



Genetic Selective Abortion: Still a Matter of Choice

Bruce P. Blackshaw¹ 

Accepted: 24 March 2020/
© The Author(s) 2020

Abstract

Jeremy Williams has argued that if we are committed to a liberal pro-choice stance with regard to selective abortion for disability, we will be unable to justify the prohibition of sex selective abortion. Here, I apply his reasoning to selective abortion based on other traits pregnant women may decide are undesirable. These include susceptibility to disease, level of intelligence, physical appearance, sexual orientation, religious belief and criminality—in fact any traits attributable to some degree to a genetic component. Firstly, I review Williams’ argument, which claims that if a woman is granted the right to abort based on fetal impairment, then by parity of reasoning she should also be granted the right to choose sex selective abortion. I show that these same considerations that entail the permissibility of sex selective abortion are also applicable to genetic selection abortion. I then examine the objections to sex selective abortion that Williams considers and rejects, and show that they also lack force against genetic selection abortion. Finally, I consider some additional objections that might be raised, and conclude that a liberal pro-choice stance on selective abortion for disability entails the permissibility of selective abortion for most genetic traits.

Keywords Sex selective abortion · Fetal abnormality abortion · Genetic selective abortion · Disability · Liberal pro-choice · Selective abortion

1 Introduction

Selective abortion can be controversial depending on its target, even amongst those who generally hold a liberal pro-choice stance towards abortion—a view predicated on the importance of individual rights and liberty, particularly the right of women to control their own

✉ Bruce P. Blackshaw
bblackshaw@gmail.com

¹ Department of Philosophy, University of Birmingham, Birmingham, UK

bodies. A central argument used to justify the permissibility of abortion on this view is Judith Jarvis Thomson's much debated violinist analogy, which is intended to demonstrate that no-one has a right to the use of another person's body (Thomson 1971). For the sake of argument, Thomson grants that the fetus has the rights of a person, and her goal is to show that despite this, in at least some circumstances, abortion is still permissible. Thomson's reasoning is not the only argument in the liberal pro-choice arsenal—it is commonly argued¹ that the fetus does not have equivalent moral status to children and adults, primarily because it lacks certain attributes such as sentience or self-awareness that are required for personhood. If it can be shown that this is the case, it is clearly far easier to justify the primacy of the woman's right to control her body—her interests will always override those of the fetus. These arguments form the primary justification for the liberal pro-choice position, but other moral theories are also drawn upon that are not strictly liberal—the most common being consequentialist arguments such as claims that restricting abortion will force women to use illegal abortions that are far more dangerous for women (Grimes et al. 2006), or will result in higher levels of child abuse (Bitler & Zavodny 2002).

While most pro-choice advocates seem comfortable with permitting selective abortion for disabilities—what Kate Greasley (2017 p.223) refers to as *fetal abnormality abortions* (FAA)—they are often reluctant to endorse *sex selective abortion* (SSA). For example, Jeff McMahan defends FAA, but states that in the case of SSA the solution 'is to eliminate the social discrimination, not to eliminate the victims of it' (McMahan 2005 p.167). Allen Buchanan et al. argue that fetuses have no right to be born, and so it is permissible to abort fetuses with disabilities (Buchanan et al. 2000 p.277)—but they advance a consequentialist argument against SSA, stating that the 'practice depends on and reinforces a systematic bias against women' (2000 p.184). Feminist philosophers in particular generally favour an outright ban on SSA, while being strong pro-choice advocates (Widdows 2014).

These concerns regarding SSA are not universally held—Julian Savulescu is one well-known defender of SSA who argues that respect for procreative autonomy overrides any concerns about possible harmful side effects, whether those harms are incurred by children, women or society (Savulescu 2006). On similar grounds, John Harris has argued for the regulation of SSA, initially permitting a restricted number of procedures (1 million in a population of 60 million) over a ten-year period until the effects are better understood (Harris 2005). Savulescu and Harris are, however, amongst a minority who consider that reproductive freedom trumps concerns regarding SSA.

Both FAA and SSA involve selection of fetuses for termination, and so this raises the question of what differences there are between these practices that are significant enough to entail that we should permit one practice while prohibiting the other. Jeremy Williams has argued that if we are committed to a pro-choice stance with regard to FAA, we will be unable to justify the prohibition of SSA (Williams 2012). Briefly, his approach is as follows. Firstly, he shows that the arguments commonly used to support a woman's right to FAA are equally applicable to a right to choose SSA. Secondly, he demonstrates that the reasoning used to *refute* arguments critical of FAA is also applicable to arguments critical of SSA.

