**“Positive Modern Eugenics and the Issue of**

**Correlation Between High Intelligence and Mental**

**Illness”**

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# 1.0 Abstract

Modern eugenics has been embraced by the advances of genetic germline editing (GGE) through intentional control of desired genetic properties. Such interventions hold a precautionary lesson to the pursuit of ethically permissible eugenic practices. While there are distinct causative correlations between high IQ and mental illness, we present a novel set of arguments in part to enhance: (A) low to average and/or high IQ, and (B) average to high IQ, upon the goal of positive modern eugenics. By correlating intellectual enhancement and possible mental illness in different cases, we argue that GGE is morally right if and only if it fulfils both the subsequent criteria: First, the individuals carry more than 50% heritable mental disease risk. Second, the resultant intervention must promise an overall benefit without further exacerbation of the illness. In the absence of a clear, standardized theoretical model, this heterodox conclusion including research discrepancies, which should future studies attempt to resolve.

**Keywords: Positive modern eugenics, high intelligence, mental illness, genetic engineering, genetic germline editing, human enhancement**

# 2.0 Introduction

In the course of human evolution, the incorporation between mutation, natural selection, and random genetic drift have been long recognised as an important mechanism attribute to diversification on genotypic traits.1 The breadth of genomic diversity seems to shape brain formation during embryological development, and affect various cognitive functions, including intelligence and mental health.2 In the *Origin of Species*, Charles Darwin proposed the theory - “survival of the fittest” that emphasised phenomenon supporting the survival of favourable or ‘fit’, and the elimination of the less favourable or ‘unfit’.3 In modern societies, however, a paradigm shift from ‘natural’ to ‘nurture’ breeding is taking place, involving two general concepts: genetic advancement and transhumanism.4 Parallel development in science and cutting-edge technology has made gene manipulation possible. Multiple detrimental diseases, including HIV AIDS,5 leukemia,6 and sickle cell disease7 have been successfully ameliorated by genome editing (e.g., CRISPR-Cas 9) under early-stage clinical application.8 Further, for other more complex genetic-based diseases, constant advances in gene editing and gene therapies are slowly but surely ushering a new age of treatment options. As a result, even the unfit can lives freely from detrimental illness. To importantly note, here we state the term “unfit”, when relating to individuals today, purely in the traditional Darwinian context, and not in terms of their individuality. Such advancement in genetic manipulation has been extended to germ-line editing (GGE), not only to correct and prevent genetic diseases, but also towards human enhancement, e.g., intellectual capacity. Imagine if we could get into the possibilities of selecting traits that most correlated to enhanced cognitive functions, as such high intelligence for our offspring, it could be a valuable tool to improve the human gene pool. Whilst there is no specific ‘intelligence gene’ identified presently, we theoretically could find ourselves in a future whereby gene clusters associated with intelligence are identified, leading to the technical point of being able to genetically engineer an ‘intellectually gifted’ child. By doing so, the goal of realizing a significant enhancement, i.e., positive modern eugenics (selecting for a desired trait via biotechnological intervention), on human capacities seems to be possible.

The philosophical and scientific movement defending the use of advanced technologies to nurture evolutionary processes and enhancement to transcend base humanity is seen to flourish within transhumanist movements.[[1]](#footnote-1) The ideology of transhumanism promotes not only traditional means of improving human nature, e.g., elimination of unnecessary mental illnesses and extend human lifespan, but also direct application of genetic technology to overcome and further enhancement on our basic biological limits.9 One of the co-founders of Humanity+ (formerly the World Transhumanist Association) – Dr. Nick Bostrom, highlighted his statement on increasing eugenics pressure to breed a human race with superior intellectual capability. , 10 That is to say, he aims to eliminate mental illnesses and create superior posthumans with high intelligence, 10 a *Homo-superiorus o*f sorts. In line with our main concern, questions on whether one could modify genetic traits that are involved in the variance of intellectual capability and subsequent mental health have raised important questions among scientists and philosophers. The fundamental issue is that, even if one could enhance intelligence via genetic engineering, should they, if there could be a correlation between high intelligence and mental illness? Further, if there was a direct correlation, would it still be (morally) right to enable enhanced intelligence in an individual who would suffer from mental illness, for the presumed benefit of the many due to their high intellectual capacity? Regardless of numerous research studies available, results still leave no place for an unambiguous answer to define the correlation between high intelligence and mental illness.11, 12 Therefore, we must also consider the inverse. The capability of genetic enhancement on intelligence, indeed, appears be able to facilitate the creation of a better quality of life, resulting in procreative beneficence (parents should select the children promised the best life, or at least a normal life as others). 13

