Sir Francis Galton (1822-1911)

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Sir Francis Galton was the founder of the quantitative study of the psychology of individual differences. In his work on intelligence, he identified the general factor later demonstrated by Spearman, the importance of heredity, race differences, and dysgenic fertility. His proposals on eugenics were widely accepted in the first half of the Twentieth Century, but have subsequently been largely rejected. With the benefit of hindsight, his article reviews Galton's contributions to differential psychology, and assesses his conclusions in the light of current knowledge.

Key Words: Francis Galton; Heredity; IQ; Charles Spearman; Race differences; Dysgenic fertility.

A century has now passed since the death of Sir Francis Galton, and this is an appropriate time to evaluate his contributions to psychology. He is a controversial figure, who has been described as a Victorian genius by his biographer Derek Forrest (1974) and as a "fascist swine" by Steve Jones, former president of the Galton Institute (Grove, 1991).

Galton made important contributions in many academic disciplines. He identified the existence of anti-cyclones drew the first weather maps, and drew up a beauty map of England by recording the frequency of attractive women in different towns. He pioneered composite photography and devised a fingerprint-classification still used in forensic science. He even contributed to the study of religion by showing that prayer is ineffective. While ardently embracing the theory of evolution, Galton disproved Darwin's hypothesis that genetic information is transferred from other parts of the body to the gonads by showing that white rabbits transfused with the blood of brown rabbits still

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produced only white offspring. He made important advances in statistics in which he formulated the method for calculating the correlation coefficient and worked out the subtleties of regression to the mean. Both of these discoveries are regarded by mathematicians as some of the greatest achievements in the history of statistics.

Importance of differences in intelligence

Galton's principal work in psychology was on intelligence. He first published his ideas on this in 1865 and elaborated them in his book *Hereditary Genius* (1869) and during the rest of his life. He advanced six principal ideas. The first of these was that there are huge differences between people in intelligence: "the range of mental powers between … the greatest and the least of English intellects, is enormous" (Galton, 1869/1962, p. 66). This is widely accepted today but was quite a novel idea in the mid-nineteenth century. Galton sent a copy of his book to his cousin Charles Darwin, who replied that hitherto he had always supposed that there was not much difference between people in intelligence and that differences in achievement were largely due to differences in application, but that after reading *Hereditary Genius* he was convinced that Galton was right.

For Galton, the pursuit of research into individual differences was a lifelong effort. His 1883 book Inquiries into Human Faculty and Its Development has been considered (e.g., Boring, 1950) as marking the beginning of the study of individual differences.

Generality of Intelligence

Galton's second contention was that intelligence is a single entity that could be directed into a number of different avenues. Thus, he wrote "People lay too much stress on apparent specialities, thinking over-rashly perhaps, that because a man is devoted to some particular pursuit, he could not possibly have succeeded in anything else" (1869/1962, p.64). This contention was largely confirmed by

Charles Spearman (1904) in his famous paper in which he demonstrated the positive correlations between numerous mental and sensory abilities. Using the methods of factor analysis pioneered by Spearman, these positive correlations are today described as *g*, the general mental ability that is an important determinant of performance in all cognitive tasks. This emphasis on a general ability factor contradicted earlier phrenological theories which had posited the existence of specialized innate abilities and personality traits that were thought to be localized in different parts of the brain (Boring, 1950).

Spearman's theory was disputed in the first half of the twentieth century, not by phrenologists but by some experimental psychologists including Thurstone, who maintained that there are a number of independent intelligences (verbal, spatial mathematical, musical, etc). Theories positing multiple independent "intelligences" were still championed in the late 20th century, with Howard Gardner's theory of multiple intelligences (Gardner, 1983) and Robert Sternberg's triarchic theory (Sternberg, 1988) being the most notorious. These theories are now very much a minority view, mainly because study after study demonstrated positive correlations between diverse mental abilities, and because *g* proved to be an excellent predictor of many real-world outcomes (Jensen, 1998).

However, Galton overstated his argument that an individual possessing high intelligence as a general unitary entity could succeed in any field that he or she chose to enter. It is now accepted that in addition to Spearman's g, there are a number of "second order abilities" that contribute to achievement. For instance, there is a mathematical ability that is independent of *g*. To be an outstanding mathematician, a person would need to have strong *g* and also strong mathematical ability. Another example are social skills, which can vary somewhat independently from general intelligence. This dissociation is

most evident in individuals with autism-spectrum disorders who can be eminent mathematicians, physicists or computer scientists despite their social incompetence (Baron-Cohen et al, 1999).