In this paper, I review William's arguments before considering their applicability for selection against other traits that pregnant women might find undesirable in their children,

¹ For example, David Boonin requires that the fetus exhibits 'organized cortical brain activity' before it can possess rights (Boonin 2002 p.115). Jeff McMahan's Embodied Mind Account similarly requires consciousness for an individual to exist—prior to this point the fetus is *something* rather than *someone* (McMahan 2002 p. 267).

depending on their beliefs and values. These include susceptibility to disease, level of intelligence, physical appearance, sexual orientation, propensity for religious belief, various psychological conditions and criminality—in fact *any* traits attributable to some degree to a genetic component *or* that hypothetically may be found to contribute in the future. I conclude that *if* we are committed to a liberal pro-choice stance with regard to FAA, as with SSA we are unable to justify the prohibition of selecting against these traits—what we might call genetic selective abortion (GSA).

It is worth noting that FAA may well be a subset of GSA in many cases—for example, where Down's syndrome is diagnosed by genetic testing. SSA could similarly be considered a subset of GSA if sex is determined by this method. In fact, the diagnostic tool itself is not particularly relevant here—objections are based on the *type* of selections that can be made, and genetic testing happens to provide the most comprehensive data about the fetus. In effect, advances in diagnostic technology have vastly expanded (and will continue to expand) the information upon which our choices can be made.

2 Women's Interests

Williams' approach is to suggest three uncontroversial scenarios in which a liberal pro-choice advocate would agree that a woman has the right to opt for an abortion, all for pre-sentient fetuses: pregnancy from rape, a single woman who cannot afford a child, and a woman with three children who is afraid another child will destroy her marriage. In the rape scenario, the woman believes she cannot cope with the emotional distress of having her attacker's child. In the second scenario, the woman will be forced into poverty, and in the last scenario, there is the possibility of a relationship breakdown. If the pre-sentient fetus has no interests, then these weighty interests of the woman are guaranteed by the right to an abortion. Williams then suggests parallel scenarios involving women who wish to have a child but know they have a 25% chance of conceiving a child with a serious disability. If they are denied abortions, these women will experience *exactly the same bad effects* as those in the first group of scenarios: increased emotional stress, relationship difficulties and susceptibility to poverty. Williams points out that in a society that allows abortion up to 20 weeks, but prohibits FAA, women in the second scenario are penalised for their desire to have a healthy child: in both scenarios the women can choose to have an abortion, but women in the second group must *gamble* with their interests if they continue with their pregnancies. As Williams states, this does not seem compatible with equal concern for women—if we believe abortion in the first set of scenarios is justified, then we should agree that selective abortion is also justified in the second set of scenarios.

Williams then presents a third set of scenarios, this time involving SSA. The first involves a woman who was sexually abused by her mother as a child, and who believes she cannot cope emotionally with having a daughter—instead, she has a strong preference for a boy. The second is a woman who lives in a culture where raising girls is far more expensive than raising boys, as discrimination in the labour market they cannot contribute financially to the family, and dowry requirements mean marriage is expensive. She believes she cannot afford a daughter, and also wants a son. The final scenario is a woman with four daughters who fears her marriage will break down if her husband's desire to have a son is not satisfied.

Williams' crucial point is that the women in the third set of scenarios involving SSA are trying to protect *precisely the same interests* as the women in the second set of scenarios, who

wish to use FAA. *If* we are willing to grant that the interests of the women in the second set of scenarios justifies the use of FAA, then we should be willing to grant that these *same* interests justify the use of SSA in the third set of scenarios.

Williams notes there will be cases where the reasons a child of a certain gender is desired are not as strong as those shown above—they may even seem frivolous. But in a liberal society, why should we enforce a certain threshold for what is regarded as a ‘good enough’ reason? And if we choose to do so, and were able to develop a suitable criterion, it seems unlikely that women’s reasons could be consistently and fairly assessed by the state against this criterion.

Of course, as Williams points out, these considerations are equally applicable against restrictions that permit abortion only for severe fetal abnormalities or a risk to the mother’s mental health. Let us now examine their applicability to GSA after a brief overview of recent research into inheritable traits.

