhorn 2007b,c). Furthermore, the precisely timed collection of semen—“man’s most precious fluid” (Moore 2007)—can produce deep anxiety and even impotence but is imperative for all ART procedures (Inhorn 2002b, 2007b). Occasionally, sperm are extracted surgically from the testicles (Inhorn 2007b,c) or posthumously from dead men’s bodies (Simpson 2001), creating physical discomforts and ethical concerns. In some cultural contexts and circumstances, the uses of ARTs may entirely marginalize men in the reproductive

process, configuring an exclusively female fertility domain, wherein problems are not only detected but also resolved within a female network, supported by female relationships and resources (Birenbaum-Carmeli et al. 1995, Goldberg 2009, Roberts 2009).

In most societies, male infertility remains deeply hidden because of its conflation with impotency and emasculation (Birenbaum-Carmeli et al. 2000, Carmeli & Birenbaum-Carmeli 2000, Tjørnhøj-Thomsen 2009, Upton 2002). Until the early 1990s, the only solution to severe male-factor infertility was DI—the oldest of the “new” reproductive technologies, but one still shrouded in secrecy and stigma (Becker 2002; Becker et al. 2005; Bharadwaj 2003; Birenbaum-Carmeli & Carmeli 2002a,b; Grace et al. 2007; Hanson 2001; MacDougall et al. 2007; Nachtigall et al. 1997, 1998). The introduction of intracytoplasmic sperm injection (ICSI) in Belgium in 1992 has created new possibilities for infertile men and supplanted DI to some degree. Designed to overcome male infertility through micromanipulation and injection of “weak” spermatozoa directly into oocytes under a high-powered microscope, ICSI has led to the birth of biological offspring to thousands of infertile men who would never before have fathered their genetic children (La Rochebrochard 2003). The coming of this new “hope technology” (Franklin 1997) has repaired masculinity in men who were once silently suffering from their infertility (Inhorn 2003a, 2004). However, ICSI also has other important gender effects, not always beneficial, suggesting that ARTs have the potential to destabilize a given society’s gender order. Whereas the fecundity of older men can often be enhanced through ICSI, women’s fertility is highly age sensitive, often requiring donor eggs at later stages of the reproductive life cycle (Friese et al. 2006, 2008). ART-induced time may thus become a thoroughly gendered problematic in some societies, giving new powers to men (including divorce of once-fertile wives) and creating new feelings of stigma among aging women (Inhorn 2003a, 2005). Thus,

another effect of the ARTs is the enhancement of gendered notions of time and life-course disruption (Becker 1994, 1997; Friese et al. 2006, 2008; Kirkman 2003).

At the same time, gender scripts surrounding conjugality are also being reworked in complex ways as ARTs reach wider audiences. The very growth of a global ART industry, including in “seats of patriarchy” (Ghousoub & Sinclair-Webb 2000), bespeaks the love, companionate marriage, and financial commitments of spouses around the globe (Inhorn 2007d, Inhorn & Bharadwaj 2007). Increasingly, couples are staying in long-term childless marriages while trying repeated cycles of ARTs (Inhorn 2003a, Birenbaum-Carmeli & Dirnfeld 2007). Although ART success rates have improved over time—leading to the birth of five million test-tube babies—only ~27% of all IVF cycles result in a live birth, even in the technologically advanced United States (Spar 2006). Most couples, therefore, experience the “emotional rollercoaster” and “never enough” quality of repeated but unsuccessful ART cycles (Franklin 1997; Sandelowski 1991, 1993). Becker (2000) has captured most vividly the discourses of hope and despair among infertile American couples in their pursuit of what she calls “the elusive embryo.” Thompson (1996, 2005), meanwhile, has unpacked the complex “ontological choreography” required to make a viable embryo. To do so, numerous actors (e.g., physicians, nurses, patients) must enact a complex choreography of precisely timed biological actions (e.g., injections of hormones, ejaculation of sperm, cryopreservation of gametes) in the IVF clinic. According to Thompson, this choreography increasingly includes the “strategic naturalization” of so-called third parties—gestational surrogates and gamete donors—whose contributions to the world of ARTs and new forms of kinship have piqued the anthropological imagination.

