

## SON PREFERENCE, SEX SELECTION, AND THE “NEW” NEW REPRODUCTIVE TECHNOLOGIES

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Throughout recorded history, humans have tried to influence the sex of their offspring, through pregnancy injunctions, infanticide, and infant/child neglect. Reproductive technologies developed in the late 20th century allow determination of the sex of the offspring during pregnancy, making “sex selection” through abortion possible. Especially in parts of East and South Asia, sex selection *against* female fetuses has had dramatic consequences for male/female sex ratios. However, “newer” new reproductive technologies, such as prenatal genetic diagnosis and DNA-weighted semen selection, can now be applied for sex selection; eventually, the latter technology may become easily accessible as a noninvasive method. The prospects of these new technologies for sex selection must be considered in the light of cultural values surrounding son preference / daughter discrimination in many parts of the world, most notably Asia, as well as preferences for a “gender-balanced” family in much of the West. The ethical issues surrounding these technologies, such as the right to life and the equal treatment of female children, are potentially profound, but legislating the appropriate use of these “newest” new reproductive technologies will be difficult.

Since the beginning of recorded history, human beings have tried to influence the sex of their offspring, and the ways in which they have done so have varied considerably. For example, before fertilization, intercourse may be attempted on special days, in special ways, with special ablutions. During pregnancy, certain foods may be eaten or avoided. After birth, conscious infanticide or less conscious infant neglect may be practiced to influence the gender composition of the family.

Since the last quarter of the 20th century, however, with the dawning of the “new reproductive technology” era, new and efficient technologies have become available to both facilitate conception and determine the sex of the fetus. Among couples unable to conceive, these new technologies include intrauterine insemination (with husband’s or donor sperm), in vitro fertilization (IVF), intracytoplasmic

sperm injection for cases of male infertility, oocyte donation followed by IVF or intracytoplasmic sperm injection, and both gestational and full surrogacy. Among both infertile and fertile couples, new diagnostic and screening technologies used during pregnancy—including ultrasound, amniocentesis, chorionic villus sampling, and maternal serum screening to detect abnormalities—are routinely used in many Western and non-Western settings, in part to determine the sex of the developing fetus. However, even “newer” new reproductive technologies—including pre-implantation genetic diagnosis and DNA-weighted semen separation to “sort” X- and Y-bearing sperm, both of which methods are situated at the interface of conceptive and diagnostic techniques—have become available for the purposes of sex selection. Thus, it is now possible to choose to become pregnant with a son or daughter, or to allow a pregnancy to continue only if the offspring is of the desired sex.

In this article we analyze the developments in the field of reproductive technology regarding sex selection and investigate their consequences for offspring-preference behavior, in the light of compelling data that demonstrate ongoing patterns of son preference / daughter discrimination around the world, particularly in Asia. We begin by examining the thorny issue of son preference / daughter discrimination and its relationship to both female infanticide and female “feticide” through abortion of female fetuses following ultrasound screening. As part of this discussion, we also examine evidence on the existence of “balanced family” preferences—that is, an equal number of sons and daughters—in a growing number of Western and non-Western societies. We then examine the sex-selection technologies themselves, including those already in use (e.g., ultrasound for prenatal sex selection), as well as the newer technologies of pre-implantation genetic diagnosis and semen separation of X- and Y-bearing sperm. In the last section, we evaluate these technologies with respect to ethical debates on the beginning of human life and at what point life should be “protected”; the right to choose both the sex of offspring and abortion; and the principle of gender equality. We conclude with some speculations on the expected developments, future use, and legal developments surrounding these ethically contentious technologies on the global level.

### OFFSPRING SEX PREFERENCE

As is now known from a large number of studies, sex preferences of offspring are prominent in many societies, with male offspring usually enjoying a distinct advantage over females. In the most extensive recent demographic study of son preference, Hill and Upchurch (1) analyzed male and female infant mortality data in 35 developing countries, but not including China or India. They concluded that in almost all these societies—located in regions ranging from the Middle East to sub-Saharan Africa to southeast Asia to Latin America—there is a pervasive pattern of girl disadvantage, as reflected in differential infant mortality patterns.