3 Genetic Selective Abortion

There are currently numerous tests that can be conducted that give an indication of the health of the fetus. *Screening tests* use ultrasound or maternal blood tests to estimate the probability that a fetus has Down’s syndrome, neural tube defects or other abnormalities, and are not invasive. These blood tests rely on the presence of fragments of fetal DNA in maternal blood, known as cell-free DNA. The proportions of certain sequences of DNA that are specific to chromosomes such as chromosome 21 can be measured, indicating whether Down syndrome or other aneuploidies are likely in the fetus. *Diagnostic tests* are more definitive, and use amniocentesis or chorionic villus sampling (CVS) to obtain cells from the fetus or placenta for testing.² Technological advances are rapidly expanding the number of genetic conditions that can be diagnosed from these tests.³

As well as being able to detect genetic diseases and conditions, research is increasingly informing us of genes that are correlated with certain traits and tendencies to a wide range of conditions and behaviours. For example, certain mutations of the BRCA1 and BRCA2 genes significantly increase the risk of developing breast cancer and ovarian cancer (Kotsopoulos et al. 2018); we are beginning to discover gene variants that predispose children to acute leukaemia (Churchman et al. 2018). It is now possible to detect severe intellectual disability (Gilissen et al., 2014), and researchers are beginning to associate certain genes with intelligence (Sniekers et al. 2017). According to John Alford et al. (2005), ‘genetics plays an important role in shaping political attitudes and ideologies’, while Bryanna Fox states that ‘it is increasingly clear that criminal behaviour results from a combination of factors, both biological and environmental’ (Fox 2017). Recently, Michael Price has reported on Andrea Ganna’s research presented at the American Society of Human Genetics, which identified four genetic variants correlated with same-sex sexual experiences (Price 2018), and Jinting Liu et al. have identified a gene that is correlated with altruistic behaviour (Liu et al. 2017). Wray et al. (2018) have identified 44 loci associated with major depressive disorder. In time, it is likely that the range of available prenatal genetic tests will expand to include these and other traits,

² According to Van den Veyver (2018), fetal cells also circulate in maternal blood, but they are rare and difficult to isolate.

³ See Van den Veyver (2016).

such as propensity for religious belief. We must consider, therefore, whether selective abortion based on the results of such tests should be permitted.

Again, let us consider three hypothetical scenarios, this time involving potential genetic selection:

1. Alice has lived with major depressive disorder for most of her life. She does not believe she can cope with the emotional strain of raising a child with the same condition.
2. Wanda is a single woman with a child and no medical insurance. She believes having another child who develops leukaemia will bring financial costs that will result in severe financial stress, leaving her unable to support her existing child.
3. Sally is married with three children who are all high achievers, and she fears that having a rebellious child with criminal tendencies could result in sufficient strain to destroy her marriage. She has friends who divorced as a direct result of a similar situation, and her father was constantly in and out of jail.

Once again, the women in this set of scenarios are trying to protect the *same* interests as the women in each of Williams' sets of scenarios, including those involving FAA. Again, if we are liberal pro-choicers willing to grant that the interests of the women in the second set of scenarios are sufficiently strong to justify the use of FAA, then we should be willing to grant that these same interests justify the use of GSA in order that women do not need to gamble with these interests. The same arguments against requiring minimum thresholds for the strength of women's reasons to abort in order to prevent frivolous use of GSA also hold.

To summarise, then, liberal pro-choice advocates allow FAA in order that women's interests are not harmed. If this stance is taken, the same reasoning applies to both SSA and GSA—if these are not permitted, in certain circumstances women's interests will be harmed. Limiting the use of SSA and GSA by forcing women to justify their reasons to the state is also likely to harm their interests. Consistency requires that if FAA is permitted, so should SSA and GSA.

4 Objections

We must now consider how Williams deals with objections to SSA, and whether similar objections are applicable to GSA in general. He identifies three standard objections: (1) that if SSA is available, women will be coerced into abortions against their will, undermining their autonomy, (2) SSA supports 'harmful sexist attitudes towards women in the society at large', and (3) SSA is analogous to genocide.

4.1 Autonomy Objection

The *autonomy objection* claims that SSA should be banned because it will contribute to cultural pressures to abort female fetuses, reducing women's autonomy. However, Williams points out that precisely this occurs in relation to FAA—significant pressure is exerted on women to abort a fetus that is diagnosed with Down's syndrome (Saxton 2000). Moreover, Williams shows that the same reasoning actually entails *all* access to abortion should be prohibited on the grounds that women in a wide variety of situations are pressured into having abortions.