While GGE has potential benefit, biological, ethical, and societal concerns in human rights are of course deeply rooted. For instance, while low intelligence was meant to have an association with mental illness, is it true that creating such genetically enhanced intelligence would positively change anything pertaining to mental health later in life?14 What if the apparently ‘bad’ or undesired genes serve as a protective factor against other conditions? Is it better then not to bring any new life to existence then, as posited by Prof. David Benatar?15 Well, even Benatar, whose position is logically solid via his asymmetry argument, acknowledges that the drive to reproduce is stronger than higher intellectual capabilities of people to accept and act on an antinatalist position,15 therefore this paper argues to look at how to best minimise harms of coming into existence with respect to intelligence and mental illness. Human experience can indeed hold distinct cognitive functions, both good (high intelligence and good mental health) and bad (low intelligence and poor mental health).16, 17 In this review, we further argue that it is worthwhile bringing enhancement to intelligence into reality when the ‘good’ outweighs the ‘bad’, or at least showing a net benefit in better cognitive function (‘not bad’) than before. The argument proposed here is that genetically enhanced intelligence should be considered ethically feasible if and only if – we are able to fulfil the following characteristics: (i) mitigate the mental illness normally associated with low or high intelligence (‘good’), (ii) enhancement to normalcy from poor cognitive function associated with low intelligence and mental illness (‘good’), or (iii) enhancing intelligence from a normal or base level while reducing the risks towards any

new mental illness (‘not bad’). While universal guiding policymaking is needed to address that antagonistic duality, in the sense of good and bad, the precautionary principle could play an integral role to evaluate potential moral imperatives of GGE on intelligence (and even the inverse precautionary principle). Changes in population genetic diversity and their effects on social equity are other concerns to be considered, thus, a proper assessment on transhumanism and eugenics is required.

Creating designer babies is known to be biologically possible, but would it be ethically desirable and widely accepted by public? The door is open; hence, one aspect of this review is to assess the potential causative correlation between high intelligence and mental illness to best establish an ethical argument for or against genetic intellectual enhancement. Further there is also the aim to give consideration from an almost inverse perspective; would it be morally right to enhance intelligence to normalcy, given the perceived association between sub-intelligence and mental illness. This review will also introduce an overview of research on the evolution of eugenics and the extension within this particular domain relating to various genetic engineering technologies. Second, this is followed by integrating the correlation between intelligence and mental illness, and considers how GGE on intelligence applies to the normative basis of the eugenics movement. Third, this review will be presenting the precautionary logic relating to GGE on individuals differing in intelligence scores, along with their associated ethical arguments, in addition to the inverse of precautionary principles. Finally, a framework will be developed for the consilience of pursuing the realm of modern positive eugenics.

# Eugenics

***An Overview****.* The birth of the theory of evolution by natural selection was first created by

Charles Darwin.3 In 1883 his cousin, Sir Francis Galton, proposed the term ‘eugenics’ derived from Greek word ‘eugenes’, meaning ‘good in birth’ to deliver the idea of using the new science of heredity to improve the human species.18 Natural selection strictly implies that the evolutionary process is natural as in, without the direct hand of man. In stark contrast, eugenics interfered with this natural process by intentional control for theenhancement human species, preventing the unprivileged or whoever that is unfit of reproduction.19 The theory of eugenics was posited on increasing the elite offspring (positive eugenics), while decreasing defective classes (negative eugenics).