Furthermore, it is now generally believed that *g* is less important and second order abilities are correspondingly more important among high IQ individuals. Thus, for instance, it is now regarded as very improbable that Einstein could equally well have become an outstanding novelist, painter or composer, if he had chosen to do this kind of work, and equally improbable that van Gogh could equally well have become an outstanding mathematician and physicist.

Nature and Nurture

Galton's third contention was that intelligence is much more strongly determined by inheritance than by environment, or by "nature" rather than "nurture", in a phrase coined by himself. He supported this position by examining the achievements of the relatives of eminent men. He argued that if intelligence is largely hereditary, there should be more eminent men among the relatives of eminent men than among the general population. He examined a number of family pedigrees of eminent scientists, lawyers and writers and showed that this was so, and that the numbers of eminent relatives were greater in close relatives than in the more distant. Thus, he found that the sons of very eminent men were less eminent than their fathers, and their grandsons were still less eminent. This argument has sometimes been dismissed on the grounds that this could equally well be explained as an environmental effect. It has been objected that eminent men frequently had the environmental advantages of encouragement and instruction from their fathers, such as that received by Mozart and Beethoven, that more distant relatives such as grandchildren and cousins would not have received.

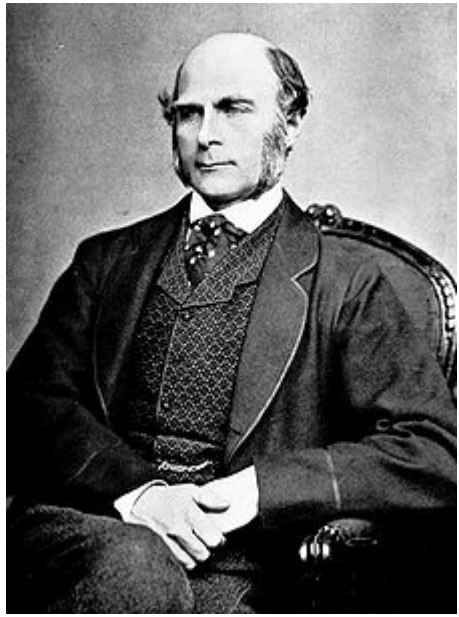

Figure 1: A Portrait of Sir Francis Galton (1822-1911)

Galton anticipated this objection and attempted to answer it by showing that the adopted sons of popes rarely achieved eminence, unlike the biological sons of eminent fathers. Galton (1875) also studied nature and nurture with twins, but failed to realize the important difference between monozygotic and dizygotic twins. This distinction requires knowledge of the mechanism of inheritance, and specifically the diploid nature of the human genome, which has each chromosome (except the sex chromosomes) in two copies. This knowledge emerged only toward the end of Galton's life.

Throughout much of the twentieth century the size of the genetic contribution to intelligence was disputed. Based mainly on the results of twin and adoption studies, it had become virtually universally accepted by the end of the century that the heritability of intelligence lies between 40 and 80 percent in modern societies. Heritability does not describe the extent to which a trait that is observed in an individual is caused by genes. It rather is defined as the extent to which the observed (phenotypic) variations of a trait in a pre-defined population are caused by genetic differences or environmental differences between individuals. Therefore heritability can be different in different societies and in different historical epochs, depending on the extent of genetic and environmental variability in the population.

Heritability also varies with age. The heritability of intelligence is lower at about 40 percent in young children aged around five years, and increases in later childhood reaching around 80 percent among adults. This suggests that family influences, such as parents reading to their children, playing cognitively stimulating games with them and so forth, can boost young children's intelligence. However, this effect wears off as the children become older. They emancipate themselves from the influences of their parents and teachers and gravitate towards their "natural"

level, which is determined mainly by their genes.

Galton's belief that genetics is far more important than environment in determining ability (and other psychological qualities as well) is therefore to a significant extent supported by modern behavioral genetics. Galton nevertheless underestimated the effects that strong and persistent changes in environmental conditions can have on the development of intelligence. Today we know that the average level of intelligence has risen strongly in industrialized countries during most of the 20th century (Flynn, 1987; Lynn & Hampson, 1986). These IQ gains, sometimes called "Flynn effects," have been variously attributed to better nutrition, massive expansion of the school system, and generally more complex environments (Neisser, 1997). Perhaps, the best explanation is a feedback between intelligence and environment, in which rising intelligence leads to the creation of favorable environments, which in turn raise the intelligence of the next generation even more (Dickens & Flynn, 2001; Meisenberg, 2003). Incidentally, this dynamic explains the progressive nature of modern civilization during the last two centuries. Clearly, the large IQ gains observed in the 20th century, while not incompatible with strong genetic effects, show that Galton underestimated the effects that large and persistent environmental changes can have on human intelligence.

