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A BLUEPRINT FOR GENETIC DETERMINISM

Blueprint: How DNA Makes Us Who We Are

By Robert Plomin. Cambridge, MA: The MIT Press, 2018. 280 pp. Hardcover, $27.95.

In 2018, behavioral geneticist Robert Plomin published *Blueprint: How DNA Makes Us Who We Are*. In this book, Plomin argues that DNA is the main factor that determines differences in human behavior, that many environmental influences on behavior are really genetic influences, that true environmental influences are mostly random and "we cannot do much about them," and that the molecular genetic "polygenic risk score" method is a "new fortune-telling device" that uses a person's genetic profile to "predict psychological traits like depression, schizophrenia and school achievement" (p. vii). According to Plomin, the book "interweaves my own story and my DNA in order to personalize the research and to share the experience of doing science" (p. xii). He describes the polygenic risk score method as a molecular genetic technique that combines statistically significant and nonsignificant individual single nucleotide polymorphism (SNP) associations identified in genome-wide association (GWA) studies to produce a polygenic (composite) risk score (p. 134). Others have described polygenic risk scores as "generally constructed as weighted sum scores of risk alleles using effect sizes from genome-wide association studies as their weights" (Janssens, 2019, p. R143). In Plomin's view, the first GWA studies published "about a decade ago" in 2005–2007 marked the beginning of what he calls "the DNA revolution" (p. 118).

Several commentators have pointed to problems with GWA studies and the polygenic risk score method, including noncausative or spurious "gene-associations," population stratification, a lack of individual predictive value, the potential "fishing expedition" aspect of "hypothesis-free" studies, and other limitations and potential confounds (Baverstock, 2019; Charney, 2021; Comfort, 2018a; Coop & Przeworski, 2022; Kaufman, 2019; Richardson & Jones, 2019). Sociologist Callie Burt described several potential polygenic risk score environmental confounds and concluded that scores should be used "sparingly and cautiously with caveats placed front and center" (Burt, 2022, p. 23).

Plomin's thesis is that "the DNA differences inherited from our parents at the moment of conception are the consistent, lifelong source of psychological individuality, the blueprint that makes us who we are" (p. ix). Behavioral genetic researchers don't like to be called "genetic determinists," which might explain why Plomin makes occasional statements that "the environment is important" (p. 32) and that "genes are not destiny" (p. 92). And yet, in *Blueprint* he repeatedly conveys the message that genes *are* destiny and that environmental influences are not important.

A leader of the behavioral genetics field since the 1980s, Plomin, who has lived and worked in the United Kingdom since the 1990s, was awarded the American Psychological Association (APA) Award

for Distinguished Scientific Contributions in 2017, in part for having led "the transformation of behavior genetics from an isolated and sometimes vilified scientific outpost to a fully integrated mainstay of scientific psychology" (APA, 2017). He has conducted "quantitative genetic" twin and adoption studies since the 1970s, and since the early 1990s he has also conducted molecular genetic studies in an attempt to discover genetic variants that he believes underlie cognitive ability (IQ) and other areas of behavior.

In 2019, psychologist and behavioral genetic researcher Eric Turkheimer published a review of *Blueprint* (Turkheimer, 2019). Turkheimer is known as a critic, from within behavioral genetics, of some of his field's theories and claims. At the dawn of the 21st century, "the great era of behavioral genomics was on the horizon," Turkheimer wrote in his review, "but it never arrived" (p. 45). Countless studies (and accompanying media reports) have appeared over the past few decades reporting the discovery of genes that influence behavioral differences, but they did not hold up, leading to what he characterized as the "failure of the gene-finding project" (p. 46).

Nevertheless, Turkheimer wrote, *Blueprint* is "hardly the product of a gloomy author" but is instead "a declaration of victory of nature over nurture, a celebration of the vindication of Plomin as a scientist and of behavior genetics as a field of study" (p. 46). Because Plomin relies on the polygenic risk score method, in Turkheimer's view "the original task of figuring out which gene does what on a biological level was abandoned," because "polygenic scores achieve their predictive power by abdicating any claim to biological meaning" (p. 46).

Turkheimer took the former gene–environment "interactionist" Plomin to task for his new stance that "DNA makes us who we are," a phrase Plomin uses in *Blueprint*'s title and repeats in a similar form no fewer than 25 times in the book. Turkheimer pointed to a sentence by Plomin that "may in fact be the worst ever written by an important behavior geneticist" (Turkheimer, 2019, p. 47). According to Plomin, "Put crudely, nice parents have nice children because they are all nice genetically" (p. 83). This led Turkheimer to ask, "And not-so-nice parents? Criminals, beggars, the unintelligent, the miserable, and the insane? What of them and their children? He can't have it both ways" (Turkheimer, 2019, p. 47).