NEW KINSHIP STUDIES

Of all the anthropological work that has been written about ARTs, the most substantial and

Intracytoplasmic sperm injection

(ICSI): variant of IVF that overcomes male infertility by micromanipulation and injection of “weak” sperm directly into oocytes under a high-powered microscope

Cryopreservation:

long-term freezing of sperm, embryos, and ova, as well as human ovaries for later use in postmenopausal women and cancer survivors

Surrogacy: the use of third parties to gestate the fetuses of both heterosexual and single-sex couples

most foundational, in some sense, is that which explores the effects of these technologies on kinship and notions of family. Strathern's book, *Reproducing the Future: Anthropology, Kinship, and the New Reproductive Technologies* (1992a), paved the way for the new anthropology of kinship (Carsten 2004, 2007; Edwards et al. 1999; Franklin & McKinnon 2001; Strathern 1992b) and stimulated burgeoning interest among anthropologists of reproduction in how ARTs might redefine and expand notions of relatedness (Bonaccorso 2008, Clarke 2007a, Edwards 2000, Franklin 1997, Konrad 2005, Thompson 2005).

Strathern's major contribution was to question how ARTs might denaturalize and therefore blur the so-called nature/culture intersection: Namely, if kinship, as a set of social relations, is seen to be rooted in the natural facts of biological reproduction, then the nature of kinship itself might be called into question by ARTs, which, in effect, destabilize the biological within parenthood through the assistance of technologies and third parties. As noted by Strathern (1992a, pp. 27–28), ARTs have created “a new convention, the distinction between social and biological parenting, out of an old one, kinship as the social construction of natural facts.” This early insight by Strathern served to spur a wide range of empirical research on ARTs and kinship in Euro-America (Bonaccorso 2008, Edwards 2000, Edwards et al. 1999, Franklin 1997, Franklin & Ragoné 1998, Harrington et al. 2008, Konrad 2005, Melhuus 2007, Ragoné 1994, Thompson 2005), as well as in various non-Western societies where kinship is probably even more central to social organization (Clarke 2006a,b, 2007a,b, 2008; Inhorn 2006a,b; Kahn 2000; Roberts 2009; Tremayne 2009).

What are some of the major findings of this large body of work? First, given that Euro-American notions of kinship are biogenetically based (Schneider 1980), many infertile couples now “chase the blood tie” (Ragoné 1996) in a relentless quest to produce biogenetically related offspring through the ART-assisted manipulation of their own gametes (Becker

2000, Franklin 1997, Inhorn 2003a, Ragoné 1994). Indeed, the very presence of ARTs has served to marginalize, to some degree, alternate means of family formation through adoption (Bharadwaj 2003, Birenbaum-Carmeli & Carmeli 2009, Storrow 2006), once regarded in Euro-America as the “natural solution” to infertility (Becker 2000, Carsten 2000).

Second, ARTs have pluralized notions of relatedness and led to a more dynamic notion of “kinning” (Howell 2006), namely, kinship as a process, as something under construction, rather than a natural given (Carsten 2004, 2007; Strathern 2005). In fact, ARTs can be thought of as deconstructive in introducing ambiguity and uncertainty into kinship relations, including the fundamental categories of motherhood and fatherhood (Collard & de Parseval 2007). As ARTs are applied to an ever-expanding range of people and problems, they are unseating core notions of kinship and undermining the traditional family by introducing a whole range of quasi-, semi-, or pseudobiological forms of parenting (Franklin & Ragoné 1998; Thompson 2001, 2005).

Surrogacy, for example, threatens dominant Western ideologies that presume an indissoluble mother-child bond (Baslington 1996, Birenbaum-Carmeli 2007, Markens 2007, Ragoné 1994), gradually deconstructing motherhood into genetic, birth, adoptive, and surrogate maternities, with the potential for three “biological” mothers to a single child (Sandelowski 1993, Thompson 1998). The “hybridized fusion” of the surrogate with the intended mother that is introduced by surrogacy can create alliances between women (Teman 2003a,b), as well as hierarchies, especially when gestational surrogates come from different ethnic and class backgrounds than do the intended parents (Ragoné 2000). Furthermore, the raft of antisurrogacy legislation around the world, as well as the many court cases, bespeak the societal discomfort with the very notion of maternal multiplicity (Baslington 1996, Birenbaum-Carmeli 2007, Collard & de Parseval 2007, Pashigian 2009, Weisberg 2005).