Galton, like Darwin, did not know about the biological basis of inheritance. The chromosomal theory of inheritance was pioneered by August Weismann around 1890, and Mendel's laws were rediscovered only in 1900, after Galton had made his most important contributions. Galton simply observed that close relatives are similar through what seemed to be biological inheritance, and treated heritability with statistical methods related to trait distributions and probabilities. Today, the modern concept of polygenic inheritance (formulated and mathematically described by Ronald A. Fisher in 1918) explains most of the genetic

resemblance of family members, including normal variation in personality and intelligence.

Race Differences

Galton's fourth contribution concerned race differences in intelligence. He noted that some populations have produced large numbers of geniuses, while others have produced very few. He believed that these differences reflect genetically based differences in intelligence. This theory was neither particularly original nor controversial, for it was generally accepted as true in Galton's time, even by most of those who opposed slavery and those who defended the rights of native peoples. Galton's original contribution was a method for calculating these differences that consisted of estimating the number of intellectually outstanding individuals produced by different peoples, in relation to the size of the population. He argued that a population with a high average level of intelligence would produce a large number of geniuses at the high tail of the normal distribution, and therefore it could be inferred that a population that produced a large number of geniuses must have a high average level of intelligence.Galton quantified these population differences in intelligence by constructing an intelligence scale divided into a number of grades, and used this scale to calculate the average grades of some of the races. He concluded that the intelligence of the Greeks of classical Athens (around 530-430 B.C.) that produced Plato, Aristotle and a number of other geniuses from a small population, had the highest average intelligence of any population. He calculated that the intelligence of the classical Athenians was nearly two grades higher than that of the contemporary English. One grade in Galton's metric was the approximate equivalent of 10.5 IQ points on the modern intelligence test, so this would give them an IQ of approximately 118 in relation to an English IQ of 100.

Using this method, he calculated that the lowland Scots scored one-third of a grade higher than the English, and

therefore on the modern intelligence test had an IQ of approximately 103.5. This may have been true of the eighteenth and early nineteenth centuries although more recent studies carried out in the second half of the twentieth century indicate that the IQ in Scotland has fallen below that in England by close to 4 IQ points, possibly as a result of the emigration of large numbers of higher IQ Scots to England, America and other countries that offered better opportunities for advancement (Lynn, 1977).

Galton also applied his metric to sub-Saharan Africans and concluded that they scored approximately two grades below the English, and therefore on the modern intelligence test had an IQ of approximately 79 in relation to an English IQ of 100. He calculated that the Australian Aborigines were a grade below the sub-Saharan Africans and therefore on the modern intelligence test had an IQ of approximately 68. These calculations have proved to be fairly accurate except that they slightly overestimated these IQs, which were estimated at 67 for sub-Saharan Africans and 62 for Australian Aborigines in a review of numerous IQ studies summarized in Lynn (2006). However, because Flynn effect gains were large in Europe during the century after Galton's death but are starting only now in many of the most backward countries, it is likely that the observed, phenotypic intelligence differences between the British and the native races of Africa and Australia have indeed been smaller in Galton's time than they are today.

Galton did not include the Chinese in his calculations of population IQs. However, he evidently regarded them as a highly intelligent people because he published a letter in *The Times* in 1873 in which he contended that although China was backward, the historical record shows that the Chinese are capable of producing a high civilization and had only been held back by the historical failures of Chinese rulers. That this conjecture was correct is shown not only by the turbo-charged economic growth that China has

experienced during the last 30 years, but also by the results of IQ testing, which show that the average IQ in the more developed parts of China today is in the vicinity of 105 (Lynn, 2006). Galton also believed that the Jews "appear to be rich in families of high intellectual breeds" (1869/1968, p.47). He did not research or develop this conjecture, but many studies have shown that it was correct and that Ashkenazi Jews have an average IQ of approximately 110 (Lynn, 2011a).