Major Problem Areas in Blueprint

I will now describe some important problem areas in *Blueprint* (while skipping over numerous less important problem areas), with an emphasis on areas that are not covered, or are mentioned only briefly, by other reviewers.

PLOMIN AS HISTORIAN

In *Blueprint*'s Prologue, Plomin misrepresents the history of genetic research in the area of human behavior. He writes that genetic researchers, using twin and adoption studies, began accumulating evidence in favor of genetics in the 1960s and that environmental theories had been dominant until then. For example, "For most of the twentieth century it was assumed that psychological traits were caused by environmental factors" (p. 3). He also writes that "genetics had been ignored in psychology" until the early 1970s (p. xi):

> One of the best things in life is to find something that you love to do, and I fell in love with genetics when I was a graduate student in psychology at the University of Texas at Austin in the early 1970s. It was thrilling to be part of the beginning of the modern era of genetic research in psychology. Everywhere we looked we found evidence for the importance of genetics, which was amazing, given that genetics had been ignored in psychology until then. I feel lucky to have been in the right place at the right time to help bring the insights of genetics to the study of psychology.

In fact, twin and adoption studies conducted by psychologists date back to the 1920s and earlier (e.g., Hirsch, 1930; Thorndike, 1905), psychiatric twin studies date back to 1928 (Luxenburger, 1928), and a belief in the power of heredity has a long history. In making these statements, Plomin overlooks the worldwide eugenics movement of the first half of the 20th century, German psychiatric genetics (Joseph & Wetzel, 2013; Weiss, 2010), compulsory sterilization laws, top psychologists' claims that intelligence is largely innate and fixed, and so on.

In the first four decades of the 20th century, hereditarian and eugenic theories and policies were mainstream, and leading British and American psychologists played a major role in promoting them (Chase, 1980; Gould, 1981; Hearnshaw, 1979; Kamin, 1974). The field of psychology (and especially its psychometrics subfield) has always held that genetic factors play a role in causing differences in cognitive ability and other behavioral characteristics, although the emphasis, meaning, and especially the weight given to genetic influences change from era to era.

In an era when Plomin says that genetics "had been ignored in psychology," Edward Thorndike, listed by the APA in 2002 as the ninth "most eminent psychologist" of the 20th century (APA, 2002; Plomin was number 71), performed a 1905 twin study of "mental traits." In a much earlier version of the IQ hereditarian "blueprint" argument, Thorndike concluded, "It is highly probable from the facts given . . . that the similarity of twins in ancestry and conditions of conception and birth accounts for almost all of their similarity in mental achievement—that only a small fraction of it can be attributed to similarity in training" (Thorndike, 1905, p. 8). Cyril Burt was a knighted British psychologist and eugenicist whose IQ hereditarian publications (and probably fraudulent twin studies) appeared for decades before the 1970s (Hearnshaw, 1979; Kamin, 1974; Tucker, 1997). Burt's beliefs about heredity were a major influence on the shaping of the British selective (11+) postwar education system. In 1923, a leading American psychologist wrote that intelligence testing had demonstrated the "definite intellectual superiority of the Nordic race" while warning American "citizens" not to "ignore the menace of racial degeneration" (Brigham, 1923, p. viii, 187).

No dog whistles were needed in this era, as it could be openly proclaimed by leading psychologists in scholarly works that "science" had found that, due to heredity, the "Nordic race" was intellectually and genetically superior to all other "races" (an additional example is Hirsch, 1926). Between 1944 and 1965, the *American Journal of Psychiatry* published a eugenics- and compulsory-sterilization-friendly annual report with the title "Review of Psychiatric Progress: Heredity and Eugenics" (e.g., Kallmann, 1965). In 1937, the eugenically oriented British-American psychologist Raymond Cattell (number 16 on the APA's "most eminent psychologist" list) published the IQ hereditarian book *The Fight for Our National Intelligence* (Cattell, 1937). Toward the end of his career, in 1972 Cattell wrote about the desirability of promoting what he called "genthanasia," which he described as the "phasing out" and "ending" of genetically "moribund cultures" (Cattell, 1972, p. 221; Tucker, 2009).