Although not included in Hill and Upchurch's analysis, India and China are the world's two most populous countries, where son preference is particularly pronounced. On the Indian subcontinent, son preference has a long history (2), harkening back to the Hindu scriptures (3), and is still a prominent finding in anthropological field studies, records from clinics and hospitals, and regional population and health censuses. For example, in an analysis of population records covering the period 1981 to 1991 in the state of Punjab, Das Gupta (4) concluded that the number of "missing" girls actually increased during that period, suggesting that sex-selective practices—including female infant neglect and female infanticide, which are practiced primarily among the lower castes in rural areas—continued well into the late 20th century (5–7). However, in India, the strongest forms of son preference seem to be restricted to certain regions and castes. For example, son preference is most pronounced in the northwestern states and the southern state of Tamil Nadu, including among the relatively affluent Jats, Rajputs, and Gujars. In most of the northern states, an indication of the strength of son preference is reflected in the fewer than 90 girls for every 100 boys in the 0 to 6 age group (8).

In a recent medical anthropological study of infertility, new reproductive technologies, and cultural prohibitions against child adoption in India, Bharadwaj (3) argues that the ongoing son preference in India is part of the Hindu normative order deriving from the scriptures themselves, as well as from ancient legal texts. As noted by Bharadwaj (3, pp. 11–12):

The assigned importance of a son over a daughter, however, must be understood in the context of the gendered norms permeating Hindu patriarchal order where the male principle is sustained through the agency of male offspring. According to most ancient texts—codes of law and the *Upanisads* alike—the son is the perpetuation of the self. The man, through the agency of his son, recreates himself; and in this sense is reborn as and in his son. . . . In these narratives we find a theme that makes the life of a man permanent through the agency of his son—an open defiance of death. In the event of a man not reproducing himself in his son specifically, and in his offspring of any gender more generally, we find a situation where a man is faced with the possibility of a genetic death—complete oblivion.

Bharadwaj also points to the widespread belief in India that the ancestors themselves are born in the form of children. Thus, the performance of *Shraddhas*, or the sacrifices for the ancestors, in the Hindu faith is one way of offering prayers for the departed spirits. In these rituals, the son becomes an important player in rescuing the dead. To a father, the sacrificial duties performed by the son upon his death serve to liberate his soul and free him from the unending cycles of birth and death. Thus, Bharadwaj concludes that sons "are very important contributions toward the Hindu patriarchal notions of self worth, fruitfulness and salvation which infertility disrupts."

Similarly, in China, there is now ample evidence, demographic, anthropological, and historical in nature, of a strong son preference, dating back to ancient times and leading to both female infanticide and female infant neglect (9, 10). Although outright infanticide seems to have declined in the People's Republic of China since the communist revolution, the introduction of the one-child policy there has been associated with a profound decline in the number of female infants born compared with males. For example, in 1980, the reported sex ratio at birth was 106 males to 100 females, which is close to the "natural" rate of 105 males to 100 females (11). However, by 1995, that rate had increased to 113.6 male births for every 100 female births. When these numbers were "corrected" for the widespread practice of underreporting of female births, the resulting sex ratio was still 111.4 males to 100 females (12).

That millions of "missing girls" were either never born or died as a result of son preference / daughter discrimination in India and China has been carefully documented by anthropologist Elisabeth Croll (13) in her recent book, *Endangered Daughters: Discrimination and Development in Asia*. In this sweeping, comparative study, which draws equally upon demographic and local ethnographic data from both countries, Croll powerfully demonstrates that discrimination against daughters, as manifested in increasing excesses of female mortality before birth, at birth, and in infancy and childhood, has continued to rise, even with significant economic and educational improvements in both countries. According to Croll, the reasons for son preference accompanied by active daughter discrimination are manifold and culturally complex. In India and China, they include, among other things, notions of filial piety and the obligation of sons, not daughters, to worship ancestors and carry on the family line; virilocal marriage patterns, where sons remain within the family but daughters marry "out," making them "temporary visitors" in their natal households; and the perceived economic value of sons (in agricultural work, family businesses, and old-age support of parents) and concomitant perceived economic burden of daughters, especially in India, where an oppressive dowry system has led to a highly publicized spate of dowry suicides and homicides.