Dysgenics

Galton's fifth contribution concerned the genetic deterioration of the population for which he proposed the term *cacogenics*, but which was later designated *dysgenics* by the British physician Caleb Saleeby. Saleeby argued that those who were being killed in the First Great War were predominantly more healthy and intelligent than non-combatants, and hence that the genetic quality of the population was being impaired. In the United States the same argument was elaborated by David Starr Jordan, 1915), chancellor of Stanford University. Galton read Charles Darwin's *The Origin of Species* when it appeared in 1859, and he concluded that the process of natural selection, by which the genetic quality of the population is maintained and sometimes enhanced, had begun to weaken in England and other economically developed nations. He first discussed this problem in 1865, when he wrote: "One of the effects of civilisation is to diminish the rigour of the application of the law of natural selection. It preserves weakly lives that would have perished in barbarous lands" (Galton, 1865, p. 325). He went on to contend that natural selection had weakened against those with poor health, low intelligence and what he called "character", by which he meant a well developed moral sense, self-discipline and strong work motivation. Galton was not alone in this assessment. His half-cousin Charles Darwin wrote: "We do our utmost to check the process of elimination; we build asylums for the imbecile,

the maimed, and the sick; we institute poor-laws; and our medical men exert their utmost skill to save the life of every one to the last moment… Thus the weak members of civilised societies propagate their kind. No one who has attended to the breeding of domestic animals will doubt that this must be highly injurious to the race of man." (Darwin, 1871, Chapter 5)

Galton discussed the genetic deterioration that he believed was taking place at greater length in his *Hereditary Genius*. He argued that in the early stages of civilization what he called "the more able and enterprising men" were the most likely to have children, but in older civilizations, like that of Britain, various factors operated to reduce the number of children of these and to increase the number of children of the less able and the less enterprising. He thought that the most important of these factors was that able and enterprising young men tended not to marry, or only to marry late in life, because marriage and children would impede their careers. The effect of this was that "there is a steady check in an old civilisation upon the fertility of the abler classes: the improvident and unambitious are those who chiefly keep up the breed. So the race gradually deteriorates, becoming in each successive generation less fit for a high civilisation" (Galton, 1869/1962, p. 414).

Galton's concern about dysgenics was based on two assumptions: (1) The same forces of differential survival and reproduction that drive the evolution of species also apply to humans; and (2) these forces can work on relatively short time scales of centuries to millennia. The first of these assumptions, although ignored by many 20th century social scientists, has never been doubted by those who accept the reality of biological evolution. The second, that evolution can cause substantial genetic changes on relatively short time scales, has been proven only recently with the help of genetic evidence (Cochran & Harpending, 2009;

Meisenberg, 2008). For example, variations in skin color and other climate-selected race differences can have evolved only during the last 50,000 years because before that time, the ancestors of modern humans had been confined to tropical environments (Stewart & Stringer, 2012). Other traits, for example the ability to digest lactose (milk sugar) in adulthood, evolved only after the Neolithic Revolution, during the last 5,000 to 10,000 years (Burger et al, 2007). Other work has provided evidence for selection effects on genetic variants during the last 2 to 3 centuries (Jin et al, 2012; Stefansson et al, 2005). Therefore Galton's belief in on-going human evolution is vindicated by modern knowledge of molecular genetics, and his conjecture of eugenic and dysgenic fertility as causes for the rise and fall of civilizations is plausible.

Many studies in the twentieth century and up to the present have shown that Galton was correct in his belief that the more intelligent had begun to have fewer children than the less intelligent and hence that the genetic quality of the population was deteriorating. Today, negative relationships of education and intelligence with fertility are a near-universal feature of modern societies at every level of economic development (Meisenberg, 2008). We know from numerous studies that dysgenic fertility today is greater among women than among men, evidently because high-IQ childless career women have been educated out of their reproductive function (Lynn, 2011b). Galton anticipated this development. As early as 1901 he wrote: "There is unquestionably a tendency among cultured women to delay or even to abstain from marriage; they dislike the sacrifice of freedom and leisure, of opportunities for study and of cultured companionship." (Galton,1909, p. 26)

Also Galton's belief that before his time the more able and enterprising men had been most likely to have children has been supported by research during the century after Galton's death. For example, a strong positive effect of

wealth on the number of surviving children has been demonstrated for early modern England (Boberg-Fazlic et al, 2011; Clark & Hamilton, 2006). This fertility pattern, which scattered both the genes and the cultural values of the higher classes throughout the British population, has been proposed as a reason for the development of Britain towards the scientific and industrial revolutions (Clark, 2007). Most studies of fertility patterns in Europe before the demographic transition showed higher fertility of the higher social classes (Skirbekk, 2008). These results of modern scholarship confirm and extend Galton's view of history by suggesting that widespread eugenic fertility in pre-industrial Europe was a reason for the technological, scientific, cultural and economic advances on this continent since the Dark Age.

