Stacking the Genetic Deck
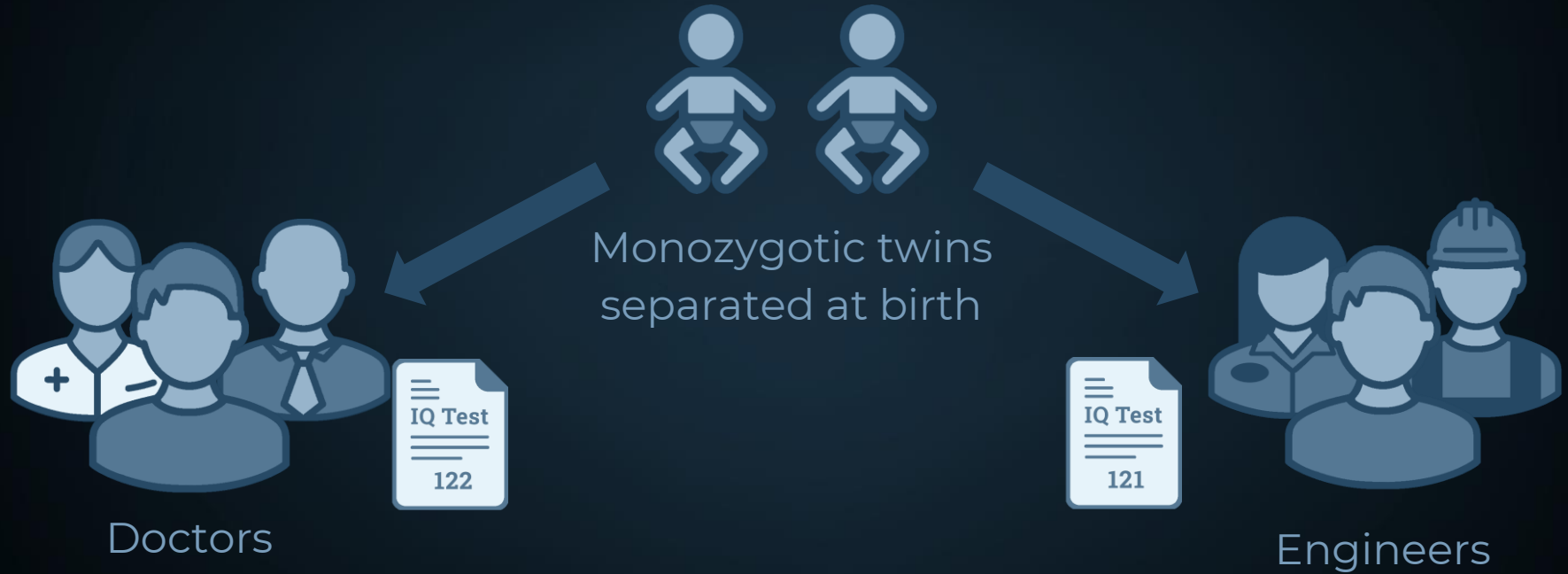
Jonathan Anomaly

What do we know about heritability?

1. All traits are **heritable**.

2. Complex traits are **polygenic**: they're influenced by many genes of small effect.

3. **Rare genetic variants** can have larger effects on complex traits, usually negative.

Twin Studies

Heritability Estimates

Height	~ 90% heritable
General intelligence (g)	~ 75% heritable
Personality traits	~ 50% heritable
Political orientation	~ 40% heritable