Croll shows how the perceived benefits of sons—and the perceived disadvantages of daughters, especially second and "higher-order" ones—have led to a cruel "culture of gender" rife with both overt and covert daughter discrimination. Because daughters are deemed so "secondary" and so "unsubstitutable" for sons, many parents, both rich and poor, in both India and China, have gone to great lengths to guarantee the survival of sons at the expense of their own daughters, whom they have effectively "extinguished" before, during, and after birth. Although Croll does not explore the psychological implications of killing one's own daughters—through drowning and "sleep" medicines given at birth or through the withholding of breastmilk, food, and medical attention leading to fatal neglect—it is clear from Croll's scholarly account that these practices are still quite common in parts of India and China, particularly among

more “traditional” segments of society without access to the newer sex-selective technologies.

However, Croll’s book also demonstrates that the dramatic imbalances in sex ratios that appear to be steadily increasing in both countries are largely, if not exclusively, due to the newer sex-selective technologies, which are beginning to reach even rural areas. Indeed, concerns over dwindling numbers of girls (who are, of course, the future brides of potentially competing bachelors) have led to legislation banning the use of medical technology (i.e., ultrasound and amniocentesis) for sex identification purposes. However, as Croll shows rather convincingly, enforcing such legislation will be exceedingly difficult, given the demand for these technologies and the ways in which bribes and other “pre-arrangements” can be used to subvert the legal requirements. Croll points out that the very demand for these technologies is a reflection, or outcome, of the persistent, widespread, and increasing discrimination against daughters in Asia—discrimination that can only be overcome through major local, national, and international interventions aimed at increasing the visibility and status of female children.

Although the severe daughter discrimination and sex-ratio disparities in both India and China are quite alarming, it is important to point out that these phenomena have not been widely reported from other non-Asian societies where son preferences are also thought to exist. Indeed, some evidence suggests that traditional son preferences may be declining in other parts of the world. For example, Obermeyer, in a detailed anthropological and demographic study in Morocco, shows that “what appeared from a distance to be son preference has somewhat evaporated under our scrutiny” (14, p. 290). Namely, a small proportion of women in her study stated that they wanted more sons than daughters, and there was a slightly greater probability of contraceptive use in families that had more boys. However, these differences were “very small,” according to Obermeyer, and there was no evidence of systematic discrimination against girls or of preferential treatment of boys, findings that were congruent with the lack of excess female mortality in the country. Thus, Obermeyer concludes that a historical approach to son preference in Morocco should be taken. She states (14, p. 290):

While the ideology that once supported its existence is slow to evolve, the attitudes and behaviour of individuals are more responsive to socio-economic changes and to the emergence of norms that are more egalitarian. As a result, the persistence of the rhetoric and rituals of son preference obscures a dynamic situation of rapid transformation. If this explanation can be validated through other research, then it would call for a reformulation of some of the key questions linking gender to demographic outcomes.

Indeed, research from other Middle Eastern countries suggests that traditional son preferences may be lessening over time. For example, in Egypt, medical

anthropological research conducted by Inhorn (15, 16) shows that son preferences, although still pronounced in rural areas (17, 18), are more difficult to detect in urban areas, including among the urban poor. In a study of both fertile and infertile Egyptian women of the lower socioeconomic classes (16), most women considered the ideal number of children to be two—one girl and one boy. In fact, although most poor women acknowledged that they *needed* a son to secure their position in the patrilocal extended family, they nonetheless *wanted* a daughter, whom they considered to be their “darling” and their “best friend.” Many women described the close affective ties that they shared with their own mothers and that they expected to share with their adult daughters, whom they could “count on” to take care of them in their old age. Many women stated that changing times and new notions of marriage have made grown sons less reliable in terms of both emotional and instrumental support, a view which seems to be widely shared by both men and women in poor urban settings. Thus, sons, once considered imperative to family agricultural labor and to old-age security, seem to have lost much of their value and appeal to parents in a rapidly urbanizing Egypt.