ARTs are also unseating traditional notions of heterosexual parenthood by creating previously inconceivable offspring for single-sex couples (Agigian 2004, Cadoret 2008, Kahn 2000, Mamo 2007). The introduction of ARTs—particularly donor insemination for lesbians and gestational surrogacy for gay men—has led to the “queering of reproduction” in the United States (Mamo 2007), with specialty clinics and Web sites designed to assist would-be gay parents, as well as nonmarried couples and single women and men (Spar 2006). Nonetheless, antigay ART legislation, even in the most “progressive” countries (e.g., Denmark; Bryld 2001), serves as a potent reminder of these technologies’ subversive effects on social norms, as well as states’ ability to channel governmentality in conservative directions through legislation (Franklin 1997, Melhuus 2005, Ong & Collier 2005).

Furthermore, gamete and embryo donations—in which one or more third parties transmit genetic material to a resulting child—have led to a variety of interesting consequences (Collard & de Parseval 2007, Konrad 2005, Spilker & Lie 2007). Sperm donation, which is undertaken anonymously in most cases, has led to an increase in secretive family space (Becker 2002, Birenbaum-Carmeli et al. 2000) in a variety of ways: (a) Most donors prefer to remain anonymous (although laws now mandate the disclosure of donor identity in some countries such as Sweden, the United Kingdom, and Australia); (b) most infertile men base their donor selection on purported physiognomy to create family resemblances; (c) most infertile men, feeling emasculated by their condition, prefer to hide from family and friends their use of donor sperm; (d) many parents who have used donor sperm decide not to disclose this information to the resulting child; and (e) finally, many parents engage in “resemblance talk” to mask the child’s origins (Becker 2002; Becker et al. 2005; Birenbaum-Carmeli & Carmeli 2002a,b; Birenbaum-Carmeli et al. 2000; Nachtigall et al. 1997, 1998).

Egg donation, on the other hand, has created kin-like female alliances, including those among actual kin (e.g., sisters) who donate their ova to relatives (Roberts 2009, Tremayne 2009) as well as those among unrelated women who “share” their ova with other women in infertility clinics or “donate” them for a fee (Bonaccorso 2008, Edwards 2000, Konrad 2005). Ova donation in particular invokes the notion of altruistic “gift exchange” (Konrad 2005), even though ova are increasingly sold on the market for up to \$50,000 (Almeling 2007, Spar 2006). As with surrogacy, ova donation has produced new forms of labor among reproductive “assistors,” who, in this case, undergo risky forms of hormonal stimulation and egg harvesting (Pollock 2003). Concerns over the potential harm of such bodily commodification are mounting, given the newly recognized category of the “traveling foreign egg donor,” who seeks economic mobility through the sale of her body parts (Heng 2007; Storrow 2005a,b). Indeed, legal scholars are beginning to worry that significant “reproductive tourism” between countries involves the search for human gametes in countries with relaxed legal and regulatory environments (Blyth & Farrand 2005; Deech 2003; Jones 2008; Jones & Keith 2006; Pennings 2002; Spar 2005; Storrow 2005a,b). Anthropologists are beginning to confirm that these concerns are warranted because infertile couples travel from countries where gamete donation is outlawed (including in “progressive” countries such as Norway) to those where it is available (including in “traditional” countries such as Lebanon and Iran), usually for hefty fees (Clarke 2007a,b, 2008; Inhorn 2009; Melhuus 2003, 2006, 2008; Nahman 2006).

MORAL ECONOMIES AND EMBRYO ETHICS

The processes of assisted reproduction described above introduce ever more problematic global and local divisions (Spilker & Lie 2007, Thompson 2008a), threatening to augment domestic and transnational disparities and

Third-party

donation: the use of embryos and gametes (sperm and ova) from third parties, including for assisted conception among single-sex couples

perpetuate social injustice (Deech 2003). Multiple sets of inequalities surface in the practice of assisted reproduction, reflecting intersecting oppressions based on gender, race, class, and nationality (Quiroga 2007, Thompson 2008a). For example, poor minority women in some countries are being “recruited” (some would say “coerced”) as gestational surrogates, similar in some ways to their domestic servitude as low-paid maids and nannies (Ragoné 2000). Similarly, racially preferential “white” women from the economically dislocated post-Soviet societies are being recruited as egg donors for affluent Western European and Israeli couples (Nahman 2006), a form of reproductive “trafficking” that is being compared with sex tourism (Storror 2006).