The general post–World War II era view on the nature–nurture question in American psychology is found in a 1958 article by Anne Anastasi, who later became APA president. Anastasi wrote that the "heredity–environment question" was a "dead issue" because "it is now generally conceded that both hereditary and environmental factors enter into all behavior" (Anastasi, 1958, p. 197). In the United Kingdom, psychologist H. Maddox wrote in a 1957 edition of the *British Journal of Educational Psychology* that genetic influences had been overemphasized: "The British tradition in psychology has stressed the biological and hereditary determinants of behavior to the relative neglect of social and cultural determinants" (Maddox, 1957, p. 166).

Plomin writes that "thirty years ago it was dangerous professionally to study the genetic origins of differences in people's behaviour and to write about it in scientific journals" (p. xi). Here Plomin conflates the noneugenic and eugenic aspects of behavioral genetic research. In the wake of the social struggles of the 1960s in a sense it *was* "dangerous" to come out in favor of eugenics or to promote genetic explanations of racial group differences in IQ, criminal behavior, and other areas. Outside the racial difference and eugenics contexts, however, in the United States and Western Europe it was not unusual for psychologists and others to write about or conclude in favor of genetic influences on behavior.

IGNORING CRITICS AND COLLEAGUES ALIKE

In *Blueprint,* behavioral genetic and psychometric concepts and methods, including twin studies, adoption studies, heritability, "biometric model-fitting" techniques, and general intelligence (IQ) are presented as valid concepts and methods. Plomin does not mention the names, arguments, or publications of the critics, or the fact that these concepts, techniques, and methods have always been controversial. Nor does he mention the name of any of his behavioral genetics colleagues or mentors in the book's main body, even as celebrity and historical names are sprinkled throughout the text, including Bill Clinton and his "ne'er-do-well half-brother" (p. 72), W.C. Fields, Mark Twain, Brian Wilson, Aristotle, and Benjamin Franklin.

In an October 29, 2018 blogpost, Turkheimer wrote that in *Blueprint,* Plomin seems to take credit for his "First Law of Behavior Genetics" (Turkheimer, 2018). According to Turkheimer's 2000 "First Law," "All human behavioral traits are heritable" (Turkheimer, 2000, p. 160). In *Blueprint,* Plomin cites a 2016 article that he (Plomin) and his colleagues wrote as the source of the "First Law" (p. 195). He does not mention Turkheimer's name in this context, even though he credited Turkheimer as the developer of the First Law in this 2016 article (Plomin, DeFries, Knopik, & Neiderhiser, 2016, p. 4).

As Turkheimer wrote in this 2018 blogpost, Plomin "endorses a hard-line hereditarianism" but

"doesn't bother to actually defend his ideas from even the most obvious objections. Faced with arguments or data that might contradict him, he ignores them, demagogues them, or, as he mostly does with me, pretends that the inconvenient ideas were actually his all along."

IGNORING THE MOST CONTROVERSIAL AND CRUCIAL ASSUMPTION IN TWIN RESEARCH

Behavioral genetic arguments rely heavily on the "classical twin method," which compares the behavioral resemblance or psychological test score correlations of reared-together monozygotic (MZ, identical) and reared-together same-sex dizygotic (DZ, fraternal twin pairs. MZ pairs are said to share a 100% genetic resemblance, whereas same-sex DZ pairs are said to share an average 50% genetic resemblance.

Genetic interpretations of the usual twin method finding that MZ pairs behave more similarly than DZ pairs are based on the long-controversial "equal environment assumption (EEA). This assumption states that MZ and DZ pairs grow up experiencing roughly equal environments and that the only behaviorally relevant factor distinguishing these pairs is their differing degree of *genetic* relationship to each other (100% vs. 50%). Critics have argued since the 1930s that the EEA as it relates to behavioral twin studies is obviously false (Joseph, 2015, p. 445; Richardson & Norgate, 2005; Stocks, 1930), because when compared with same-sex DZ pairs, MZ pairs grow up experiencing

- Much more similar treatment by parents and others, including being dressed alike
- More similar physical and social environments, including spending more time together, attending classes together, and having more similar peer groups
- More similar treatment by society due to their sharing a very similar physical appearance
- A greater tendency to model their behavior on each other
- Identity confusion and a much stronger level of emotional attachment

If the EEA is false, twin method results cannot be interpreted in favor of genetics because the potential influences of genes and environments cannot be disentangled. In *Blueprint,* Plomin does not mention the EEA or the fact that genetic interpretations of his own Twins Early Development Study (TEDS), which he discusses throughout the book, were based on the validity of this disputed assumption.