The desire to have an equal number of male and female offspring found in urban Egypt—and generally called a preference for the “balanced” family—is supposed to exist to some degree in most Western societies. An illustration of this preference is, for instance, found in the Dutch language, in which to have a boy and a girl is considered the fulfillment of a “royal wish.” Indeed, in two recent Dutch surveys, no clear son preference was found (19, 20). Of the respondents, 83 percent and 71 percent, respectively, did not have a preference for the gender of the firstborn child. Son preference was mentioned by 10 percent and 18 percent, respectively, of the respondents in the two surveys. However, daughter preference was mentioned by 7 percent and 11 percent of respondents, respectively. Moreover, most respondents, both men and women, preferred a family composed of an equal number of boys and girls (19).

In the United States, evidence for a balanced-family preference is less strong and somewhat equivocal, suggesting that Americans, too, may harbor lingering son preferences. For example, some research indicates that about 60 percent of U.S. citizens prefer a son as a firstborn child (21). However, in a small but rather representative sample of pregnant women in a Midwestern city, Steinbacher and Gilroy (22) reported an almost equal preference pattern for the firstborn child: 59 percent of the respondents had no preference, 23 percent would prefer a daughter, and 18 percent would prefer a son. In addition, in a survey among college undergraduates, Gilroy and Steinbacher (23) found that half of the respondents did not show a preference for either a boy or a girl. However, when a preference was stated, significantly more respondents desired a boy than a girl. In another U.S. study, a pattern of moderate son preference was found—although if the firstborn was a boy, the preferred gender of the second child was usually female (24). In other words, in the United States, there are some indications that a “balanced” family is desired,

but this desire, especially for firstborn children, is accompanied by a slight son preference.

Although it is often argued that the equal valuation of sons and daughters is most pronounced in “modern” Western societies, it is important to point out that having at least one daughter is highly valued in many other non-Western societies around the globe, including Latin America, the Caribbean, and sub-Saharan Africa (25). Even in areas with a very strong son preference, most women still want a daughter in addition to several sons (26). Furthermore, in some communities, such as those studied by Sargent and Harris in Jamaica (27), daughter preferences may be pronounced and reflected in superior *female* child health. Thus, despite the strong demographic data suggesting persistent son preferences around the world, the lived reality of gender preferences may be more subtle and complex than suggested by survey data (14), and may be changing in many societies in ways that have yet to be revealed. But it is extremely important to reemphasize the strong empirical evidence supporting the continuance of son preference in many societies worldwide, and particularly in China, India, and other parts of Asia, where this form of gender bias has serious implications for the use of new sex-selective reproductive technologies.

#### NEW REPRODUCTIVE TECHNOLOGIES FOR SEX SELECTION

Given the son preferences and daughter discrimination reported above, it is not surprising that new reproductive technologies for sex selection are already being used on a massive scale in some societies. In China, Taiwan, Korea, and India, a considerable number of studies report that the ultrasound machine is currently being used primarily for sex determination, followed by abortion of female fetuses. In China, for example, the decline in the number of female births compared with male births was initially attributed to a variety of other factors, including lack of registration of female infants, putting up female infants for immediate adoption, and female infanticide (10, 12, 13, 28–30). However, studies based on new material about the early availability of advanced ultrasound technology and the massive practice of abortion in China have accentuated the role of sex-selective abortions (10, 12, 13). It appears from these studies that lack of female registration and the out-of-country adoption of female children are not important factors in the decline of the female/male birth ratio. Rather, when one considers the number of induced abortions in China—approximately 10 million a year—it is, indeed, plausible that abortion is being used as a primary method of sex selection (28). In fact, in a recent study of infertility and new reproductive technologies in the People’s Republic of China, Handwerker (31) argues that reproductive technologies such as IVF and diagnostic ultrasound (followed by abortion) are being used in the service of what she and others have called the “new eugenics” in modern China. Namely, couples making “modern” babies, including

through IVF, want a “mentally and morally superior” child, a notion that has been perpetuated by the Chinese media. New reproductive technologies are being used for “selective” ends, which, as Handwerker shows, include “selecting” male infants through ultrasound-aided prenatal diagnosis and follow-up abortion of female fetuses. Thus, Handwerker warns of the serious bioethical considerations accompanying the use of new reproductive technologies in China, a country with millions of “missing females.”