***A History of Eugenics – The Good and Bad.*** Man was thought born to inherit what our parents bequeathed to us at birth. In the nineteenth centuries, the core idea embedded in eugenics was mainly on assortative mating, regulating birth control, and/or immigration restriction.19, 20 As stated in Galton’s book, eugenics involved both the genetics and the scientific principles of inheritance.21 By instilling such understanding to parents, Galton encouraged the fit to mate with a genetically similar individual (positive eugenics). The goal was to prevent the birth of and eliminate people with disabilities, thus, to achieve procreative beneficence in breeding a better offspring for the human race.21 Nonetheless, the implications of eugenics movements were extensive. On the dark side, the very immoral, horrific and cruel fact is that in the eugenics movements (the most well-known occurring in Nazi Germany between 1933 – 1945), not only was breeding controlled with respect to undesirable traits, but further, those deemed as unfit breeders risked elimination through involuntary sexual segregation, stigmatization and denigration, sterilization, and even murder. 22

***New Theoretical Understanding in the Context of Modern Eugenics.*** In the Declaration of Independence Benjamin Rush claimed: “It is possible the qualities of body and mind in parents, which produce genius in children, may be fixed and regulated, and it is possible that the time may come when we shall be able to predict with certainty the intellectual character of children, by knowing specific intellectual faculties of their parents”.23 While the old idea would require a continual selection for breeding the fit, and the elimination of the unfit; today, eugenics is actively being pursued in the practice of human genetics, driving human liberty to a new level which is necessary to convert unfit populations to achieve an average fitness (i.e., correction of certain genetic disorders), or even performance beyond the typical scope. This brings up the consideration of negative and positive modern eugenics – genetic engineering (e.g.*,* prenatal diagnosis of Downs syndrome and genetic editing), allowing mankind to control its innate endowment and genetic properties of future offspring. There are groups of transhumanists and scientists now proposing more radical modifications, involving improving significant human attributes and abilities to levels that greatly exceed what is currently possible for human beings, bringing posthuman existence closer.9, 24

***The Core of Genetic Engineering Towards Modern Eugenics*.** Since the completion of the Human Genome Project in 2003, the power of heredity and genetics were further embraced to overcome human limitations, i.e., human enhancement.20 Indeed, under genetic control, some birth defects can be avoided by merely selecting healthy traits. Prenatal genetic diagnosis intervening gene selection could identify any abnormal genes or embryos. For instance, preimplantation genetic screening (PGS) and preimplantation genetic diagnosis (PGD) are often used in conjunction with *in vitro* fertilization (IVF) to examine any potential genetic defects prior implantation *in vivo* or during pregnancy stages, holding promise in revolutionizing selective breeding. It is true that prenatal genetic tests carry some controversial arguments regarding their use against nature principles and increased rates of abortion, mostly from the religiously conservative side. Still, most people have fewerobjections on prenatal genetic diagnostic services as they involve screening and selecting desired traits, causing only minimal risks. Nevertheless, if we go to the broader concept of eugenics as seeking to improve the human gene pool, prenatal diagnosis alone is clearly not sufficient to further drive and grow modern eugenics.25 Genetic editing technologies such as clustered regularly interspaced short palindromic repeats (CRISPR-Cas-9) have facilitated GGE, allowing direct modification to human DNA through targeted intervention in the genome to create new or ‘repaired’ versions of the genes of embryos prior to implantation.

**Intelligence and Its Correlation with Mental Illness***.*

***Intelligence.*** The conceptualization of intelligence has evolved incrementally, with different paradigms and models of intelligence coexisting. While there remains no specific definitions, intelligence, in particularly academic intelligence, is an umbrella term describing a set of cognitive skills related to memory, reasoning, problem solving, and logic skills.26 The general cognitive intelligence or Spearman’s *g* factor is often used to model these diverse intellectual capabilities and can be characterized by testing one’s intelligent quotient (IQ) that reflect their average performance across cognitive tests relative to the norm referenced (*See Appendix 1*).12 The Wechsler Adult Intelligent Scale (WAIS) is now one of the most commonly used standardized tests to estimate g factor. This test combines results of multiple tests in one measurement, the full-scale IQ score.2, 27