ADOPTION STUDIES

Plomin writes that in behavioral genetic adoption studies, birth parents "share nature but not nurture with their children" (p. 13). Researchers conducting these studies typically find that, for behavioral characteristics, adopted children correlate higher with their biological as opposed to their adoptive relatives. They conclude that genetic factors explain this finding. However, even children adopted away at birth share several environmental factors in common with their often-stressed birth mothers. This always includes the prenatal environment, usually includes skin color and "race" (often leading to oppression or privilege), and often includes similar physical appearance, social class, culture, religion, and so on.

Additional biases and environmental confounds in adoption research include attachment rupture and its impact on an abandoned/rejected child's developing brain (Newman, Sivaratnam, & Komiti, 2015), late separation from the birth parent, late placement after separation, selective placement (Kamin, 1974; Richardson & Norgate, 2006), and non-representativeness and the restricted range of adoptive family environments (Stoolmiller, 1999). Plomin's argument (p. 13) that adoption studies "disentangle nature and nurture" is not supported by the evidence.

In Plomin's own 1998 "Colorado Adoption Project" adoption study of personality (Plomin, Corley, Caspi, Fulker, & DeFries, 1998), he and his colleagues found an average personality test score correlation of .01 (that is, zero) between birth parents and their 240 adopted-away 16-year-old biological offspring, a correlation that Plomin believed "*directly indexes genetic influence,* unlike the indirect comparisons between nonadoptive and adoptive relatives or between identical and fraternal twins" (Plomin et al., 1998, p. 211, italics added). Although he and his colleagues concluded in favor of genetic influences on personality (14% heritability, p. 215), a better explanation of the results is that Plomin's large and carefully planned 1998 adoption study "directly indexed" genetic influences on personality and found no such influences, a result that stands in remarkable contrast to his later claim in *Blueprint* that "DNA makes us who we are" (for further analysis of this 1998 adoption study, see Joseph, 2013a, 2015 Appendix B).

REARED-APART (SEPARATED) TWIN STUDIES

Plomin also cites so-called "twins reared apart" (TRA) studies in support of his positions, which include his own Swedish Adoption/Twin Study on Aging of the 1980s and 1990s. He writes in *Blueprint,* "The most dramatic test of genetic influence is to

study MZ twins separated by adoption early in life. They share nature completely but do not share nurture at all, so their similarity is a direct test of genetic influence" (p. 18).

However, several commentators have described the many flaws and biases found in the six published TRA studies and have shown that most twins studied in these investigations were only partially reared apart (Farber, 1981; Joseph, 2015, in press; Kamin, 1974; Taylor, 1980). In the Swedish Adoption/Twin Study on Aging, for example, Plomin and colleagues defined twin pairs as "reared-apart" if they had been "separated by the age of 11." The twins, who averaged 65.6 years of age, had been "separated" from each other for an average of only 10.9 years at the time of testing (Pedersen, Plomin, Nesselroade, & McClearn, 1992, p. 347).

In the famous Minnesota Study of Twins Reared Apart IQ study, the researchers needed to omit and bypass their DZ-apart control group IQ correlations (Bouchard, Lykken, McGue, Segal, & Tellegen, 1990, p. 223), and to count environmental influences on twins' behavior as genetic influences (pp. 227–228), to reach conclusions in favor of IQ heritability (Joseph, 2015, in press).

Plomin stands by the behavioral genetic assumption that reared-apart MZ (identical) twins "do not share nurture at all," a faulty assumption because even perfectly separated reared-apart MZ twins share many common behaviorally relevant cohort influences such as common age (birth cohort effects), common sex, common physical appearance, common culture, common skin color (contributing to oppression or privilege), common prenatal and perinatal environment and health care, and so on (Elder & Shanahan, 2006; Joseph, 2015, in press; Rose, 1982).

THE MOST IMPORTANT QUESTION IS INTERPRETATION, NOT REPLICATION

In the context of the ongoing "replication crisis" in psychology and other areas of science (Open Science Collaboration, 2015), Plomin argues that behavioral genetic studies are well replicated (pp. 32–33). This claim has been challenged (e.g., Lerner, 2018), and Plomin fails to address the long-controversial assumptions underlying these studies. If a key assumption is false, such as the twin method's EEA, genetic interpretations of hundreds or even thousands of behavioral studies finding similar results will *all* be wrong (as occurred in the 2015 Polderman et al. twin study meta-analysis, which Plomin discusses on p. 29). The most important question independent analysts should ask about a behavioral genetic study is not whether its results have been replicated, but how its results *should be interpreted*.

ARE ENVIRONMENTAL INFLUENCES ACTUALLY GENETIC INFLUENCES?