Apparently, South Korea is no different. The spectacular decline in female compared with male births appears to be the result of the enormous growth of ultrasound-aided female abortive feticide (30, 32), given that the underreporting of female births is not considered a problem in that country. In India, where the use of prenatal diagnosis for sex selection is now illegal, it is nonetheless common knowledge—widely reported in the media—that diagnostic ultrasound is being used for this purpose. Yet the exact extent of the problem in India is difficult to assess. A way to measure the present use of prenatal diagnosis for sex-selective abortions would be to analyze the sex ratio at birth. However, in India, reliable national data on the sex of newborn babies are not available (33, 34). In the Indian census, which is carried out every ten years, it is only asked whether a child has been born alive in the last year, without asking about the sex of that child. The data on the sex ratio of young children within the household are sufficiently reliable (34), but it is not known how much this ratio is influenced by abortions or by infant and childhood death. Also, the ten-year time span between censuses makes it difficult to discern recent developments. Despite these difficulties in obtaining reliable demographic data, estimates suggest that hundreds of thousands of Indian girls “disappear” each year—approximately 20 percent before birth (4). In Indian hospitals, applications for “genetic diagnosis” are often made by couples who already have a girl but want a boy (5, 7, 35, 36).

In the West, on the other hand, there are no indications that prenatal diagnosis (by ultrasound, amniocentesis, or chorionic villus sampling) is being used with the aim of aborting a fetus of the undesired sex. Singer (37) concluded that 38 percent of Americans would approve of the use of abortion for sex selection, if the couple already had three or more children of the same sex, regardless of whether these were girls or boys. However, another investigation in the United States showed that the overwhelming majority of women who are having either amniocentesis or chorionic villus sampling, as well as the genetic counselors who guide them, condemn abortion for reasons of sex selection (38, 39). Steinbacher and Gilroy (22) conclude, on the basis of several studies, that between 18 percent and 45 percent of American respondents would be potential users of sex-selection technology. However, as the authors concede, statements are not the same as actions. A recent study by Wertz and Fletcher (40) of American geneticists discerned a positive response to sex selection, although this could be interpreted as a client-centered professional approach rather than as a positive attitude to sex selection per se.



In short, these studies show that a majority of the U.S. population does not approve of abortion for the purposes of sex selection, and probably an even larger majority would not undergo an abortion for the purpose of “balancing” the family. However, as shown in the next section, this situation may change once new technologies that do not require an abortion become widely available.

### THE “NEW” NEW REPRODUCTIVE TECHNOLOGIES FOR SEX SELECTION

As of this writing, there are now two “new” new reproductive technologies for sex selection, one that acts before fertilization and one that acts after fertilization but before embryo implantation or pregnancy. The “older” of these two technologies is pre-implantation genetic diagnosis (PGD), which has been practiced for about ten years. PGD makes sex determination possible in the earliest embryos, before they are implanted in the uterus. In the eight-cell, pre-embryo created through IVF, one or two cells (41–43), or “polar bodies” (44, 45), can be studied in the IVF laboratory in order to establish the sex of the pre-embryo. For the purposes of sex selection, only those pre-embryos of the desired sex are then transferred to the uterus.

PGD was initially developed to preclude the birth of a child with a sex-linked genetic disease, but it is now being used in some “gender clinics” for couples who want to have a child of a specific sex. Such clinics advertise on the Internet and in glossy brochures and can be found both in the West (e.g., the Rainsbury Clinic in the United Kingdom) and in non-Western sites (e.g., the Malpani Clinic in Mumbai, India).