Genome-Wide Association Studies
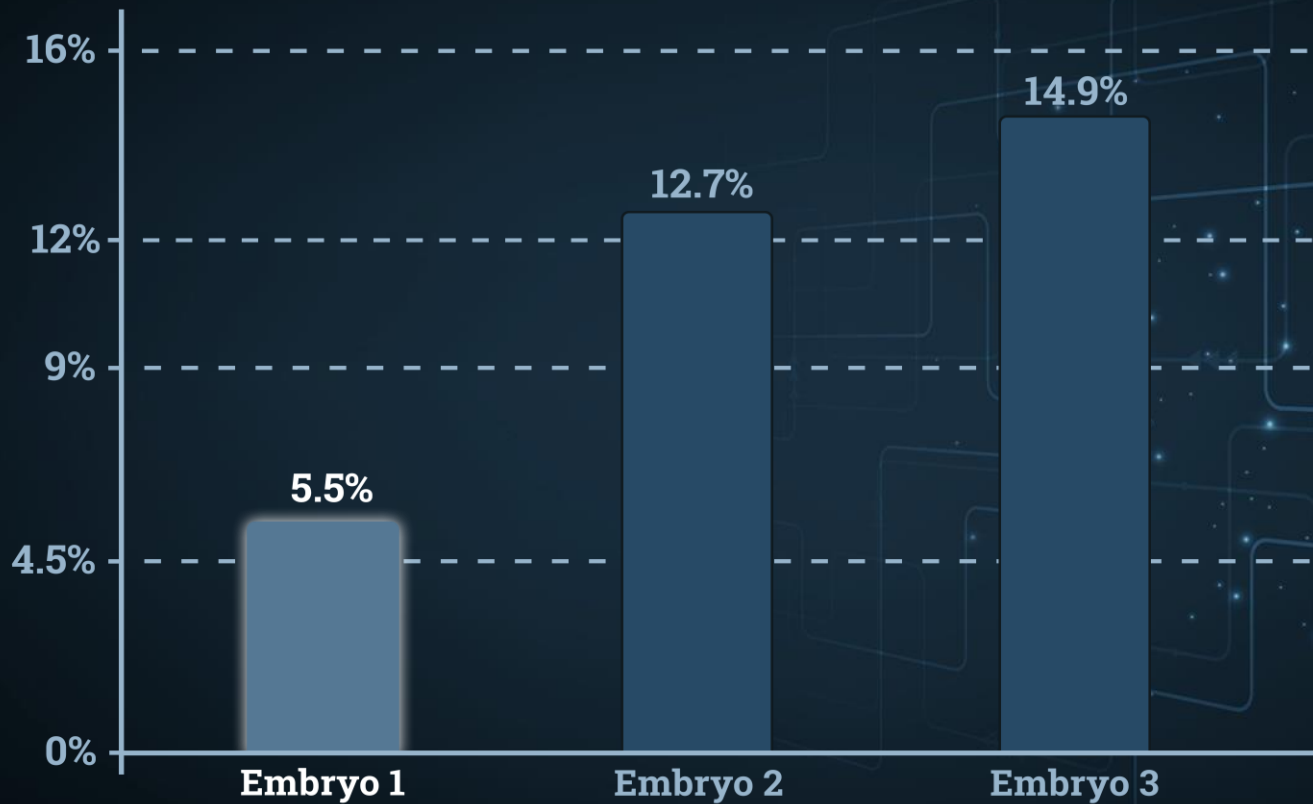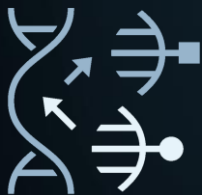
How to influence children's traits

