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Genius and premature birth: little evidence that claims about historically eminent scientists are accurate

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Abstract
A number of very eminent and highly creative individuals are often claimed to have been born prematurely, and the idea that widely recognised scientific geniuses such as Newton, Kepler, and Darwin were preterm has become a cultural meme through the popular press, and through popular and academic science books. This potentially raises very important questions, related to the nature and origin of creativity and innovation, as it has been suggested that prematurity and genius may be linked. Here, we review suggested links between prematurity and genius, in terms of psychological traits associated with genius, and compare the percentage of top geniuses in Murray's *Human Accomplishment* who are claimed to have been born prematurely to that of Western populations in general. Although a significant number of those in Murray's sample have been asserted to be preterm, we found that none of them could be said with certainty to have been so, refuting the hypothesis that there is a clear connection between prematurity and scientific genius.

Keywords Birth weight · Genius · Historical analysis · Premature · Scientific achievement

Introduction

A 'genius' is usually defined as an individual who is widely recognized to have made an extremely significant and, indeed, ground-breaking contribution to their particular field (Dutton & Charlton, 2015; Simonton, 2009). In the case of scientists, this term is applied if they have made a scientific breakthrough that is widely regarded as being of pronounced importance. In this regard, scientists such as Sir Isaac Newton, Johannes Kepler, Charles Darwin and Albert Einstein are widely proclaimed to be geniuses. Leaders may be regarded as geniuses if, through their own ingenuity, they have radically changed the course of history (Dutton & Charlton, 2015; Post, 1994; Simonton, 2009). Many popular science publications and mainstream newspapers have noted that a number of historical figures who are often regarded as geniuses were supposedly born preterm, sometimes with the implication that geniuses are disproportionately born early, or that being born prematurely somehow leads to subsequent genius (Dutton, May 2017; Donnelly, 2nd June 2012; Linden, Paroli, & Doron, 2000). This possible connection has also been referred to in a variety of scholarly works (Branch & Cash, 1966; Treffert & Tammet, 2011). Further, Terman's research on gifted children found that the prematurely born were over-represented among extremely intelligent youngsters. They were 4% of his sample where, as we will see below, they should have been 2.4% (Terman, 1947). Though these gifted children must be distinguished from recognised geniuses, their outlier high IQ is a central component of genius.

Accordingly, one idea that has gained popularity is that geniuses are born prematurely more often than can be expected by chance alone. However, as far as we know there has not been systematic research that has tried to confirm or disconfirm the notion that prematurity may be associated with recognised genius. The question is of great importance, because genius underlies many of the profound discoveries and advancements that shape our current environment, whether in terms of medical, technical, scientific,

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philosophical, or societal innovations. The conditions that foster genius are therefore essential to maintain, and maybe even promote, for a prosperous and sustainable future. To this end, it is useful and timely to empirically test this particular proposed relationship between characteristics at birth and achievement later in life. Here, we examine the most important characteristics of geniuses, as suggested by the relevant literature, and consider how they might be affected by being born preterm.

Premature birth is defined by the World Health Organization as being born at least 3 weeks before full term, which is 39–40 weeks. If the baby is born at between 37 and 33 weeks it is 'moderately preterm,' 32 to 28 weeks is 'very pre-term,' and less than 28 weeks is termed 'extremely preterm' (World Health Organization, 19th February 2018). Currently, approximately 10% of births in Western countries are preterm (Rowland et al., 2019) of which more than 90% survive (Musona-Rukweza et al., 2017). In developed countries, the survival rate of babies born 3 months early is 90% (Irish Neonatal Health Alliance, 2020). As recently as 1970, pretty much all children born 3 months early in the UK would die within a few days (Salter, 17th November 2014) and, as recently as 1980, 75% of babies born at 27 weeks died soon afterwards (Hunt, 20th January 1993). Although preterm babies increasingly survive, there is a long list of chronic physical and mental problems associated with being born prematurely. They are in part due to not having developed sufficiently in the optimal environment of the womb, and due to having been unable to pass sufficient oxygen to the brain as a consequence of under-developed lungs. These problems include under-developed muscles, hearing problems, sight problems, co-ordination difficulties, cerebral palsy of various degrees of severity, ADHD, deficiencies in certain kinds of memory, delayed cognitive and physical development, Autism Spectrum Disorder, reduced levels of effortful control, lower intelligence, depression, aspects of psychopathology, and much else (Behrman & Butler, 2007; Poehlmann, 2010). People born prematurely are also less likely to have sexual relationships and less likely to have children (Mendonca, Bilgin, & Wolke, 2019).