To some, PGD may be a more acceptable form of sex selection than aborting a fetus, because it takes place before the actual pregnancy, when the embryo still comprises eight undifferentiated cells. However, the method requires IVF, a somewhat risky, extracorporeal form of conception usually limited to the infertile, which is successful in only about 20 percent of cases. Furthermore, the high costs and limited availability of PGD around the world guarantee that PGD will be out of reach for the lower and middle classes in the West, as well as for the majority of people in developing countries. In short, the invasiveness, the low success rate, and the high costs of PGD will probably hamper the global spread of this method. Worldwide, just a few clinics specialize in this technique with the specific aim of sex selection, and the number of patients treated—including medical cases—is still under 1,000 per year. Higher success rates and lower costs would probably create a greater demand. Nevertheless, the necessity of undergoing IVF treatment in order to carry out PGD will continue to be a serious impediment to the widespread use of this technique.

The other new reproductive technology—which involves separation of Y-bearing from X-bearing sperm, and then insemination by Y- or X-enriched

sperm—promises to become a more accessible technique. Because IVF is not needed, at least among healthy fertile couples, sperm separation is less invasive, less technically demanding, and less expensive than PGD. With this technology, sex selection occurs before conception—that is, before the “romance” of egg and sperm (46)—and thus it does not tamper with the “beginning of life” for those who believe that life begins at the moment of conception. Clearly then, for many of those opposed to abortion, including for the purposes of sex selection, this newest technology may pose less ethical challenges than any of the aforementioned procedures.

As with other technologies in this field, the application began in veterinary medicine. However, the initial semen-separation procedures designed for use in animals—involving albumin gradients, Percoll gradients, and swim-up procedures—are not accepted within the scientific community as either functional or successful, even though they are being used in “gender clinics” (47). Instead, a new procedure called flow cytometry, which separates individual sperm cells on the basis of their DNA weight (X-bearing sperm cells carry more DNA and thus are heavier than Y-bearing sperm), appears to be successful in “enriching” sperm among livestock, including cattle, pigs, sheep, and rabbits (48–50). Originally, only a small number of spermatozoa could be separated, and because these numbers were insufficient for insemination, IVF was still required to create an embryo. However, a newly developed nozzle has increased the speed of the procedure (51). Through high-speed “sorting,” sufficient numbers of X- or Y-enriched sperm can be separated for insemination in cattle. According to the inventor, the current technology achieves 90 percent purity of X and Y sperm, and is adaptable to virtually all mammalian species, including human beings (52). As a result, “sexed” sperm on demand should soon be on the market for use in livestock (53).

In humans, the first, relatively successful trials of flow cytometry have already been carried out (53, 54). Current problems due to the small difference in DNA content between X- and Y-bearing sperm in humans, compared with cattle, and the rather small number of sperm collected after high-speed sorting, will probably be solved (51–55). However, it is more difficult to enrich Y-bearing human sperm than X-bearing human sperm (56). In other words, the technology may eventually be more useful for couples who want a daughter rather than a son.

It is important to point out that, at present, DNA-weighted sex selection is an expensive and difficult procedure and has been used in humans in only a few clinical trials (56). Fugger and co-workers (57) have described their initial success—the birth of 11 healthy babies and 12 ongoing pregnancies—but also some setbacks, including seven spontaneous miscarriages and one ectopic pregnancy. In an account published a year later, Fugger (56) reported having used flow cytometry for 332 patients—286 for family balancing and 46 for the prevention of X-linked diseases (56). Of 518 intrauterine insemination cycles involving DNA-weighted sex selection, 61 resulted in pregnancies (11.7 percent),

and 145 IVF cycles resulted in 35 pregnancies (24.1 percent). Thus, these results are comparable to the low success rates reported with intrauterine insemination and IVF for infertility patients. Of the 83 babies born and 47 ongoing pregnancies, the fetal or birth sex was as expected in 94 percent of procedures performed for girls but in only 73 percent for boys.

Although the potential negative health effects for “sperm-separated” offspring are still unknown, the practical difficulties of separating sufficient numbers of X and Y sperm for intrauterine insemination in human beings are being solved. Thus, the inventors of flow cytometry are explicitly offering their technologies to parents with at least one child of a particular sex for the purpose of family “balancing,” as well as a non-coercive method of population control (58).