***The Correlation.*** Numerous reports initially suggested that a high IQ could serve as a protective factor for mental illness and related conditions12, 28 throughout a person’s lifetime.29 For instance, Karestan *et al.,* found that persons with higher IQ tend to have lower risks of agoraphobia and post-traumatic stress disorder (PTSD), albeit the results were not significant due to small effect size. throughout a person’s lifetime.29 For instance, Karestan *et al.,* found that people with a higher IQ tend to have lower risks of agoraphobia and post-traumatic stress disorder (PTSD), albeit the results were not significant due to small effect size.30 They also reported that lower IQ in childhood was correlated with increased risks of developing schizophrenia, anxiety, and depression in later adulthood.30 Further, Toulopoulou *et al.,* reported a strong correlation between intelligence and schizophrenia due to the overlap of substantial genetic liability.31 Ample evidence started amassing that many of the same genes that contribute to variation in intelligence are also likely to influence susceptibility to mental illness, in particularly towards depression 32, 33, schizophrenia 31, 34, and PTSD35, 36. On the flip side, individuals with lower cognitive capacity (IQ scores <85) often results in poor academic performance and stress coping strategies, which may affect their daily functioning,37, 38. Linda *et al.,* reported that the chances of teens with borderline IQ (IQ scores between 70-84) being diagnosed with mental illnesses were significantly (almost five times) higher, as compared to the average group (IQ scores ≥ 85).38 Among the diagnosed psychiatric disorders, attention-deficit/hyperactivity disorder (ADHD), anxiety, and depression were the main causal factors in borderline IQ.38

Contrary to the above though, some say the opposite.12, 29 Weiser *et al.,* reported that high IQ adolescents showed a higher risk for schizophrenia 39,39 According to the Polish psychiatrist Kazimierz Dabrowski, high IQ people tend to have heightened awareness and greater responsiveness to stimuli.40 These ‘overexcitabilities’ could lead to hyper-reactivity of the central nervous system, subsequently increasing the vulnerability to detrimental psychological consequences.11 Among various mental illnesses, ADHD, autism spectrum disorder (ASD), and learning disabilities are greatly found to comorbid with high intelligence.11 Other studies have also suggested that bipolar disorder 41, 42 is more common in high IQ people. Together, published studies indicate at least two different plausible findings of the correlation between high IQ and mental illness. Different mental illnesses appeared to show distinct and meaningful correlation, which indicates genetic variants associated with high levels of intelligence have both facilitative and protective effects on genetic liability of mental illness. Another possible explanation for the positive correlation between high IQ and mental illness could be health literacy, where people with high IQ are generally more self-aware towards their changes in mental health, and vice versa; leading to a greater proportion of high IQ population being reported to be associated with mental illness.

***Application of genetic germline editing (GGE) in intellectual enhancement.*** While low intelligence and mental illness could hinder human character development, genetic engineering serves to improve genetically-based traits and capabilities for unfit individuals. Here, one would aim at the obtainment of good traits (i.e., high intelligence), whilst mitigating and/or eliminating detrimental traits (such as mental illness). By directly targeting healthy gene clusters or with the selection of SNPs most correlated to intelligence, GGE has the potential to restore or enhance the intelligence prior to fertilization. Unlike somatic gene editing, these genetic changes are produced by germline (heritable) interventions; thus, they could potentially change a person’s fate and future descendants, eventually leading to large-scale impact in the long run of human evolution (though it is important to note that there is a high level of diversity and action of individuals and groups). This may carry immerse potential for beneficial deployments, however, there could also be the possibility to cause irreversible harm, ranging all the way to extreme possibility of an actually beneficial trait becoming extinct (though this should be easily fixed via the same gene editing technology used to remove said trait). Other potential outcomes include widening social inequalities or a gradual erosion of human rights and possible recapitulation of the horrific old days of eugenics. This is why force and use of Nazi-style state sponsored eugenics should always be rejected; individuals must be allowed fully informed choice.

Genetic enhancement is therefore beset with different sets of ethical and policy dilemmas. Hence, such risks must be taken seriously and thoroughly before human enhancement can be made to feasible.