Plomin's "nature of nurture" argument states that "what look like environmental effects are to a large extent really reflections of genetic differences," which "implies that parents don't make much of a difference in their children's outcomes beyond the genes they provide at conception" (pp. 82–83). Like that of the Minnesota twin study researchers (Bouchard et al., 1990), Plomin's justification for counting most environmental influences as genetic influences is that "we select, modify and even create our experiences in part on the basis of our genetic propensities," meaning that "the environmental effect of parenting on children's psychological development actually involves parents responding to their children's genetic differences" (p. ix). Therefore, "children make their own environments, regardless of their parents" (p. 83).

Plomin promotes the general theme that parental and other environmental influences are not important. As he puts it, true environmental effects are "mostly random—unsystematic and unstable—which means that we cannot do much about them" (p. xii). He even rejects the metaphor that "parents are . . . like gardeners, providing conditions for their children to thrive." In Plomin's view, "parents are not even gardeners, if that implies nurturing and pruning plants to achieve a certain result" (p. 215). Apart from the ability to simply conclude that "all human behavioral traits are heritable" (Turkheimer's "First Law"), if society "cannot do much about" the environment and cannot do much about heredity either (short of instituting a eugenic breeding program), how can spending hundreds of millions of dollars on behavioral genetic research be justified?

The "nature of nurture" argument is based on what we have seen are unsupported genetic interpretations of the results of twin studies and adoption studies, and it largely ignores decades of research from other social and behavioral science areas that record the importance of environmental influences. It also overlooks or denies the behavior-shaping influences of culture, class, religion, nation, birth cohort, region, the mass media, peer groups, advertising, and so on. "It is quite striking," wrote the late psychiatrist (and at times Plomin collaborator) Michael Rutter, "that behavioral genetics reviews usually totally ignore the findings on environmental influences. It is almost as if research by non-geneticists is irrelevant" (Rutter, 2006, pp. 11–12).

Do children "create" family environments containing physical, sexual, and emotional abuse? If children who are forced to endure such abuse experience depression, low self-esteem, and even suicidal feelings as adolescents and adults, should we conclude that their DNA is the cause? And what about children who grow up in neglectful, cold and distant, or psychologically invalidating family environments? Do children and adults of color "create" psychologically harmful racist environments? How does the oppression of women factor in? The list of examples is endless.

The bottom line is that Plomin's "nature of nurture" argument makes no sense, because it portrays children as creating environments based on their inherited behavioral blueprints while portraying *parents* as possessing an amazing ability to override their own behavioral blueprints by "responding to their children's genetic differences." Even in this mythical parent–child "Battle of the Blueprints," the family environments created by the parents would certainly prevail, because parents possess size, power, and authority in addition to their rigid DNA behavioral blueprints and because they have experienced many more years of "random" and "unsystematic" behavior-shaping events. Children would be largely unable to "select, modify, and create" their family environments for the simple reason that they would be no match for the "DNA blueprint plus random-environmental-event-determined" behavior of their parents.

Plomin's original "nature of nurture" article, followed by "open peer commentary," was published in a 1991 edition of *Behavioral and Brain Sciences* (Plomin & Bergeman, 1991). Plomin writes in *Blueprint* that "most" of the peer commentaries "were hostile or disbelieving" (p. 44), but by my count over half were written by behavioral geneticists or by people supportive of their work.

The "nature of nurture" is not a behavioral genetic "big finding," as Plomin believes, but is in reality a false and illogical argument.

THE ENVIRONMENT "DOESN'T MAKE A DIFFERENCE"

The entire discussion in Chapter 8, where Plomin writes that parents, schools, and life experiences "matter" but "don't make a difference," is confusing and contradictory. If something doesn't make a difference, it doesn't much matter. It certainly "mattered" and "made a difference to" American football coaching brothers Jim and John Harbaugh that they grew up with a father who was a career football coach.

A major theme of Plomin's previous writing was that, in addition to genetics, "behavioral traits are substantially influenced by non-genetic factors" (Plomin & Rende, 1991, p. 177). The moderate pre-*Blueprint* Plomin wrote things like, "As the pendulum of fashion swings from environmentalism to biological determinism it is important that it be caught mid-swing, because behavioral genetic research clearly demonstrates that both nature and nurture are important in human development" (Plomin, 2004, p. 144).

Let's compare two quotations. The first is found in *G Is for Genes,* a 2014 book Plomin co-authored with Kathryn Asbury (Asbury & Plomin, 2014, p. 96): "The truth is that next to nothing is determined by genes, and our environments are hugely powerful."

