How Should Australia Regulate Reproductive Selection for Predicted Intelligence?

An Ethical Analysis of Models Regulating Embryo Selection for Predicted Intelligence Using Polygenic Scores

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Background - Science

Approximately 50% of population variance in intelligence is attributable to genetics. Recent scientific advances have allowed us to better understand this relationship. As of 2018, DNA tests can generate "polygenic scores" which account for 10% of intelligence variance. These scores situate individuals on a bell curve of predicted genetic propensity for intelligence.

We can apply this test to IVF embryos using preimplantation genetic diagnosis (PGD), to select embryos on the basis of their predicted intelligence.

PGD process

- Embryos formed during IVF treatment and grown to blastocyst stage
- Up to 8 cells are removed from each blastocyst for genetic testing
- Test results can help inform decisions regarding which embryos to implant

Figure 1

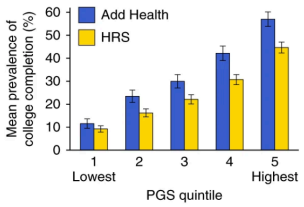
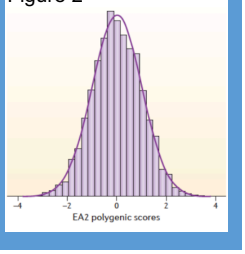


Figure 1 (above): College completion rate by polygenic score (PGS) quintile when applied to two cohorts (HRS & AH)

Figure 2 (right): Normal distribution of polygenic scores for Educational Attainment (EA)

Figure 2



Background - Ethics

The concept of selecting embryos based on predicted intelligence raises many ethical concerns:

- Concerns about PGD - the moral status of embryos, the reaction of the disability community, the history of eugenics
- Is enhancing intelligence through reproductive selection morally worthwhile? Procreative beneficence, the non-identity problem, impact of intelligence on wellbeing
- How will this impact society? Benefits (boosting economies, solving global issues, improving overall welfare) vs. Harms (exacerbating inequalities, commodification of children, "slippery slope" concerns)

Much will depend on how we regulate PGD

Project Outline

Research Question: How should Australia regulate the practice of embryo selection using PGD for predicted intelligence?

Hypothesis: The current Australian model of PGD regulation may not be optimal given the new ability to select embryos based on predicted intelligence.

Aim: To develop a model of PGD regulation in Australia which will have optimal ethical and practical outcomes in the context of its new application for selecting embryos based on predicted intelligence.

Methodology:

1. Analyse scientific and ethical literature to understand possibilities and ethical implications.
2. Evaluate models of PGD regulation, focussing on their ethical implications when applied to selection based on predicted intelligence →
3. Generate criteria which an ideal model would fulfil
4. Propose a model fulfilling these criteria → The Welfare Model
5. Address objections to the new model

Models of Regulation

Model	Explanation	Example
Unrestricted-use model 	PGD is unregulated. Its use is subject to service-provider preferences and market forces.	**Current American model.** There is no regulation for PGD. In early 2019 an American company began offering to test embryos for "intellectual disability" using polygenic scores.
Disease-based model 	PGD is permitted to select against "disease" traits, but not against non-disease traits. The permissibility of PGD to select against a certain trait depends on whether or not that trait constitutes "disease".	**Current Australian model.** PGD can currently be used to select against conditions which would "severely limit quality of life" in the resultant child.
Prohibition model 	PGD is expressly forbidden.	**Historic Italian model (2004-2009).** This model prohibited all uses of PGD

Evaluation Findings

The American "unrestricted-use" model highlights the need to:

- ✓ Attain the benefits of selection for intelligence
- ✓ Overcome concerns about social justice, lack of oversight and absence of ethical input

The Australian "disease-based" model highlights the need to:

- ✓ Be applicable to polygenic tests and continuous traits
- ✓ Be publically acceptable

The historic Italian "prohibition" model highlights the need to:

- ✓ Minimise risks
- ✓ Prevent exacerbations of inequality
- ✓ Respect the principle of Procreative Liberty

The Welfare Model

Allows for selection against low IQ up to a certain threshold, but this threshold is determined based on predicted welfare rather than statistics (the current, somewhat arbitrary, threshold). Parents can select against embryos falling below the threshold, but can't select for high intelligence.

Threshold: After considering multiple candidates, the threshold of "predicted ability to complete high-school without specialised help" was selected. This is correlated to a polygenic score for selection purposes.

Funding: in order to avoid exacerbating inequality, universal public funding would be the best funding approach. However for this to be ethically justifiable, the test must be cost-effective, adequately reliable, detect sufficient "at-risk" embryos, be effective across populations and provide welfare-relevant benefits.

If these criteria cannot be met, other ethical funding models include:
- Providing conditional funding to those with low IQ (or polygenic score)
- Providing no funding but taxing the test to fund programs favouring the intellectually disabled
- Delaying provision of the test until it fulfils criteria for universal public funding

In Conclusion… The Welfare Model fulfils criteria for an optimal model and provides an ethical and feasible approach to regulating PGD in light of the new ability to predict intelligence from DNA.

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Figure 1 credit: Lee JJ, Wedow R, Okbay A, Kong E, Maghzian O, Zacher M, et al. Gene discovery and polygenic prediction from a genome-wide association study of educational attainment in 1.1 million individuals. Nat Genet. 2018;50(8):1112-21.

Figure 2 credit: Plomin R, Von Stumm S. The new genetics of intelligence. Nat Rev Genet. 2018;19(3):148-59.

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