### THE ETHICAL IMPLICATIONS OF SEX-SELECTION TECHNOLOGIES

The practice of sex selection in humans raises a myriad of ethical questions, involving some of the most basic issues facing human societies: when life begins, the right to life, the right of free choice, and the equal rights of men and women or, in this particular case, male and female children.

In an evaluation of the ethical aspects of sex-selection methods, the idea of “increasing protectiveness” of the developing human immediately comes to the fore—that is, a human baby has more rights than a human fetus, and a human fetus has more rights than a human embryo. From this ethical point of view, infanticide and fatal neglect of children of the unwanted sex are fundamentally worse than abortion of the fetus for the same reason. Similarly, abortion of a fetus is worse than PGD for sex selection, which involves destroying a two- or three-day-old embryo of the unwanted sex. However, adoption of this ethical stance would mean that semen selection of X- or Y-bearing sperm is fully acceptable, because most ethicists, and even those who adopt a “pro-life” position, do not consider individual human life to begin before conception. Indeed, most of the world’s major religions, including the Roman Catholic Church, acknowledge that the beginning of life does not occur before fertilization of the egg by the sperm.

The notion of a progression from the “most” to “least” acceptable forms of sex selection—from sperm selection, to PGD involving embryo selection, to prenatal diagnosis followed by abortion, to infanticide and fatal infant neglect—would appear to have strong societal support around the globe. Virtually all societies today condemn and forbid infanticide and fatal willful neglect of children, but many nation-states allow abortion of the fetus under varying circumstances. In a considerable number of countries, abortion is paid for or reimbursed by national health care systems (e.g., in England and the Netherlands). Several Western countries also allow research on embryos that are not implanted until 14 days after fertilization, and in some countries, following England’s lead, embryos can be created under specific circumstances solely for the purpose of research. In fact,

England—with its famed “Warnock Report” (59) and later its Human Fertilisation and Embryology Authority Act (HFEA)—has led the way for many other Western countries, including the Netherlands and the United States, in terms of setting ethical standards for embryo research. But in the United States, these ethical standards are now in question vis-à-vis the “stem cell wars” between the pro-life and pro-choice (including research) communities, which are currently rocking the nation.

In the United States, however, some ethicists and constitutional rights experts have adopted an affirmative position on the right to make choices about one’s offspring, including to “select” traits such as sex (29). For instance, Jones (60) argues that in the United States, access to sex-selection technologies should receive federal protection. Indeed, in some respects, the discussion of sex selection mirrors the abortion debate in the United States, specifically regarding the rights of women versus the rights of the fetus. However, an important difference is this: sex selection can now take place *without* an abortion. Thus, ethically speaking, the new “early” methods of sex selection may seem like a justifiable replacement of current practices of ultrasound-aided feticide.

Yet for many people, including apparently the majority of Americans, sex selection is morally repugnant independent of its method. Some object to preferences of all kinds, whether it be son preference, daughter preference, or preference for a balanced family. However, because of global patterns of son preference and their linkage to sex-selective abortion, the most attention has been given to issues of gender inequality: namely, that sex preferences are inherently wrong because they represent a severe form of discrimination against women and girls. The pattern of son preference is perceived to be a consequence of a male-dominant (i.e., patriarchal) culture and, often, male-dominant religions. And although the existence of male domination is often denied—especially by men vis-à-vis the argument that women’s roles “complement” in an equal way those of men—the association between male-dominant cultures, son preference, gender discrimination against women, gender and age discrimination against female children, poor female health outcomes, and “missing females,” including those missing due to female feticide, remains strong (61–64).