For much of the twentieth century, the genetic deterioration of intelligence was more than compensated for by environmentally caused increases in measured intelligence ("Flynn effects") that began to be recorded from the 1940s in the United States, Britain and Scandinavia (Flynn, 1987; Lynn & Hampson, 1986; Tuddenham, 1948). However, in the last two decades these increases have ceased and been replaced by declines of measured intelligence in Britain and Denmark (Shayer & Ginsburg, 2009; Teasdale & Owen, 2008).

These declines, if real and sustained, may indicate deteriorating environmental conditions and/or adverse cultural trends. However, the observation that dysgenic fertility tends to be stronger on tests with higher *g*-loadings (i.e., the "purest" and most heritable measures of general intelligence) suggests that dysgenic fertility may very well have resulted in population-wide declines of *g* (Woodley & Meisenberg, in press). This prediction is supported by a recent study that finds stronger secular declines ("anti-Flynn effects") on tests with higher *g*-loadings in the Netherlands (Woodley, under review). Another line of research suggests

that with appropriate controls for other factors, the performance of school children aged 13 to15 years on international assessments of scholastic achievement tends to decline over time in countries with stronger dysgenic fertility (measured as the magnitude of the negative education-fertility correlation), relative to countries in which dysgenic fertility is small or absent (Meisenberg & Woodley, under review). Observations of this kind, if reproducible, are likely to kindle renewed interest in the consequences of dysgenic fertility during the 21st century. It appears that in the most advanced societies, the genetic limits of human intelligence are being approached today. Galton made the mistake of assuming that these limits had been reached in his time already.

Eugenics

Galton believed that the genetic deterioration of Western populations was a serious problem and that steps needed to be taken to counteract it. His sixth contribution was concerned with formulating proposals to overcome this problem. In 1883 he coined the word *eugenics* for the study and implementation of this program. Eugenics is not a scientific theory, but a value system that Galton promoted as a guide for scientific research and social policy. It would be implemented by adopting the methods that animal and plant breeders had used for centuries, breeding from the best varieties to obtain improved strains. He proposed that the same method would work in humans, and should be applied by measures designed to increase the fertility of talented individuals.

During the next decades, up to his death in 1911, Galton restated and elaborated the desirability of devising and implementing eugenic programs (Galton, 1909). In 1904, he wrote: "What Nature does blindly, slowly, and ruthlessly, man may do providently, quickly, and kindly. As it lies within his power, so it becomes his duty to work in that direction; just as it is his duty to succour neighbours who suffer

misfortune." (Galton, 1909, p. 42) In his autobiographical *Memoirs* he writes: "Man is gifted with pity and other kindly feelings; he has also the power of preventing many kinds of suffering. I conceive it to fall well within his province to replace Natural Selection by other processes that are more merciful and not less effective…. Natural Selection rests upon excessive production and wholesale destruction; eugenics on bringing no more individuals into the world than can be properly cared for, and those only of the best stock." (Galton, 1908, chapter 21)

This new ideology can be understood only on the background of the utilitarian moral philosophy that was endorsed by most Victorian intellectuals, with its emphasis on promoting, in Jeremy Bentham's words, "the greatest happiness of the greatest number." One corollary of this philosophy was that all human beings, being (more-or-less) equally endowed with the capacity for pleasure and pain, are equally deserving of our concern. This was sometimes understood as including concern for future human beings. John Stuart Mill wrote in 1859: "The fact itself, of causing the existence of a human being, is one of the most responsible actions in the range of human life. To undertake this responsibility—to bestow a life which may be either a curse or a blessing—unless the being on whom it is to be bestowed will have at least the ordinary chances of a desirable existence, is a crime against that being." Galton simply applied this element of utilitarian philosophy to his understanding of genetics and evolution.