If there is a relationship between being born prematurely and genius, potential germane factors might be autism, depression, and behavioural problems. Analyses of historical geniuses argue that common features are a certain distinct kind of personality combined with high intelligence (Eysenck, 1993), this being widely accepted by psychologists to refer the ability to solve complex cognitive problems combined with the ability to solve them quickly. The more intelligent person will solve a given cognitive problem more quickly and will also be able to solve more difficult problems (Jensen, 1998). Apart from the high intelligence, geniuses seem to sport moderately low Agreeableness (that is: low altruism and low empathy) and moderately low Conscientiousness (that is: low impulse control and low rule following) in particular, two dimensions from the Big Five personality model. In terms of the scientific genius, low Conscientiousness probably facilitates thinking 'outside the box' and making unusual connections. Low Agreeableness will render this free-thinker unaware or unconcerned about offending people, which is useful in the light of breakthroughs being a threat to those with vested interests (Dutton & Charlton, 2015; Eysenck, 1993; Feist, 2007; Simonton, 2009).

Moreover, a significant component of autism is low empathy, and it has been found that highly creative scientists—which is what genius scientists are understood to be—are higher in this than are more incrementalist scientists (Feist, 1998, 2007). On this basis, it would make sense that if a highly intelligent person was born prematurely, they might develop more genius traits than the same person born at term. Artistic genius has been found to be associated with low altruism, low empathy, low impulse control, and low rule following, and also with a propensity towards depression and sub-clinical psychopathology (Post, 1994; Simonton, 2009). So, on this basis, there indeed seems to be the possibility that those born prematurely might be over-represented among scientific and artistic geniuses. On the other hand, what would militate against this would be the fact that being born prematurely is associated with reduced intelligence and, in addition, a very precise and unlikely psychology has to be achieved for a genius to manifest. This is because, in general, intelligence correlates with a pro-social personality (Dutton & Charlton, 2015). Nevertheless, it has been suggested that there may be a relationship between prematurity and genius based on the surprisingly noteworthy number of premature geniuses seemingly found. This is what we propose to test.

Method

In his 2003 book *Human Accomplishment*, Murray (2006) attempted to identify all those who might reasonably be regarded as geniuses. In this formidable amount of work, Murray carefully ranked in importance geniuses in the Sciences (and also the Arts) based on the available evidence that their genius is widely agreed upon, such as the number of entries in encyclopaedias. He consulted cross-national sources in order to avoid the influence of ethnocentric bias and drew upon sources from different periods to avoid the influence of 'current fashion.' As his analysis is extremely thorough there is no reason to attempt to redo it. Murray (2006, p. 96) presented a 'Top 5' for a series of important areas of innovation, which we will use as our sample of geniuses. These individuals have clearly made enormous contributions to their field and this is widely accepted, according

to convergent bibliography. Murray's list of geniuses has a cut-off point whereby their contributions must have been made before the year 1950, his reasoning being that time tells whether a person is truly accepted as being a genius or not. This means that all of his geniuses were born in the nineteenth century or earlier. We did, however, exclude geniuses from the Ancient World on the grounds that knowledge about their childhoods has generally been lost. It should be said that we are not aware of any critique that has cast doubt on the accuracy of Murray's database. With our geniuses established, we can compare the percentage of the population born prematurely but who survive into adulthood with the percentage of geniuses that display this characteristic. But first we must explore whether any of these geniuses were actually born prematurely.

We obtained evidence of prematurity from biographies using Google Book and the key words 'born prematurely,' 'born preterm,' 'born' and 'prematurely,' and 'born' and 'preterm,' and 'born' and 'premature,' alongside the name of genius. As all of those in Murray's list are highly prominent, it is reasonable to expect there to be biographical and even autobiographical material and, moreover, considering the rarity with which premature infants survived, we would expect this to be mentioned. As such, we are not simply assuming the accuracy of historical sources, as these are often riven with minor inaccuracies. But we are assuming that surviving premature birth, which was exceptionally rare, would have been likely to have been known with regard to an individual.

Results

Murray's list of geniuses can be seen Table 1, alongside an example of a source asserting that the genius was born prematurely, when this was found. As noted, we have removed those from the ancient world, meaning some of them are fewer the five. Two of them occur in two fields, indicated with an asterisk. It can be seen that in many cases the sources are not merely popular science sources, but articles in scientific journals and other scientific publications. As we will see later, many of these can be traced back to two specific articles in scientific journals.