ARTs and the bodily commodification that has accompanied them bring into sharp relief the moral economies surrounding reproductive technoscience that may serve to exacerbate transnational inequalities and challenge, even rupture, local legal, religious, and ethical orders (Bharadwaj 2006a,b; Gupta 2006; Inhorn 2003a). As ARTs have made their way around the globe, they have often invoked fervent ethical and legal debates (Hudson et al. 2008, Kitzinger & Williams 2005, Macklin 1995, Melhuus 2005, Tsuge 2005), debates that are deeply embedded within particular “local moral worlds” of religion and culture (Kleinman 1995, Thompson 2006). In the Western countries, religion-science rifts are normally addressed in plurivocal public debates, while leaving a moral vacuum to be filled by ethicists and lawyers. For example, the ART industry in the United States is often described as “The Wild West,” with little if any regulation and a profession that is largely free market regulated and profit driven (Spar 2006). In the United States, any federal foray into ARTs would probably fall prey to the intense politics of abortion (Morgan & Michaels 1999, Nachtigall et al. 2005, Spar 2006). As a result, cases of ART negligence and abuse are handled in the legal system, with the courts forced to chart new legal terrain (Blyth & Landau 2004). A different model is the United Kingdom’s government-

commissioned Warnock Committee, which has tackled the thorny ethical issues surrounding ARTs and has been very influential throughout Europe (Franklin 1997, Hudson et al. 2008).

Outside of Euro-America, religion may impact the practices of assisted reproduction more directly. For example, across the Sunni Muslim world, gamete donation and surrogacy have been religiously prohibited (Culley 2006; Culley & Hudson 2008; Inhorn 2003a, 2006b,d,e; Zuhur 1992), although minority Shia *fatwas* (religious decrees) issued by leading clerics in Iran and Lebanon have opened the door to third-party donation in these two Middle Eastern countries (Abbasi-Shavazi et al. 2008; Clarke 2006a,b, 2007a,b, 2008; Inhorn 2006b,c; Tremayne 2006, 2009). By contrast, in neighboring Israel, all attempts to restrict ART provision have failed in both court and Parliament, where, in the name of the Biblical commandment to “be fruitful and multiply,” permissive treatment options have consistently outweighed opposing voices (Shalev & Gooldin 2006). Only in Israel is IVF almost completely state subsidized (Birenbaum-Carmeli 2004, Kahn 2000, Rabinerson et al. 2002), even for Palestinian citizens of Israel (Inhorn & Birenbaum-Carmeli 2009, Kanaaneh 2002). Israeli society is ardently pronatalist, with ARTs viewed as a way to reproduce the nation through the birth of Jewish babies. The religious emphasis on procreation, plus the fear of being outnumbered by non-Jews on Israeli soil (Kanaaneh 2002), has served to promote one of the most aggressive and proactive ART regimes in the world, in which single and lesbian women, surrogates, gamete donors, and recipients all participate in the ontological choreography of making Jewish babies in Israeli IVF clinics (Birenbaum-Carmeli & Carmeli 2009; Goldberg 2009; Haelyon 2006; Kahn 2000, 2009; Nahman 2008, Prainsack 2006, 2007; Seeman 2009). Halakhic (rabbinical) law has shown remarkable flexibility in accommodating technologies such as sperm donation, interpreting them in ways that are consistent with religious views of kinship and family formation,

even in ultraorthodox communities (Kahn 2000, 2002, 2006).