Obviously, cultural change, particularly change of deep-seated cultural ideologies of male domination, is not easy to achieve. Preference patterns regarding the sex of offspring are often deeply interwoven with basic cultural values that have a long historical tradition, as shown in the aforementioned work of Indian anthropologist Aditya Bharadwaj (3). As we have demonstrated in this article, son preference has survived the great changes of nationalist and communist revolutions in China, the decolonization and modernization of India, and the rapid introduction of modern capitalism in India, China, and South Korea. As of this writing, there are no indications of rapid improvements in the valuation of daughters in those societies; indeed, the situation seems to be getting worse (13). However, in other societies, including those of the Middle East cited above

(14, 15), son preferences may be slowly evaporating under the influences of rapid urbanization, globalization, and increasing access to “gender-blind” educational opportunities for men and women.

Furthermore, the globalization of new reproductive technologies themselves may, in some senses, exert a positive influence. For example, one could argue from an ethical standpoint that the examples of China and India show how the availability of new technologies for sex selection, including abortion, can replace older and less “humane” ways of sex selection, including infanticide and infant neglect. In due course, “early” methods of sex selection could take the place of sex selection by ultrasound, chorionic villus sampling, or amniocentesis, all of which require an abortion. Flow cytometry may eventually replace prenatal diagnosis followed by abortion. However, for those who favor sons, flow cytometry has an important disadvantage: this technology is far less successful in ensuring the birth of sons than of daughters, because of problems associated with “enriching” Y-bearing human sperm. Thus, constraints on the technology and, ultimately, the biology of human reproduction mean that this most “acceptable” form of technologically enhanced sex selection may not be easily implementable in societies where sex selection (in favor of sons) is most likely to be desired and practiced.

A major question remains: is it ethically acceptable to promote the use of a reproductive technology that will ultimately increase the likelihood of sex selection, whether of sons or of daughters? This question has perhaps special ethical urgency in the West, where these technologies may eventually be in great demand among couples wanting to “balance” their families. In many Western countries, the decision to have a child is often a conscious, well-planned reproductive “choice” made by couples in relation to decisions about the work and careers of both partners. Furthermore, many couples attempt to achieve optimum birth spacing—usually about two years—between the birth of desired children. Thus, the “choice” for a girl or a boy would seem to fit well within this very Western notion of “family planning” (65). Although few Western couples appear to practice sex selection by means of prenatal diagnosis and abortion, the eventual availability and high success rates of sperm-selection methods may ultimately change Western sex-preference practices in dramatic ways.

Whether legislation can influence the prospects for the ethical “control” and appropriate implementation of sex-selection technologies is highly debatable. Despite the ban on sex selection by abortion in India and China, ultrasound machines are widely used for this purpose (13). Among Europeans, there is a considerable infertility “tourist” industry, whereby couples go to a foreign country for treatments not allowed in their own nation. To take but a few examples, Dutch couples travel to neighboring Belgium to undertake certain kinds of IVF treatments for severe male infertility that are currently banned in the Netherlands. And British pre-implantation “gender clinics” carry out the sex-selection phase (which is disallowed in the United Kingdom) in Malta, while only the clinical

phases of intrauterine insemination or IVF are done in England. Moreover, where abortion is readily accessible—for instance, in the Netherlands—many foreign women visit the country for the purposes of an abortion, which may, in fact, involve “disguised” sex selection.

In all likelihood, legal bans on sex-selection technologies will certainly make access more difficult, but not impossible. As with other new reproductive technologies, legislation to “control” the use of these new sex-selective technologies will be difficult to enact and enforce. To wit, despite more than 20 years of experience with IVF and other conceptive technologies, the United States has been unable to institute a coordinated national policy on assisted reproduction (66, 67), leaving the nation’s IVF industry to regulate itself. Not only is self-regulation “not working,” according to at least one expert (66), but it is leading to many ethical conundrums and “legal troublespots” (68), including problems of abandoned embryos, switched embryos or gametes, negligent destruction of embryos, and husband and wife disputes, the latter of which will invariably involve issues of sex selection.

In summary, whatever the rules, parents have been trying to influence the sex of their offspring throughout recorded human history, and they will probably continue to do so in even greater numbers as each “new and improved” reproductive technology for sex selection becomes available. Until the day comes when patriarchal relations are unseated around the globe, the desire for these technologies will largely reflect the desire for sons—in an unfortunate world where daughter discrimination remains rampant.

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“New” New Reproductive Technologies**

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