For our sample of the 49 most eminent geniuses throughout history, we could find records that 7 of them have been claimed to be born pre-term. This corresponds to 14.2%. In 1950, the earliest year for which can find data, 7% of babies in the United States were born preterm. They had a survival rate of 40%, meaning that 2.4% of children were preterm (Children's Bureau, 1950, p. 52). The chi-square statistic is 4.9. The p-value is .026857. This is significant at $p < 0.05$. And when these geniuses were born, the survival of those born prematurely would certainly been lower than in 1950. Survival of preterm children was very low until the twentieth century. In 1887, it was noted that 'an examination of many of the standard works on midwifery shows almost no suggestions as to the care of the child thus prematurely born.' The premature birth was a 'private family tragedy; physicians saw no effective means of aiding these babies in their doomed struggle to survive' (Golden, 2001, p. 180). However, pursuing the bibliographical sources, we found that the evidence of their pre-term status was weak and largely inferred from indirect indices.

Sir Isaac Newton's mother often recalled that when Newton was born he was so small that he could fit in a quart mug. One Mr. Cunduit remembered that Sir Isaac Newton (1643–1727) had himself told him this (Brewster, 1831, p. 19). It seems that from this size it has been calculated that Newton must have been born about 2 months early. However, we find that there is no direct evidence that Newton was born prematurely and he is not recorded as having ever told anybody that he was. He simply implied to one person that he was extremely small when he was born. It is true that prematurity would make sense of what has been recorded about Newton, including evidence of Autism Spectrum Disorder and extremely low empathy (Dutton & Charlton, 2015; Westfall, 1983). Many of the characteristics associated with being born preterm are also predicted by low birth weight, however, whether the baby is born preterm or not. Independent of prematurity, low birth weight is associated with delayed development (Silva et al., 2011), autism (Lampi et al., 2012), depression (Levine, 2014), reduced intelligence (Kormos et al., 2014) due to very specific and narrow intellectual deficits (Isaacs et al., 2001), and aspects of psychopathology such as low impulse control and low altruism (Drvaric, Van Lieshout, & Schmidt, 2013).

Johannes Kepler (1571–1630) used astronomical calculations in combination with the evidence that he had been a small and sickly child to conclude that he had been born after 7 months gestation. This was noted in his astronomical diaries (Gilder & Gilder, 2005, Chap. 2). In other words, he made an educated guess that he was born early, something nobody in his family had told him.

Some eminent people have evidently been told that they had been born prematurely and told others about it, resulting in contemporary sources asserting it, though this is not the case with any of Murray's geniuses. This is the case with the founder of Methodism Charles Wesley (1707–1778), however. According to John Whitehead (1740–1804), who was Wesley's physician and his first biographer, Wesley 'was born several weeks before his time. He did not cry, nor open his eyes, and he was kept wrapped up in soft wool until the time that he should have been born according to the usual course of nature, and then he opened his eyes and cried' (Whitehead ND, p. 86). Obviously, these were not first-hand

Table 1 Genius and premature birth, using Murray's 'Top Fives'

Field	Rank	Name	Preterm	Source
Science				
Astronomy	1	Galileo	–	–
	2	Kepler	Yes	Voelkel (2001, p. 12)
	3	W. Herschel	–	–
	4	De Laplace	–	–
	5	Copernicus	–	–
Biology	1	Darwin	Yes	Crosse (1950, p. 141)
	2	Lamarck	–	–
	3	Cuvier	Yes	St Louis Medical Society (1949, p. 376)
	4	T. H. Morgan	–	–
Chemistry	1	Lavoisier	–	–
	2	Berzelius	–	–
	3	Scheele	–	–
	4	Priestley	–	–
	5	H. Davy	–	–
Earth Sciences	1	Lyell	–	–
	2	Hutton	–	–
	3	W. Smith	–	–
	4	Agricola	–	–
	5	A. Werner	–	–
Physics	1	Newton	Yes	Brodestsky (1927, p. 5)
	2	Einstein	Yes	Wyly, Allen and Wilson (1995, p. 5)
	3	Rutherford	–	–
	4	Faraday	–	–
	5	Galileo*	–	–
Mathematics	1	Euler	–	–
	2	Newton*	Yes	*
	3	Gauss	–	–
	4	De Laplace	–	–
Medicine	1	Pasteur	–	–
	2	Koch	–	–
	3	Parcelius	–	–
Technology	1	Edison	–	–
	2	Watt	–	–
	3	Da Vinci	–	–
	4	Huygens	–	–
Art	1	Michelangelo	–	–
	2	Picasso	Yes	Viswanathan and Desai (1989, p. 224)
	3	Raphael	–	–
	4	Da Vinci*	–	–
	5	Titian	–	–
Literature	1	Shakespeare	–	–
	2	Goethe	Yes	Linden, Parol and Doron (2000, p. 505)
	3	Dante	–	–
	4	Virgil	–	–
Music	1	Beethoven	–	–
	2	Mozart	–	–
	3	Bach	–	–
	4	Wagner	–	–
	5	Haydn	–	–
Philosophy	1	Kant	–	–