How does the autonomy objection fare with GSA? Certainly, there are many conceivable scenarios where women might be pressured to abort their fetus if tests indicate a non-negligible chance of developing certain conditions. If the chances of a child developing a severe childhood illness is significant and health insurance costs are high, potential financial strain might result in partners pressuring women to abort. In some cultures, particularly societies where homosexuality is illegal, there may be family and societal pressure to abort fetuses exhibiting genes for certain sexual orientations. If a test for the propensity to develop certain criminal tendencies was widely available, it is conceivable that pressure could be exerted on women to abort fetuses with a positive result. Again, these pressures seem little different to those experienced by women whose fetuses have tested positive for disability, and so if these pressures are deemed acceptable in disability scenarios, they are also acceptable for GSA.

4.2 Expressivist Objection

The *expressivist objection* to FAA claims that this expresses ‘negative, extremely damaging judgements about the value of disabled persons’ (Buchanan 1996 p.28). Similarly, the expressivist objection to SSA claims that it undermines the status of women and reinforces notions of their inferiority. How do pro-choice advocates defend against this argument? The primary defence is that an act expresses the beliefs that motivate the act, and so for disability, selective abortion expresses judgements about the value of disabled persons *only* if individuals are motivated by such beliefs. Williams applies the same reasoning to SSA, arguing that women who choose to abort a female fetus need not have a personal belief in the inferiority of women—they may believe that giving birth to a girl will worsen their circumstances in some way. Provided such reasons exist—and Williams’ scenarios demonstrate it is a realistic possibility—SSA does not necessarily express a belief in the inferiority of women, and therefore we cannot make inferences regarding women’s reasons. Clearly, the same reasoning can be applied to GSA. Whether the selection is based on traits for sexual preference, political belief, criminality or susceptibility to cancer, the scenarios I have presented demonstrated that women may have reasons for abortion unrelated to negative attitudes about the particular traits that are targeted. Of course, we may be less concerned about negative judgements concerning criminality and extreme political views.

A related objection is that such abortions contribute to a negative view of disabled people, women, gay and lesbian people, and so on—irrespective of the personal motivations of women who seek abortions in these circumstances. Williams points out that in the scenarios we have seen, this is asking certain women to bear an unreasonably heavy cost to help prevent prejudice against these groups. Of course, we might consider only permitting GSA in cases where a woman’s reasons are not based on prejudice against a group, but as we have discussed, it is problematic having the state assess women’s reasons for wanting an abortion. Moreover, *any* policy that permits SSA or GSA even under restricted conditions surely contributes to negative judgements regarding these groups.

Given that pro-choice advocates consider that the interests of women being able to abort for disability outweigh the effect of the accompanying negative judgements for those who are disabled, once again this objection fails against SSA and GSA.

4.3 Genocide Objection

The third objection to SSA is that it is analogous to genocide, which according to the United Nations is the ‘intent to destroy, in whole or in part, a national, ethnical, racial or religious group’ (UN General Assembly 1948). Williams provides three reasons why this analogy fails. Firstly, SSA, if performed on pre-sentient fetuses, does not involve the violation of any fundamental human right. Secondly, SSA is undertaken by individuals, and is not a coordinated campaign to destroy a particular group, and finally, there is no *intent* to eliminate the group. Clearly, these reasons are equally applicable to GSA in cases where fetuses that are part of certain ethnic, racial or religious groups are targeted—and where they are not, the genocide objection has no force.

Williams also discusses a related objection: selective abortion might deprive group members of certain communal goods that are dependent on the group flourishing, such as shared traditions and a sense of belonging. Diminishing the numbers of a group by selective abortion might also harm the group in its ability to lobby for their interests. Of course, in the case of those predisposed to criminal tendencies, if they even exist, we would be unconcerned by their deprivation of communal goods or lobbying power. For other groups targeted by GSA, it seems unlikely that they would be deprived of communal goods or lobbying power to a greater extent than disability groups, and so once again, if we are willing to permit FAA, it implies we should be willing to permit SSA and GSA. If we do not, we are asking women to sacrifice their own interests for the sake of these groups when they are not responsible for society’s discrimination against them.