The second quotation is found in *Blueprint* (p. ix): "The DNA differences inherited from our parents at the moment of conception are the consistent, lifelong source of psychological individuality, the blueprint that makes us who we are."

What happened between 2014 and 2018? Did the "hugely powerful" impact of the environment disappear in those years, or did Plomin decide to greatly downplay its influence to make the case for his DNA blueprint position? For Turkheimer, *Blueprint* "leaves one wondering why so many social scientists start with a commitment to complex gene-environment interplay but wind up committed to blunt hereditarian overstatement." The "obvious explanations" he mentioned include "provocation for its own sake, hawking books, [and] settling scores." Such practices are "beneath a scientist of Plomin's stature," Turkheimer wrote, "although there is some of all that in *Blueprint*" (Turkheimer, 2019, p. 47).

"CONTRADICTIONS AND LOGICAL NON SEQUITURS"

In a December 14, 2018, *Scientific American* article promoting his book, Plomin wrote,

> We would essentially be the same person if we had been adopted at birth and raised in a different family. Environmental influences are important, accounting for about half of the differences between us, but they are largely unsystematic, unstable and idiosyncratic—in a word, random. (Plomin, 2018)

The logic of Plomin's position in the first sentence leads to a conclusion that someone would turn out to be "essentially the same person" whether they were adopted away at birth and placed with a poor family living in a Brazilian favela or placed with an aristocratic British family living in a London-area estate.

As psychologist Scott Barry Kaufman wrote in his January 18, 2019, *Scientific American* blog in response to the above Plomin statement, it is "impossible to make this claim based on what we currently know about genetics. Not only that, but these two sentences contradict themselves. First [Plomin] says we would be the same, but then in the *very next sentence* he says of course we wouldn't be the same." Although Kaufman in general is an admirer of Plomin's work and taught Plomin's research to his students, he wrote that many of Plomin's 2018 statements were "riddled with contradictions and logical non sequiturs, and some of his more exaggerated rhetoric is even potentially dangerous if actually applied to educational selection."

PLOMIN'S INTERPRETATION OF HIS OWN POLYGENIC RISK SCORES

Plomin offers several explanations for why some of his own polygenic risk scores do not match his personal reality. For example, his schizophrenia score is in the 85th percentile, even though "I don't feel at all schizophrenic, in the sense of having disorganized thoughts, hallucinations, delusions or paranoia" (pp. 149–150). Rather than offer this result as evidence that polygenic risk scores cannot be trusted—as he easily could—he instead suggests that his high score could be the result of creative thinking. "A nicer way of thinking about my higher than average polygenic risk score for schizophrenia," Plomin writes, "is to contemplate possible aspects of what at the extreme is called schizophrenia. The best example is a possible link between schizophrenia and creative thinking. Aristotle said, 'no great genius was without a mixture of insanity'" (p. 151).

PSYCHIATRIC DISORDERS ARE SIMULTANEOUSLY NONEXISTENT AND SUBSTANTIALLY HERITABLE

In *Blueprint*'s Chapter 6, Plomin calls for ending the idea that specific behavioral or psychiatric conditions exist, arguing that they are caused not by genes specific to each condition but instead by "generalist genes" falling into "three broad genetic clusters." This means that we will have to "tear up our diagnostic manuals based on symptoms" (p. 68). Plomin predicts the "demise" of psychiatric diagnoses, since "there are no disorders to diagnose and there are no disorders to cure" (p. 165). At the same time, he cites research claiming that psychiatric conditions are "under substantial genetic influence" (p. 5) and can be predicted by polygenic risk scores. He writes positively of the Psychiatric Genomics Consortium, a "remarkable collaboration" of international researchers attempting to identify genes associated with the major psychiatric conditions (p. 125). What Plomin fails to explain is how psychiatric conditions can be studied, predicted, "substantially genetically influenced," and the subject of Psychiatric Genomics Consortium gene searches if they do not exist.

If it is true that DNA "inherited from our parents at the moment of conception . . . makes us who we are," it follows that MZ twin concordance rates for schizophrenia and other psychiatric conditions should approach 100%. (Concordance means that both twins are diagnosed with the same condition.) In fact, MZ concordance rates for the major psychiatric conditions are well below 100%. Most textbooks report the pooled schizophrenia MZ concordance rate as roughly 50% (Kaplan & Sadock, 1996), and the pooled reared-together MZ concordance rate in the better-performed studies appearing after 1962 is less than 25% (Joseph, 2013b, in p. 448). The most recent schizophrenia twin study, performed in Denmark by Rikke Hilker and colleagues, found an extremely un-blueprintlike 12 of 81 MZ pairs (14.8%) concordant for schizophrenia, meaning that when one MZ twin was diagnosed with schizophrenia, 85% of the time his or her identical-DNA MZ co-twin was not so diagnosed (Hilker et al., 2018, Table 2).