# Precautionary principle

***Biological, Ethical, and Societal Considerations*.** We can conceive the possibility that as we develop a greater understanding of the human mind-brain interface, genetics, and gene technologies, we shall come to discover methods to mitigate any detriments to mental illness, thus bringing us closer to the realisation of *Homo superiorious*. On the other hand, a lack of solid scientific basis could result in significantly greater risks to its implementation and consequences due to the causative correlation between intelligence and mental illness and its complex network between both genes and the environment one finds themself in (e.g., the impact of the quality of parenting, a truly external and non-genetic factor). Further, any modification on germline cells can be passed on to subsequent generations as part of human gene pool. In 2015, the Second International Summit stated that the application of GGE on humans would be irresponsible until safety issues were resolved and until a mutual consensus was made.43 Hence, ethical and societal considerations on genetic engineering for intellectual enhancement remain a fundamental matter to support its future development. The ethics policy would be required and justified if GGE intelligence may affect one’s health and cognitive/social epidemiology. Also, as touched on, parenting, education attainment, and socioeconomic class are highly important environmental variables that need deep assessment (though is outside of the remit and scope of this paper).

***The logic gate***. From an ethical ground, a logic gate concept of the precautionary principle of intellectual enhancement allows potential biconditional statement interpretations; to opt for best actions and outcomes on bringing human GGE ethically and legally. Here, we present two conditions in enhancing intellectual capability from a state of: (i) CASE A: going from low IQ to average or high IQ, and (ii) CASE B: going from average IQ to high IQ *(Appendix 2*). Both conditions in GGE raise slightly different levels of biological, ethical, and societal considerations. Here, a standardized full-scale IQ score (*See Appendix 1*) was implemented to better evaluate both conditions.

CASE A: For the argument’s sake, we first assume (fairly, based on what has come previous in this paper) that there is a causative correlation between high IQ and significant mental illness, and that a significantly low enough IQ itself is considered intellectually disabled (hence an innately increased risk for mental illness); we might then speculate on if genetically modification for intellectual enhancement from low to average or high IQ is morally right if and only if one would be pre-diagnosed to carry more than 50% likelihood of a heritable mental defect, and the resultant modification has a high probability to mitigate mental illness due to a low IQ (hence moving towards the ‘good’ in terms of fitness). Whilst this may be an obvious good when looking at going from low IQ to regular, it is less obvious if we went from low to high IQ due to aforementioned issues around high IQ also having a causative correlation with mental illness. However, if any resultant mental illness, on a probabilistic basis, would be less than that associated with a low IQ, then we are now in a situation of a net benefit, or ‘less bad’. This rests on another assumption that due to enhancement to average or high IQ risks arising from unintentional germline modification through off-target effects would only have minimal impact. This is to say the overall risks of GGEs on intelligence would not deviate significantly from the risks arising from the cumulative effect of mutations in heritable mental illness (‘not bad’).

CASE B: We next proposed that GGE aims at augmenting IQ beyond typical human capacities. Rather, greater risks could be developed when considering a modification that enhances ‘normal’ to ‘beyond normal’ (average IQ to high IQ, or the movement from *Homo sapiens* to *Homo superior*). Assuming high IQ has a causative correlation with significant mental illness, and that average IQ has its lowest propensity towards mental illness, we could defend that genetically modification on intellectual enhancement from average to high IQ is morally right if and only if the resultant modification can have mitigation of any mental illness whilst experiencing a net positive effect due to the enhancement of intelligence (moving towards a net ‘good’); or at least the resultant mental illness from having a high IQ does not cause any worsening effect compared to any mental illness experienced from having an average IQ (hence a ‘not bad/worse’ scenario), also of course provided that any possible off-target effects wound only have minimal impact. While this may be true, an objection would be ethically legitimised when the genetic modification would likely confer or worsen a heritable mental illness (‘bad’).

A general risk-benefit assessment was performed, showed in *Appendix 3*. Accordingly, it seems possible, at least under our theoretical assumptions, CASE A satisfied the basis of bringing enhancement into reality, providing that the ‘good’ outweighs the ‘bad’, or ‘not bad’ (better than no enhancement). Mental illness is recognised as a form of suffering; i.e., catastrophic harm, therefore, any conditions with high risks of getting mental illness is consider as ‘bad’. Taken together, if our assumptions are vindicated, i.e., positive correlation of high IQ and mental illness, with non-significant off-target risks arising from GGE, hence, this form of germline editing is morally and scientifically validated. With GGEs intervention, an individual with pre-morbid low IQ will be able to enjoy at least a net benefit between high IQ and decreased mental illness (‘not bad’) or even protected from deteriorate mental illness (‘good’). Furthermore, specifically in CASE A, if low IQ itself is considered a mental illness, genetically engineering intelligence gene clusters could possibly free one from excess suffering. If GGEs intervention is not applied, an individual could only be possibly worst off due to low IQ and inheriting mental illness (‘bad’); i.e., nothing is in favour by against CASE A, rather accepting it. As regards to CASE B, however, the question arises when an individual could be worse off from mental illness and other potential