4.4 Consequentialist Objections

Finally, Williams considers consequentialist objections, predicated on threshold deontology, which says rights can be trumped if consequences are serious enough. He has argued that requiring pregnant women to unfairly bear the cost of society’s prejudices is an imposition on their rights, but perhaps the consequences of a skewed sex ratio are serious enough that this can be justified. There are two issues with demonstrating this (apart from theoretical issues with threshold deontology itself). Firstly, we do not really understand the consequences of allowing or banning SSA—there are too many unknowns, and typically the threshold required to override rights is thought to be very high. Secondly, this involves what Derek Parfit calls ‘different number choices’: when it comes to abortion policy, denying abortions results in additional people who exist, and it is not clear how we can decide if this will result in a better world, as measured on consequentialist terms.

Clearly these same issues are no less applicable for any kind of GSA. The consequences of such selection are unknown; in the case of selectively aborting fetuses identified with negative traits such as criminality or violence, it might be that the overall consequences are positive. Similarly, the consequences may be positive if fetuses which are more likely to die early deaths from disease are selectively aborted. Most forms of GSA will target a smaller proportion of the population compared to SSA, and so if Williams’ arguments regarding the consequences of SSA succeed, it is unlikely the consequences of other GSA are more serious. If we endorse a woman’s right to choose whether or not she continues with her pregnancy, it seems unlikely that we can trump that right based on the consequences of allowing such selective abortion practices.

4.5 Commodification Objection

There is a more specific objection that can be made: that selective abortion leads to the *commodification* of children. Heather Widdows claims it is possible with these technologies that children ‘will become the types of things which parents can choose rather than simply accept’ (2014). Let us examine this objection more closely. According to Stephen Wilkinson, the morally relevant characteristics distinguishing *commodification* in this context are treating children as *fungible*—or replaceable with similar goods—and as having only *instrumental* value (Wilkinson 2010 p.132). He cites the well-known Kantian principle that people should be treated as ends-in-themselves rather than as means as a common basis for this objection. Wilkinson believes it is difficult to show that selective reproduction as being *solely* instrumental as required by this principle—provided the child is not treated *merely* as a means once born the principle is not violated. Selective reproduction also does not seem any more objectionable than the many other reasons why parents decide to have children, some of which are selfish: providing a playmate for an existing child, to have an heir, or to please grandparents.

With regard to treating children as replaceable commodities, Wilkinson points out the moral wrong is treating as replaceable someone who should be treated as irreplaceable. However, treating *merely possible persons* as irreplaceable seems implausible, as we know almost nothing about them that would make them irreplaceable. In fact, it is difficult to imagine why prospective parents would prefer a *particular* embryo from a set of embryos that meet their broad criteria—but if this was the case, they would need to be *ultra-selective*, as Wilkinson puts it.

According to Widdows, who discusses commodification in relation to the use of genetic tests in selecting IVF embryos for implantation, ‘when the aim is to have a healthy child rather than a particular type of child or a child with certain parts or traits then there does not seem to be any dramatic move to commodity’ (Widdows 2009, p. 39). She does not, however, explain why selecting for health is *not* a strong move to commodity while selecting for certain traits *is*—a trait is nothing more than a distinguishing characteristic, and so a disability seems to be as much a trait as, say, intelligence or physical appearance. Widdows does imply, however, that health is relevant. I explore whether health makes a moral difference in the following section.

To summarise, if fetuses and embryos are not regarded as unique persons, but as merely possible persons then the commodification objection provides insufficient reason to override a woman’s interests. More importantly, both this objection and these responses are agnostic with respect to the target of selective abortion—they seem equally applicable to FAA, SSA and GSA.

5 Moral Differences

Finally, perhaps there is a *moral difference* between aborting for disability compared to aborting for certain genetic traits that allows us to justify the former and not the latter. Of course, as has been noted earlier, many abortions for disability are based on genetic testing, and so are a subset of GSA. However, we must consider whether abortion for disability has characteristics that make it less morally objectionable than abortion for other genetic traits, or perhaps even morally praiseworthy. It might be, for example, that it prevents the existence of people who have lives that are not considered to be worth

living because of pain or disability, while at the same time preventing a significant decrease in the quality of life of the prospective parents of a disabled fetus.