FOUR DECADES OF UNFULFILLED GENE DISCOVERY CLAIMS AND PREDICTIONS

By the late 1980s and early 1990s Plomin concluded that twin and adoption studies had established the "heritability" of behavioral characteristics (traits) beyond any doubt, and that behavioral genetic researchers should place greater emphasis on molecular genetic methods. He shifted his own research focus in the direction of the hunt for "inherited DNA sequence differences lurking in the genome" (p. 124).

Although in *Blueprint* he writes of mostly failed behavioral gene discovery attempts prior to the GWA era beginning 2005–2007, Plomin had been claiming gene association discoveries based on his own and others' work as early as 1978, when he and a colleague wrote that "evidence has accumulated to indicate that inheritance of bipolar depression involves X-linkage in some instances" (DeFries & Plomin, 1978, p. 479). In a 1994 article appearing in the prestigious journal *Science,* Plomin and colleagues reported that genetic linkages and associations had been found for reading disability, sexual orientation, alcoholism, drug use, violence, paranoid schizophrenia, and hyperactivity (Plomin, Owen, & McGuffin, 1994, p. 1737). Four years later, Plomin and Rutter informed psychologists that genes associated with behavioral dimensions and disorders were "beginning to be identified"

(Plomin & Rutter, 1998, p. 1223). In 2000, Plomin predicted, "In a few years, many areas of psychology will be awash in specific genes responsible for the widespread influence of genetics on behavior" (Plomin & Crabbe, 2000, p. 806). In the fifth edition of the textbook *Behavioral Genetics,* Plomin and colleagues reported gene associations or discoveries in the areas of attention deficit hyperactivity disorder, reading disability, schizophrenia, panic disorder, personality, and antisocial behavior (Plomin, DeFries, McClearn, & McGuffin, 2008).

IQ (intelligence, cognitive ability) is by far the most important area of behavioral genetic research. An example of a report in a major media outlet about Plomin's molecular genetic IQ research is found in a 1998 *New York Times* article by Nicholas Wade, titled "First Gene to Be Linked With High Intelligence Is Reported Found" (Wade, 1998; the original study was Chorney et al., 1998). As Wade described it,

> Dr. Plomin has sought to move the debate forward by arguing that if genes for intelligence exist it should be possible to track some of them down through the powerful new genetic scanning techniques that have recently become available. Searching through a small part of the human genome, the long arm of chromosome 6, he found that a particular variant of a certain gene was twice as common in his sample of children with ultra-high I.Q.'s than in those with average I.Q.'s. The gene has a very small effect, accounting for about 2 percent of the variance, or 4 I.Q. points, Dr. Plomin said.

This *New York Times* article reported on what later turned out to be a spurious false-alarm nonfinding. Twenty years later Plomin acknowledged that up until 2017, no replicable gene–intelligence associations had been found (Plomin & von Stumm, 2018). I am not aware of any subsequent *New York Times* retraction or discussion of Wade's article.

"False Starts" and the Search for Many Genes of Small Effect

In contrast to his previous discovery claims and optimistic discussions about molecular genetic research, including the 1998 *New York Times* article and similar reports, in *Blueprint* Plomin describes his own earlier failed attempts to identify genes underlying cognitive abilities and disabilities, which go back to the early 1990s (e.g., Plomin, McClearn, et al., 1994). These early failures remind him of "the cartoon about a scientist with a smoking test tube who asks a colleague, 'What's the opposite of Eureka?'" (p. 122). After "three false starts" he was preparing to end the search and retire in disappointment (pp. 122–123). Then, according to Plomin's account (Chapter 11), with the advent of GWA studies in the period 2005–2007 he began to think that psychological trait differences were caused by many genes of small effect, "microscopic creatures" as he calls them (p. 131), and that "huge GWA sample sizes" are needed to detect them (p. 134).

In an apparent attempt to explain these earlier cognitive ability "smoking test tube" false starts, Plomin writes in *Blueprint,* "When the [gene] hunt began twenty-five years ago [circa 1993] everyone assumed we were after big game—a few genes of large effect that were mostly responsible for heritability" (p. 120). "Everyone hunting for genes" in the early-to-mid 1990s, he recalls, "assumed that a handful of genes accounted for most of the heritability observed in twin studies" (p. 131).