defects. When an individual with average IQ has already possessed the least risk of a diagnosis with mental illness, will the resultant situation be worse if they were to move to a high IQ level of existence? Following the 1992 Rio Declaration; where there are threats (even 1% likelihood that modifications confer to mental illness and that lack of full scientific certainty of serious or irreversible damage), we shall be against the enhancement in CASE B to protect further deterioration of mental health.44

# Case study

***Germline modification on early embryo***. A shock wave flushed the science community in the late November of 2018 – the creation of world’s first designer babies by He JianKui (a Chinese scientist), he claimed, had come about via GGE in the early stages of human embryos using the CRISPR technique.45 The goal, JianKui said, was to eliminate the human immunodeficiency virus (HIV)-associated gene, called CCR5, with the hopes of rendering future offspring resistant to HIV.45 He modified human embryos before they were implanted into a woman’s uterus to facilitate pregnancy. So far, only the birth of germline modified non-identical twin girls, Nana and Lulu, was revealed.45 JianKui’s experiment however, was a fiasco and resulted in the development of a new mutation in both twins; so-called genetic mosaics.46, 47 As discussed, GGEs involve intentionally modifying genes in early embryo has consequences lasting throughout a person’s lifetime and potentially affecting his/her descendants. In respond to He’s experiment, the risks fall into three main groups: (i) testing CRISPR in human embryos, (ii) long-term consequences of either intended or unintended genetic changes of the person, and (iii) biological future offspring.43

***Gene-environment interplay*.** A mountain of evidence consistently shows that intelligence is substantially heritable, with 70% of the total variance accounted for by genetic influence;48 the remaining percentage is contributed to by an individual’s environment. Genes shape the brain through complex interactions with multiple environmental factors, e.g., childhood environment, parenting, education, and socioeconomic status,49 showing that gene-environment (GE) correlation plays an integral role in determining intelligence. Mental illness may be precipitated during childhood and adolescence by bullying and self-esteem issues due to specific learning difficulties and physical deficits. Lower socio-economic status may also increase the likelihood of mental illness, with interactions occurring in a vicious cycle.50 With these points being considered, will the GGE interventions on intelligence be sufficient to protect an individual from developing mental illness in later life? Individuals have different coping styles towards emotionally challenging or stressful times and events, which could moderate the relationship with intelligence. Some individuals appear to be more resilient towards adverse environmental factors, and studies show that individuals with a higher IQ are often more effective with coping with stressful life events, making them potentially less vulnerable to developing disorders after such events.49 A highly intelligent person might only be more prone to mental illness if in a negative environment, and therefore, this would mean this is not a sufficient argument against GGE of intelligence.

**Research discrepancies.** Despite a plethora of literature showing the correlation between high IQ and mental illness, the potential mechanisms underlying the clinical significance remain poorly understood. Both intelligence and mental illness are highly polygenic and pleiotropic. Most attempts in investigating intelligence have been indirect, through studies of heritability, or merely focused on academic intelligence. Currently, no specific gene that contributes to overall cognitive function, in particular, academic intelligence, is known, nor will it likely ever be due to the previously mentioned complex network of gene clusters and environmental interactions. When undertaking gene editing in any germline cells, it is necessary to sufficiently understand all potential functions and mechanisms of that gene, including its heterozygosity and homozygosity effects. It is possible, for instance, that genetic enhancement of intelligence will result in other unexpected outcomes.26 Even if the individuals created from genetically engineered germline cells could be free from mental illness, questions on whether the benefits arising from genetic intervention could last long throughout their lifetime. The issues boil down to other important questions; for example, thinking of human rights in general, the idea of GGEs requires dealing with indefinite uncertainty. In the worst-case scenario, will humanity as a whole be morality threatened?