There are of course possible scenarios involving SSA and GSA where life might be extremely difficult and even not worth living, perhaps because of attitudes towards particular groups in certain societies, but being born female (for SSA), or being born with a genetic susceptibility to certain diseases, beliefs or behaviours does not *entail* this must be the case, or that it is even likely. So *perhaps* a definitive diagnosis of a severe disability means abortion in these cases is justifiable on moral grounds, while SSA and GSA is not.

I will not take a position on this here, but rather point out that the majority of abortions on disability grounds do *not* involve people who have lives generally considered to not be worth living. An examination of abortion statistics for England and Wales is instructive. There were 3314 abortions performed in 2017 under ‘ground E’, the category recorded when aborting because of the risk of fetal anomaly (Department of Health and Social Care 2017). The most frequent recorded conditions were Down’s syndrome, accounting for 20% of terminations, followed by congenital malformations of the cardiovascular system (9%) and the musculoskeletal system (8%), and anencephaly (8%). How do these conditions affect the quality of life of those who are born with them? Anencephaly is fatal, resulting in stillbirth or death soon after birth, and so quality of life does not seem relevant. However it is known that children with Down’s syndrome live relatively happy lives (Shields et al. 2018), and according to Skotko, Levine, and Goldstein, ‘the overwhelming majority of parents surveyed report that they are happy with their decision to have their child with DS and indicate that their sons and daughters are great sources of love and pride’ (Skotko et al. 2011 p. 2335).

Clearly, a disability such as Down’s syndrome does not entail someone’s life is not worth living—quality of life is ultimately a subjective assessment by an individual, and there are a broad range of factors that will influence it. What is important to one individual may not be as important to another, particularly if it is out of their range of possibilities. In fact, Gary Albrecht and Devlieger (1999) have described what they call the ‘disability paradox’: many people with serious disabilities report having a good or excellent quality of life, contrary to what might be expected. According to Kate Greasley, ‘only a rare few disabilities and syndromes detectable before birth’ would reach the threshold of suffering beyond which life is considered not worth living (2017 p. 229). FAA, then, cannot be said to be less morally objectionable than SSA or GSA on the grounds that it prevents the existence of lives considered to not be worth living.

Interestingly, Savulescu subverts this objection with his *principle of procreative beneficence*, which he proposes in his discussion of genetic selection in the context of IVF and preimplantation genetic diagnosis (Savulescu 2001). He argues that prospective parents should ‘select the child, of the possible children they could have, who is expected to have the best life, or at least as good a life as the others, based on the relevant, available information’ (Savulescu 2001). Here, Savulescu is claiming that prospective parents have a *moral obligation* to use genetic selection to choose children with genetic traits that will ensure their children are those that will have the best possible lives. He is referring not just to the absence of disease or disability, but suggests memory and intelligence as important traits that will help ensure a better life. Although he is primarily referring to preimplantation genetic diagnosis, Savulescu is clear that this principle could be extended to termination of pregnancy. The principle does not recognise any moral difference between eliminating disabilities or enhancing traits.