1. Mate selection

2. Gene editing (CRISPR)

3. Embryo selection (IVF + PGT)

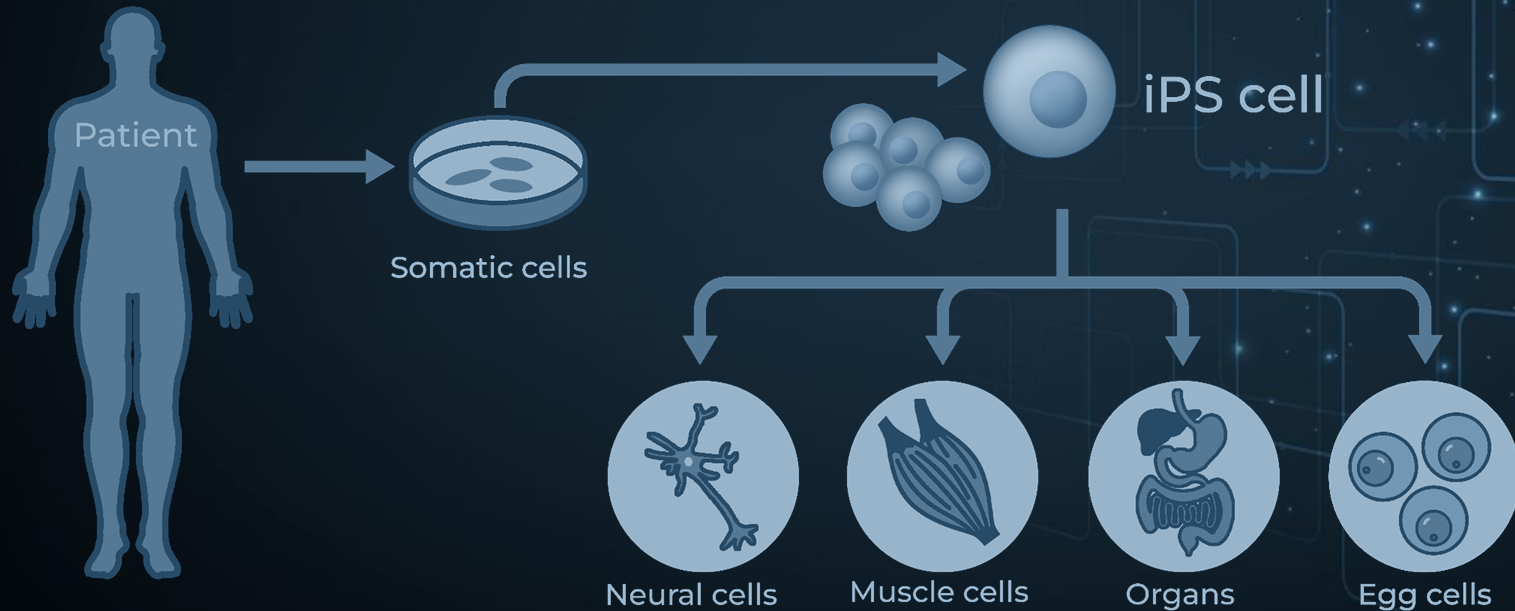# Gains from selection depend on number of embryos – e.g. IQ

For ten embryos:

Range

14 IQ points

In-vitro-gametogenesis will supercharge selection

Patient

Somatic cells

iPS cell

Neural cells

Muscle cells

Organs

Egg cells

Benefits of minimizing genetic disease

INDIVIDUAL
Longer, better, more fulfilling life

SOCIAL
Economic productivity
Benefit rather than cost on health systems

Benefits of enhancing intelligence

INDIVIDUAL
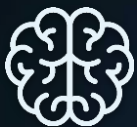Longer life, better health, more income (Plomin & Deary)
More stable relationships, less criminality (Beaver, Boutwell, Murray)

SOCIAL
Economic productivity and scientific innovation (Bostrom)
Cooperation in collective action problems (Jones)

What traits can we influence?

Mental traits

Intelligence
Schizophrenia
Bipolar Disorder
Severe Depression

Aesthetic traits

Height
BMI
Hair color
Body shape

Health traits

Cancer
Diabetes
Heart Disease
Rheumatoid Arthritis

Reasons to support genetic selection

1. Nature does not select for human happiness

2. Civilization preserves harmful mutations

3. Evolutionary mismatch is pervasive

4. Arms races create incentives

Reasons to worry about genetic selection: Collective Action Problems

Sex Ratios (imbalances)

Height (arms races)

Immunity (monocultures)

Solution: Regulatory Parsimony

When legislation is necessary to **prevent serious harms** resulting from collective action problems, we should aim for **simple rules** that **apply to all**.