Similarly pronounced, albeit in the opposite direction, is the Roman Catholic Church, which denounces all forms of assisted reproduction, as evident in anti-ART legislation in Catholic countries such as Costa Rica, Ireland, and Italy (Bonaccorso 2004a,b; 2008). However, despite the Vatican's ban on ARTs, IVF and related technologies are widely practiced in most Catholic countries around the world, including the nations of Latin America (Raspberry 2009; Roberts 2008, 2009). However, IVF practitioners there are particularly cautious about embryo disposition because the Vatican's discomfort with ARTs centers on the perceived status of the embryo as a human life (Raspberry 2009; Roberts 2006, 2007). With most ARTs, embryos are created outside the human body, without the requirement of sexual intercourse; they are returned to a woman's uterus two to five days following fertilization. During this process, embryos may be manipulated, tested, frozen, discarded, used for research, or utilized in the manufacture of human embryonic stem cells (hESCs) (Bharadwaj 2005, 2007, 2009a; Franklin 2006b; Ganchoff 2004; Kroner et al. 2006; Roberts & Throsby 2007). In terms of embryo ethics, pressing questions include, When does life begin—namely, does an embryo constitute a human life (James 2000, Morgan & Michaels 1999)? Should embryos be transferred to or “adopted” by other nonrelated infertile couples (Nachtigall et al. 2005, Tremayne 2009)? Are all embryos created equal, or can/should some be culled before embryo transfer for the purposes of research, disposal, or stem cell manufacture (Nachtigall et al. 2005)? These questions are beginning to be studied in earnest by anthropologists, particularly in the new era of so-called reproductive genetics (Franklin 2007, Franklin & Roberts 2006, Hashiloni-Dolev 2007, Hashiloni-Dolev & Shkedi 2007, Roberts & Throsby 2007, Williams et al. 2007).

At the same time that IVF and gamete donation practices were evolving in laboratories in the West, genetic tests were being developed

to detect heritable diseases in ART-created human embryos. Preimplantation genetic diagnosis (PGD) is a screening test that can detect genetic abnormalities in IVF- or ICSI-created embryos outside the woman's body, thus enabling implantation of only mutation-free embryos (Franklin & Roberts 2006, Kroner et al. 2006). Initially developed to screen for rare but life-threatening genetic illnesses, such as cystic fibrosis or Tay-Sachs disease in high-risk families, the application of PGD is currently expanding (Remennick 2006, Williams et al. 2007). PGD is now used for sex selection—either to ensure so-called family balancing among couples with existing children or to guarantee male offspring in areas of the world characterized by son preference (Lock 2009, Van Balen & Inhorn 2003). In some IVF clinics in the West, PGD is also used as a routine screening measure for couples with severe male-factor infertility (of a potentially heritable origin) and among women with so-called advanced maternal age (AMA) whose IVF outcomes may be improved through embryo screening (for aneuploidy reduction) (Franklin & Roberts 2006, Williams et al. 2007). In addition, PGD is being used to select for genetically matching embryos who will grow up to donate cord blood or bone marrow to save an older ailing sibling (Franklin & Roberts 2006, Hashiloni-Dolev & Shkedi 2007).

Unsurprisingly, PGD has spawned a bevy of ethical concerns surrounding the sanctity of life in its very early stages, the culling and disposal of female embryos, the right to life of the genetically impaired, and the creation of so-called “designer” babies (Franklin & Roberts 2006, Lock 2008, Van Balen & Inhorn 2002). Moreover, PGD has played a pivotal role in relation to other controversial technologies—cloning and human embryonic stem cells—by providing the first bridge between assisted conception and clinical genetics (Bowring 2004, Franklin 2007, Franklin & Roberts 2006). Indeed, the ability to reprogram cell development is at the heart of both cloning and stem cell technology (Franklin 2006b, Kitzinger & Williams 2005, Prainsack & Spector 2006). By now, IVF,

Human embryonic stem cells (hESCs):

cells derived from excess embryos and used for research into future therapeutic interventions

Preimplantation genetic diagnosis (PGD):

a technique used to screen IVF embryos for genetic defects, sex selection, and, potentially, certain “designer” traits

AMA: advanced maternal age

Cloning: asexual, autonomous reproduction of animals (e.g., Dolly, the sheep) and potentially humans

PGD, and embryonic stem cell research have become so inextricable that it is virtually impossible to debate any one technology separately (Franklin & Roberts 2006, Thompson 2008b).