Table 1 (continued)

Field	Rank	Name	Preterm	Source
	2	Descartes	–	–
	3	Hegel	–	–

observations, as Whitehead was born 37 years after Wesley, and he did not identify his source.

We could find no direct statement that Charles Darwin (1809–1882) was preterm. In his posthumously published memoirs, Darwin recalls, 'I must have been a very simple little fellow when I first went to school (Darwin, 2009, p. 9)... When I left school I was for my age neither high nor low in it: and I believe I was considered by all my masters and by my father as a very ordinary boy, rather below the common standard in intellect' (Darwin, 2009, p. 13). Darwin's delayed development, combined with his supposed autism (Smith, 18th February 2009), may be argued to be circumstantial evidence that Darwin was born prematurely. However, he also claims to have been a very fast runner as a child, which would not be consistent with his having been premature. On these bases, we must conclude that Darwin was most likely not born prematurely.

Likewise, for Albert Einstein (1879–1955), the evidence adduced in a textbook on prematurity is that he was a backward child, hardly speaking until the age of three, and that he was unsuccessful at school, despite subsequent stratospheric intelligence (Linden et al., 2000, p. 571). Again, then, we have developmental delay but not prematurity.

Late development, especially in learning to walk, is the only evidence we can find for Picasso's supposed prematurity. According to his mother, Pablo Picasso (1881–1973) 'could draw before he could walk' (Miller, 2012, p. 10) and he was quoted as having said, 'I learnt to walk using a tin of Oilibet biscuits...' (Penrose, 1981, p. 14), implying that he had trouble learning to walk. The evidence of Picasso's psychopathic traits should be added to this (Kyaga, 2015). Although there are indications that he suffered from delayed development, there is no direct evidence that Picasso was premature.

J. W. von Goethe's (1749–1832) preterm status has been inferred from a description of him after birth: 'a puny waif whose life was despaired of' (quoted in Linden et al., 2000). So, Goethe was of low birth weight and a chronically ill infant, but there is no reason to conclude that he was premature.

Georges Cuvier (1769–1832) was a sickly baby and child but not recorded as having been born preterm: 'George [Cuvier] came into the world with a constitution so feeble that his youth scarcely promised manhood' (Yoder, 1894, p. 47). Once again, Cuvier was a sickly baby and child but not recorded as having been born preterm.

Thus, treating the available information with caution, premature representation among geniuses is absent. Indeed, it appears that the prematurity of a number of geniuses—specifically Newton and Cuvier—was first declared, in English, as late as 1913 (Hess, 1913, 1922) in a study that cites a Francophone study, Wallrich and Fruhinsholz (1911). The first direct assertion that Darwin was born prematurely that we can find was even later**,** in 1939 in the journal of the American Medical Association (*Hygeia*, 1939, p. 203).[1]

In summary, we find that Cuvier, Einstein, Darwin, Goethe, and Picasso exhibit a pattern of delayed development and childhood sickliness that is consistent with, but not strongly indicative of, prematurity, while Kepler was supposedly a sickly child, and Newton exhibited extreme autistic traits. Thus, treating the available information with reasonable diligence, we must conclude that it cannot be said with certainty that any one of these geniuses were born prematurely.

Discussion

Our exploration reveals that the idea that people born prematurely somehow punch above their weight in terms of genius is an historical myth, in the sense that this story has been propagated without substantial evidence or even very strong indications. None of the geniuses on Murray's list can be confidently stated to have been born prematurely. Nevertheless, the fact that the few that might have been preterm did obviously survive means that there remains the possibility that being preterm could have contributed to their eminence, as we will return to below. Nevertheless, based on our evidence, the central idea is refuted.