On the other hand, it could be valuable to look on the intrinsic connection between acquisition of the capacity to bring about eugenic or even transhumanism and moral decline, and there is further is issue of not acting when we are able to in order to correct a known harm arising, which would indeed be morally repugnant.24

**Limitations and Future Directions**. This paper has several main caveats and left several questions unaddressed due to being outside of the scope of philosophical and scientific investigation. Firstly, the core assumptions are made without considering the GE interplay with environment. Hence, the statements are not sufficiently strong to back up arguments, that take this into account. Future research would likely benefit by including additional variables to best examine the consequences. Secondly, while this study uses general academic intelligence, i.e., IQ score as sole predictive factor, may support investigations on the proposed philosophical inquiry, however, could have limited accuracy in identifying individuals with mental illness.51 IQ score can vary across a person lifespan and across generations, thus, a combination of standardized tests of intelligence (e.g., Garder’s Multiple Intelligence Test, Raven’s Progressive Matrices Test)53 and other related construct (e.g., brain/cognitive imaging profile)2 can improve the reliability of data, as can factoring in intelligence concepts around environmental, cultural, and emotional intelligence. Thirdly, the present review does not provide any legal perspectives around standard rules and regulations, and procedural requirements for legitimate GGE must be explored and solidified before such interventions are allowed on humans. Finally, we did not elaborate any further on the issues of equality or equity and their involvement with posthumanism, or ‘*Homo-superiorus’*. Thus, an important future avenue of investigating impact of social class and mobility must be carried out.

# 4.0 Conclusion

The entanglement of modern eugenics and genetics carries with it many moral obligations and responsibilities. No solid argument has been proffered for the risks-benefits of GGEs upon intellectual enhancement, given that causative correlations exist between high IQ and mental illness. By integrating the precautionary logic gate, we strive to develop a plausible theoretical framework for addressing those positive and negative modern eugenics options involving genetic enhancement of intelligence. The review posits two warranting research claims, yet not mutually exclusive, to shed light on the bioethics of GGE. Here, we endorse that eugenic selection through GGE intervention should it lead to better procreation from individuals with premorbid mental illness, the alleviation of unnecessary human suffering, or as least holding a positive net effect based on the core assumptions made. In the same assumptions, we reasonably argue against GGE if it has even small likelihood to worsen mental health or cause an increased net negative outcome for future individuals currently in a state on non-existence (that is, a state that is neither good nor bad, but results in a guaranteed negative state once they come into existence).15

Indeed, rigorous scientific works are required before we can fully dissect genetic architecture of intelligence traits and the resultant genetic intervention towards the status of mental illness. Next period of research should explore more detail on how intelligence result in differ mental illness outcomes, the long-run effect of GGEs intervention, and the human rights to science. All medical and surgical procedures are meant to carry some degree of risk in order to achieve a net-positive outcome, and hence why we should not outright resist or reject nascent technology to aid in reduction of suffering in a eugenics context (though maintaining a healthy degree of true scientific scepticism is absolutely warranted and indeed, encouraged). In defence of the principle of procreative beneficence, GGEs is still a *pro tanto* ethical imperative as long as we provide strong arguments being justified in precautionary actions to sustain genetic and mental health, and if those risks can be minimized.13 Under the recognition of International Covenant on Economic, Social and Cultural Rights (ICESCR) Article 15 1.b, one has the right “to enjoy the benefits of scientific progress and its application”.54 With the ongoing evolution of our knowledge of eugenics and continuous advancement in GGEs, the groundbreaking interventions hold the promise of enhancing intelligence of future offspring and quality of life, ultimately revolutionizing the eugenics movement. As far as until we have access to the certain distribution of outcomes, GGE could potentially bridge across eugenics and transhumanism.