In the IVF-hESC encounter, infertile couples must decide whether to “donate” their spare embryos for stem cell research (Bharadwaj 2005, 2008, 2009a,b; Roberts & Throsby 2007), thereby “trans-substantiating” their embryo from being their own to becoming an anonymous, publicly owned, human embryonic cell line and part of a shared, collective commitment to scientific progress (Franklin 2006b). In the United States, embryo disposition decisions (i.e., to discard or to donate to other infertile couples or to stem cell research) appear to be emotionally significant for couples and are frequently unresolved (Nachtigall et al. 2005; see also Britt & Evans 2007 on multifetal pregnancy reduction decisions). In India, however, such donations are seen as an act of altruism (Bharadwaj 2009a), a willingness that has helped place India at the forefront of the global stem cell industry (Bharadwaj & Glasner 2008). Currently, India provides the West with generous supplies of hESC materials—a global outsourcing that has resulted from American abortion politics and restrictions on, and short-

age of, hESC materials in Europe. Whereas the Indian state is a major promoter of this biotechnology, it does not fully regulate stem cell research, thus exposing Indians, mostly women, to the potential for gender-based exploitation (Bharadwaj 2005, 2008, 2009a,b; Bharadwaj & Glasner 2008).

CONCLUSION

As seen in the many examples in this article, ARTs are a key symbol of our times, representing the growing prominence of biotechnologies in the configuration of individual, familial, and collective identities. ARTs are clearly prompting transformations in many domains of culture. As such, ARTs provide an illuminating lens through which to examine contemporary social relations during a very fluid, complex epoch. Indeed, the burgeoning corpus of theoretical and empirical research being produced by anthropologists bespeaks the centrality of ARTs at the science-society interface. As ARTs continue to evolve in the new millennium, a central goal of our discipline should be to follow these technologies into the future, elucidating their destabilizing and generative impacts as they make their way around the globe.

FUTURE ISSUES

1. Embryo disposition, or the decisions couples make regarding their excess embryos, is a critical issue for future study. This is particularly true in countries with abortion restrictions and in those where large numbers of excess embryos are frozen in IVF laboratories.
2. Multifetal pregnancy reduction, a form of selective abortion undertaken in high-order (i.e., triplets and beyond) ART-assisted pregnancies, is an especially critical issue in the non-Western world, where up to six embryos may be returned to a woman's uterus to increase IVF success rates. High-order, high-risk ART pregnancies themselves require further investigation.
3. Male infertility and the use of ICSI are poorly studied, but are especially significant in pronatalist societies where male infertility may impinge significantly on manhood. Male infertility may be especially prominent as a genetic disorder in societies where consanguineous (i.e., cousin) marriage is practiced.

4. Postmenopausal pregnancies are increasing among women older than 50, who achieve IVF pregnancies through hormonal assistance and the use of donor eggs. The ramifications of ART-assisted parenthood among older women (and men) require further study.
5. Pregnancy loss, which is a frequent occurrence in ART-assisted pregnancies, especially among older women, can be particularly devastating, given the financial and emotional investments in the ART pregnancy. However, little is known about the impact of pregnancy loss following ARTs.
6. Preimplantation genetic diagnosis is increasingly employed in non-Western countries, where it may be used for the purpose of sex selection in societies characterized by son preference. Sex-selective PGD is an important topic of future scholarship.
7. Reproductive tourism (a.k.a. fertility tourism) is the movement of infertile individuals, couples, reproductive “assistors,” and their gametes across national borders in search of conception (or, in the case of assistors, in search of financial compensation). Reproductive tourism is a burgeoning form of medical tourism, which requires additional study.
8. Stem cell research occurs through the donation of excess IVF embryos in some countries. The relationship between the IVF and stem cell industries requires investigation around the world.
9. Issues of ART access are still of paramount concern for infertile couples in most resource-poor societies around the world. This is especially true in sub-Saharan Africa, where rates of infertility are highest but ARTs are not widely available. ARTs in Africa should be studied as they emerge in the context of the HIV/AIDS epidemic.
10. ART access may be restricted among minority populations (be they racial, ethnic, or religious minorities) within dominant societies. Minority experiences of infertility and ART access are topics for future research on health disparities within Euro-American settings.
11. Further study on religion and ARTs is recommended. Attitudes toward ARTs in Catholic, Jewish, Muslim, and Hindu countries have been relatively well studied by anthropologists. But more research is needed for other religious traditions, including Protestant, Evangelical, and Orthodox Christianity and various forms of Buddhism.
12. The ART “industry” is a complex world involving, among others, scientists, medical professionals, pharmaceutical industries, sperm banks, surrogacy agencies, egg brokers, and others. The components of this complex social world should be studied ethnographically. The industry as a whole is a rich site for future investigation by science and technology scholars.

DISCLOSURE STATEMENT

The authors are not aware of any biases that might be perceived as affecting the objectivity of this review.

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