Galton's eugenic proposals fell into the two categories of negative and positive eugenics. Negative eugenics consists of measures to discourage and prevent those with undesirable qualities from having children. On this he wrote in his autobiography that "I think that stern compulsion ought to be exerted to prevent the free propagation of the stock of those who are seriously afflicted by lunacy, feeble-mindedness, habitual criminality, and pauperism" (1908,

p.311). He did not spell out how these should be prevented from having children. Because he attributed dysgenic fertility in large part to intelligent people delaying or abstaining from marriage, it can be presumed that he had restrictions on marriage in mind although he may have thought of sterilisation as well. He appears not to have been aware that in the previous year (1907) the first law providing for the sterilization of the mentally retarded and habitual criminals was enacted in Indiana. Other American states followed suit and by 1925 the sterilization laws had been introduced in twenty five American states. In the 1920s and 1930s, similar sterilization laws were introduced in Canada and a number of European countries including Austria, Denmark, Estonia, Finland, France, Germany, Norway, Sweden and Switzerland. In the Scandinavian countries, eugenic sterilizations were associated with the introduction of nation-wide systems of social welfare. In these countries, many politicians of broadly Social Democrat orientation believed that restrictions on the breeding of destitute individuals were necessary to limit the number of welfare recipients, and thereby make welfare systems both affordable and acceptable to the population (Broberg & Roll-Hansen, 1996). The countries where most sterilizations were carried out were Sweden, where they numbered about 60,000, and Germany, where they numbered about 300,000. Although these may seem large numbers, it is doubtful whether they had any significant effect on the intelligence of the populations. Sterilization became less frequent from the 1960s and virtually ceased by 1980, when the tide of liberal opinion turned increasingly hostile to eugenic measures.

Galton's proposals for positive eugenics consisted of financial incentives designed to encourage those with the desirable qualities of high intelligence and strong moral character to have more children: "The means that might be employed to compass these ends are dowries, especially to those to whom moderate means are important, assured help

in emergencies during the early years of married life, healthy homes, the pressure of public opinion, honours, and above all the introduction of motives of religious or quasi-religious character. Indeed, an enthusiasm to improve the race is so noble in its aim that it might well give rise to the sense of a religious obligation." (Galton, 1909, p. 25) Some of these measures were put into effect. For instance, in the 1930s university lecturers and professors in Britain – supposedly the nation's elite – were paid £50 per annum for every child. This incentive was ended in the 1960s, when eugenics fell into disrepute. However, as with sterilization, it is doubtful whether this or any other measures of positive eugenics had any significant effect.

As a social reform movement, eugenics lost ground during the 1930s, and it was no longer a serious social force during the first two decades after World War II. During the 1960s, eugenics became a term of abuse when it became associated with Nazi atrocities. The explanation of this fall from grace is not the progress of science. Indeed, one of the greatest oddities in the modern history of ideas is that eugenics was running strong when its scientific foundations were shaky, but went out of fashion when these scientific foundations were proved correct. For example, the first twin and adoption studies demonstrating high heritability of intelligence appeared only in the 1930s (Leahy, 1935; Newman et al, 1937), and evidence about the rapid pace of recent and on-going human evolution became convincing only during the last decade. Another development is the possibility of prenatal diagnosis and selective pregnancy termination, and of pre-implantation genetic diagnosis. The further development of these methods is making old-fashioned positive and negative eugenics all but obsolete by allowing the carriers of obnoxious genes to have healthy, unimpaired children. Thus developments in basic science and medical technology should have strengthened eugenic theory as well as practice.

However, value systems have changed during the century after Galton's death. For reasons whose discussion would lead us too far astray, the idea of being responsible for the welfare of future human beings, which was at the core of Galton's eugenics, had become unthinkable among mainstream intellectuals. Today, eugenics as an ethical principle survives in the field of bioethics, where it is discussed under terms such as "reproductive beneficence" or simply as the child welfare principle. Under these names, it is supported by some (e.g., Elster, 2011; Parker, 2005; Savulescu, 2001) and rejected by others (e.g., Solberg, 2009).

Though it may appear that Galton's work ended in failure, the ramifications of his scientific and ethical ideas are still very much present today. So what was Galton, a genius or a fascist swine? Galton was undoubtedly a genius and perhaps the only genius that psychology has produced. His eugenic proposals were certainly taken up in National Socialist Germany but they were implemented in most western nations, and Galton cannot reasonably be called a fascist, let alone a "fascist swine."

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In the Netherlands, anti-Flynn effects but not Flynn effects are associated with the Jensen effect.