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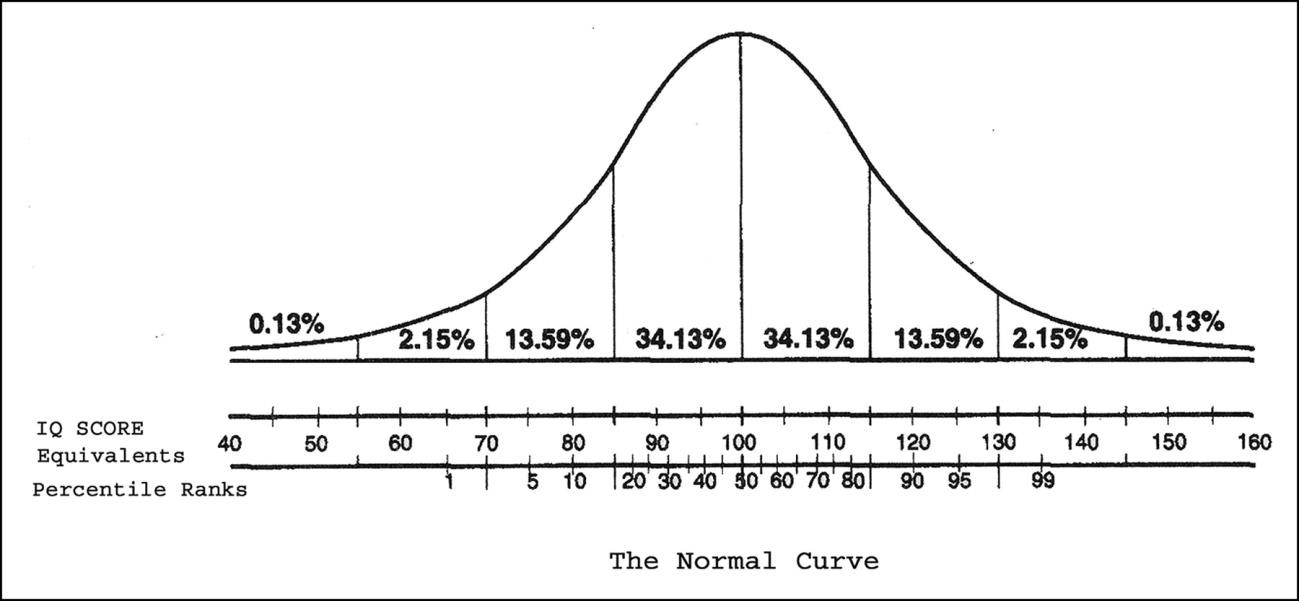
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# Appendix

*Appendix 1:*



Normalized distribution of IQ. Low IQ is score ≤ 85; Average IQ is score between 85 to 115; High IQ is score ≥ 115. Source: Ref. [Intelligence (IQ) Testing | Pediatrics In Review | American Academy of Pediatrics (aap.org)](https://publications.aap.org/pediatricsinreview/article/27/11/403/34094/Intelligence-IQ-Testing) 55

*Appendix 2:*

Genetic germline

engineering

-

Intellectual (IQ)

enhancement

Low IQ to

average (or

high IQ)

Causative correlation between

average or/and high IQ with

mental illness, provided that low

IQ itself is consider intellectual

disabled

and any off

-

target

effects would only have minor

impact

More than 50% likelihood of

inherited mental defect and

the

resultant genetic modification has

high probability to mitigate illness

due to low IQ

Average IQ to

high IQ

Causative correlation between

high IQ with mental illness,

provided that average IQ is

no/less prone to mental illness

and any off

-

target effects would

only have minor impact

The resultant genetic

modification towards high IQ can

mitigate mental illness or at least

that

mental illness resultant from

high IQ is not as bad as the

resultant mental illness from

average IQ

The resultant genetic modification

would likely confer or worsen

mental illness due to high IQ

**Assumption**

**CASE A**

**CASE B**

**“…If and only if…”**

**Yes**

**Yes**

**No**

The logic gate of genetic germline engineering in enhancing intelligence (IQ) in the correlation with mental illness.

*Appendix 3:*

**Table 1.** Risk-benefit analysis on the consequences of intellectual enhancement towards the likelihood of diagnosing mental illness.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Intelligence (IQ)** | |  |
| **Mental illness** | **High (1)** | **Average (2)** | **Low (3)** |
| **High (3)** | 3 | 6 | 9 |
| **Average (2)** | 2 | 4 | 6 |
| **Low (1)** | 1 | 2 | 3 |

Notes: Red boxes = ‘bad’; yellow boxes = ‘not bad’; green boxes = ‘good’

1. [↑](#footnote-ref-1)