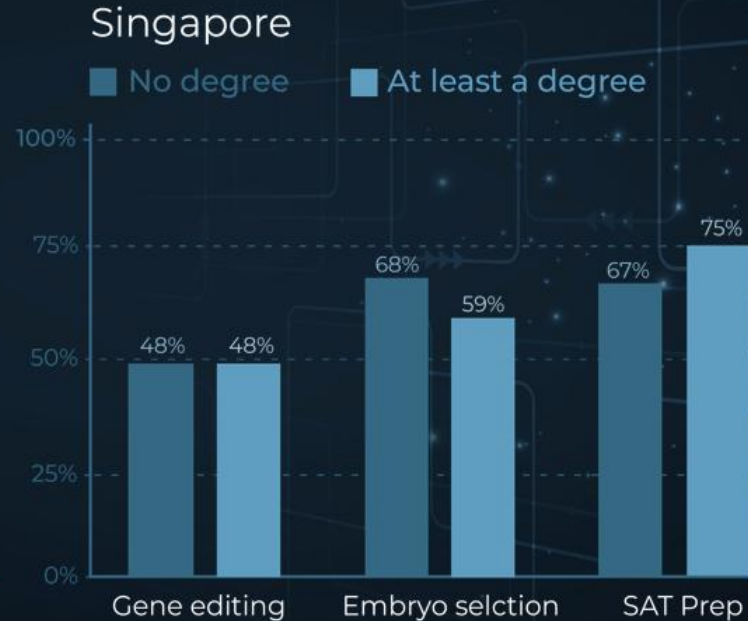We should also take the **least restrictive** alternative among the feasible set of laws.
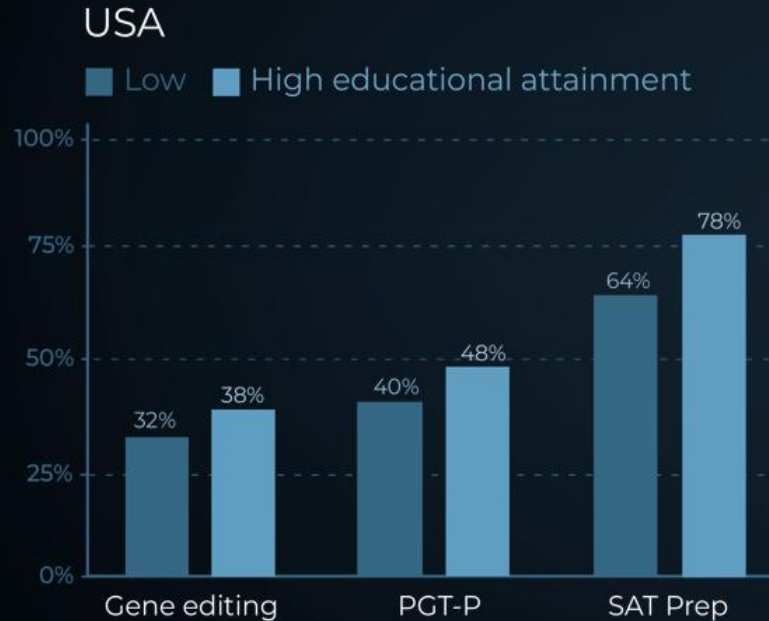
(Adapted from: Presidential Bioethics Report on Synthetic Biology, 2010)

Regulatory Parsimony Justified

1. Complex laws are easier for powerful people to navigate.

2. Too many laws can crowd out social norms.

3. Restrictive laws can encourage learned helplessness and black markets.

Embryo selection for IQ

Willingness to use each service

USA
■ Low ■ High educational attainment

	Gene editing	PGT-P	SAT Prep
Low	32%	40%	64%
High	38%	48%	78%

Singapore
■ No degree ■ At least a degree

	Gene editing	Embryo selction	SAT Prep
No degree	48%	68%	67%
At least a degree	48%	59%	75%

Sources: Meyer et al. Public views on polygenic screening of embryos. *Science*. 2023
Haining et al. Singaporean attitudes toward cognitive enhancement. *Journal of Medical Ethics*. 2024