6 Conclusion

I have explicated Jeremy Williams' argument which demonstrates that a liberal pro-choice stance with regard to FAA entails being unable to justify a prohibition for SSA, and shown that the same reasoning is equally applicable to GSA in general. I have also considered some additional objections that Williams did not examine, and concluded that provided it is accepted they are not sufficiently strong to prohibit FAA, they similarly lack force against SSA and GSA. Accordingly, pro-choice liberals are placed in a difficult position regarding their support for FAA if they are opposed to SSA and GSA.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- Albrecht G, Devlieger P (1999) The disability paradox: high quality of life against all odds. *Soc Sci Med* 48(8): 977–988
- Alford J, Funk C, Hibbing J (2005) Are political orientations genetically transmitted? *Am Pol Sci Rev* 99(2): 153–167
- Bitler M, Zavodny M (2002) Child abuse and abortion availability. *Am Econ Rev* 92(2):363–367
- Boonin D (2002) *A defense of abortion*. Cambridge University Press
- Buchanan A (1996) *Choosing Who Will Be Disabled: Genetic Intervention and the Morality of Inclusion*. *Social Philosophy and Policy* 13(2):18–46
- Buchanan A, Brock D, Daniels N et al (2000) *From chance to choice*. Cambridge University Press, Cambridge
- Churchman M, Qian M, Kronnie G et al (2018) Germline genetic IKZF1 variation and predisposition to childhood acute lymphoblastic leukemia. *Cancer Cell* 33(5):937–948.e8
- Department of Health and Social Care (2017). *Abortion statistics for England and Wales: 2017*. Available at: <https://www.gov.uk/government/statistics/abortion-statistics-for-england-and-wales-2017>. Accessed 28 Mar 2019
- Fox B (2017) It's nature and nurture: integrating biology and genetics into the social learning theory of criminal behavior. *J Crim Just* 49:22–31
- Gilissen C, Hehir-Kwa J, Thung D et al (2014) Genome sequencing identifies major causes of severe intellectual disability. *Nature* 511(7509):344–347
- Greasley K (2017) *Arguments about abortion: personhood, morality, and law*. Oxford University Press UK, Oxford
- Grimes D, Benson J, Singh S, Romero M, Ganatra B, Okonofua FE, Shah IH (2006) Unsafe abortion: the preventable pandemic. *Lancet* 368(9550):1908–1919
- Harris J (2005) No sex selection please, we're British. *J Med Ethics* 31(5):286–288
- Kotsopoulos J, Gronwald J, Karlan B et al (2018) Age-specific ovarian Cancer risks among women with a BRCA1 or BRCA2 mutation. *Gynecol Oncol* 150(1):85–91
- Liu J, Gong P, Li H, Zhou X (2017) A field study of the association between CD38 gene and Altruistic behavior: empathic response as a mediator. *Psychoneuroendocrinology* 85:165–171
- McMahan J (2002) *The ethics of killing*. Oxford University Press, New York
- McMahan J (2005) Preventing the existence of people with disabilities. In: Wasserman D, Bickenbach J, Wachbroit R (eds) *Quality of life and human difference*. Cambridge University, Cambridge, pp 142–171
- UN General Assembly, *Convention on the Prevention and Punishment of the Crime of Genocide*, 9 December 1948, United Nations, Treaty Series, vol. 78, p. 277, available at: <https://www.refworld.org/docid/3ae6b3ac0.html>. Accessed 15 Mar 2019

- Price M (2018) Giant study links DNA to same-sex experiences. *Science* 362(6413):385–386
- Savulescu J (2001) Procreative Beneficence: Why We Should Select the Best Children. *Bioethics* 15(5–6):413–426
- Savulescu J (2006) Sex selection: the case for. In: Helga Kuhse & Peter Singer (eds). *Bioethics, An Anthology*. Blackwell, pp 2–145
- Saxton M (2000) Why members of the disability community oppose prenatal diagnosis and selective abortion. In: Parens E, Asch A (eds) *Prenatal testing and disability rights*. Georgetown University Press, Washington, DC, pp 147–164
- Shields N, Leonard H, Munteanu S et al (2018) Parent-reported health-related quality of life of children with down syndrome: a descriptive study. *Develop Med Child Neurol* 60(4):402–408
- Skotko B, Levine S, Goldstein R (2011) Having a son or daughter with down syndrome: perspectives from mothers and fathers. *Am J Med Genet Part A* 155:2335–2347
- Sniekers S, Stringer S, Watanabe K et al (2017) Genome-wide association meta-analysis of 78,308 individuals identifies new loci and genes influencing human intelligence. *Nat Genet* 49(7):1107–1112
- Thomson JJ (1971) A defense of abortion. *Philos Public Aff* 1(1):47–66
- Van den Veyver I (2016). Recent advances in prenatal genetic screening and testing. *F1000Research* 5 (October): 2591
- Van den Veyver I (2018) Prenatal genetic testing and screening. In: Draper N (ed) *Chimerism*. Springer, Cham
- Widdows H (2009) Persons and their parts: new reproductive technologies and risks of commodification. *Health Care Anal* 17(1):36–46
- Widdows H (2014). Is sex-selective abortion morally acceptable? University of Birmingham. Available at: <https://www.birmingham.ac.uk/research/perspective/debate/sex-selection-widdows.aspx>. Accessed 22 Aug. 2019
- Wilkinson S (2010) *Choosing Tomorrow's children*. Oxford University Press, Oxford
- Williams J (2012) Sex-selective abortion: a matter of choice. *Law Philos* 31(2):125–159
- Wray N, Ripke S, Mattheisen M et al (2018) Genome-wide association analyses identify 44 risk variants and refine the genetic architecture of major depression. *Nat Genet* 50(5):668–681

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.