But first we will mention a few explanations for why such a myth might have developed. This idea seems to be quite recent in the scholarly literature. To the best of our knowledge, the prematurity of a number of geniuses was first declared in a Francophone gynaecology journal (Wallrich

[1] In addition, Linden et al. (2000), in a textbook on premature babies aimed at the parents of such babies, also assert that Voltaire and Rousseau were born early. Both were small and sickly infants, but there is no direct evidence that they were born prematurely (Pearson, 2010; Rousseau, 1903). They also allege that 'Napoleon Bonaparte' was born prematurely. In fact, it was his nephew, usually referred to as Emperor Napoleon III or as Louis-Napoleon, who was preterm (Addison, 2006, p. 272).

& Fruhinsholz, 1911). The idea was probably more widely propagated when Hess (1913, 1922) wrote about it in English, citing Wallrich and Fruhinsholz. As stated above, the first direct assertion that Darwin was born prematurely that we can find was in 1939 in the journal of the American Medical Association (*Hygeia*, 1939, p. 203). One can speculate that this notion has struck a chord with some psychological predisposition, so as to render it particularly likely or attractive, whether it is in fact empirically accurate or not. Then, our typical cognitive biases would suffice for us to make note of every probable instance of this association while ignoring the majority of null cases, so-called confirmation bias (Peters, 2020).

However, it should be said that the association between prematurity and genius traits has long been noted, although it has not been explicated or given a causal explanation. This is clear with regard to what might be called 'religious geniuses.' There are long traditions that Moses (Reif, 2017, p. 98; Sela, 2013, p. 44), Buddha (Droogers, 2011, p. 41), and Hoissain (the founder of Shia Islam) (Cooke Taylor, 1851, p. 55) were born prematurely, as were many mythological figures such as Dionysus (Blanchard-Lemee et al., 1996, p. 88). It can also be noted that beyond Murray's list of geniuses there are a number of people who could certainly be described as extremely influential in various fields—they have aspects of genius—and whom contemporary, primary sources specifically assert were born prematurely. We have already discussed Charles Wesley. Winston Churchill's father wrote a letter to his mother-in-law on 30th November 1874, shortly after his son's birth, in which he stated, 'The boy is wonderful, pretty so everybody says; dark eyes and very healthy considering its prematureness' (Lee & Lee, 2010, p. 236). Winston Churchill (1874–1965) also displayed many of the markers of being premature, including weak lungs, chronic childhood illness, depression, and evidence of autism and psychopathology (Dutton, 2019). One of the first biographies of the Romantic poet John Keats (1795–1821), written in 1817 while Keats was still alive, stated: 'John Keats is recorded to have been premature' (Buxton Forman, 1817, p. xxiv).

Inasmuch as these men were quite certainly preterm, it is possible that prematurity may have been causal in their genius. On the other hand, they may also represent the cases where some individuals have overcome the limiting aspects of being prematurely born and became geniuses nevertheless. Geniuses manifest due to extremely rare and unlikely combinations of genetic and environmental factors, whereby traits that are normally associated with low intelligence—such as high Neuroticism, having poor impulse control, and being socially ineffective (Dunkel et al., 2014)—are combined with outlier high intelligence. This witheringly improbable combination will reflect the fact that gene combinations and their expression, in conjunction with the environment, have been 'just right' to permit the genius to develop. Indeed, this is consistent with the fact that when geniuses have children those children mostly do not exhibit any remarkable abilities or traits at all: the precise genetic–environment interplay has not been replicated (Dutton & Woodley of Menie, 2018; Woodley & Figueredo, 2013). An intriguing area for future research would therefore be to follow up on the eminence of preterm born individuals in more recent generations, where the majority survived. Perhaps we could even distinguish between medical conditions so as to further explore if any combination of cognitive, personality, and medical variables that would seem to increase the likelihood of developing genius or aspects of genius. To this end, one needs also to consider that the conditions for developing genius, as well as the conditions for making achievements that would be defining for genius, might have changed historically. For example, it has been argued that conformism and group-think has clearly increased in our institutions today, at the same time as the influence of economically independent individuals, or patrons, has decreased (Dutton & Charlton, 2015; Williams, 2016). With the personality traits characteristic of geniuses, as have been mentioned, such individuals would therefore face more resistance today to becoming productive and successful, relative to more socially well-adapted individuals. With regard to the seemingly frequent testimony of prematurity amongst religious leaders, the dynamics of prematurity in religion and mythology would be another fascinating issue.

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