In Plomin's writings of the early 1990s, however, he often described a search for many genes of small effect. In a 1990 article published in *Science,* he wrote, "The normal range of behavioral variation is orchestrated by a system of many genes, each with small effects" (Plomin, 1990, p. 186). In his 1991 *Annual Review of Psychology* contribution, he said that "behavioral dimension and disorders are likely to be influenced by many genes, each causing small effects" (Plomin & Rende, 1991, p. 177). In a 1993 publication he stated, "It is now generally recognized that no major gene for behavioral dimensions or disorders is likely to be found in the population" (Plomin, 1993, p. 478). He wrote in this publication that the molecular genetic linkage study approach that "different major genes are responsible for the disorder in different families" was probably wrong and that "major genes" for behavior "will not be found":

> The alternative view espoused here is that major genes will not be found for behavior either in the population or in the family. Rather, for each individual, many genes make small contributions to variability and vulnerability. In this view, the genetic quest is to find not *the* gene for a behavioral trait but the many genes that affect the trait in a probabilistic rather than predetermined manner. (Plomin, 1993, p. 478)

Yet in his *Blueprint* discussion of the widely cited Wellcome Trust GWA study (2007), Plomin says "it was shocking to find that the effect sizes of the associations were all very small" (p. 124).

Private "Misery" Versus Public Excitement

When his and other groups' behavioral gene discovery attempts, claims, and predictions fell through before the "DNA revolution," Plomin reveals in *Blueprint* that he experienced private feelings of "getting nowhere" (p. 120), "misery" (p. 123), disappointment (p. 121), and "getting depressed" (p. 122). In contrast, in that era Plomin's published discussions of molecular genetic research frequently included words and phrases such as "breathtaking pace," "exciting," "on the cusp," "spectacular advances," "dawn of a new era," "revolutionary advance," "revolutionary genetic research," "begun to revolutionize," "genetic advances are just around the corner," "momentum of genomic science," "missing heritability," "golden post-genomic era," "the future looks bright," "threshold of the post-genomic era," and "accelerating pace."

Despite the rhetoric, Plomin has a 40-year track record of unfulfilled gene discovery claims and predictions (Joseph, 2015, Chapter 10). Although in *Blueprint* he again makes bold new "DNA revolution" claims and predictions, this time based on GWA studies and polygenic risk scores, there is every reason to believe that these more recent claims and predictions continue this decades-long trend.

FEARS OF GENETIC DETERMINISM ARE NOT "MISPLACED"

The implications of Plomin's claimed "DNA revolution" are enormous and if true would require rewriting all human history. He avoids the potential eugenic and racial differences implications of his claims while failing to mention the past crimes committed, and the pseudoscience promoted, in the name of genetics and eugenics, and he writes that the IQ genetics debate once raged due to earlier critics' "misplaced fears about biological determinism, eugenics, and racism" (p. 53). Why misplaced? Is Plomin aware of books such as *The Mismeasure of Man* (Gould, 1981), *The Legacy of Malthus* (Chase, 1980), *Murderous Science, Racial Hygiene: Medicine Under the Nazis* (Müller-Hill, 1998), and *The Surgical Solution* (Reilly, 1991)? Few readers of these books would conclude that fears of biological determinism, eugenics, and racism are misplaced. History can repeat itself.

In the wake of massive worldwide protests in 2020 against racism and other forms of oppression and injustice, the Behavior Genetics Association (BGA) released a 2021 "BGA Diversity and Inclusion Plan." The plan called for a "renewed urgency for scientific organizations worldwide to acknowledge the role science has played in racism" and candidly stated, "The history of our field is inextricably linked with racism, including the misuse of behavior genetic research to support violent eugenic policies" (BGA, 2021). This statement is commendable, although the document failed to acknowledge people who earlier had protested against hereditarian "racial differences in IQ" theorists, such as psychologists Arthur Jensen (1969) and Hans Eysenck (1971).

The late psychologist Leon Kamin dedicated the second half of his life to exposing the links between some genetic researchers and racism/eugenics/genetic determinism, and the faulty and even fraudulent research underlying these links, to the detriment of his academic career (Joseph, 2018). For many years, beginning with the publication of his book *The Science and Politics of I.Q.* (Kamin, 1974), Kamin was villain #1 in the behavioral genetics world (Wright, 1998). In a 1998 tribute to Jensen, psychologist and former BGA president Sandra Scarr called Kamin and other critics of behavioral genetics "politically driven liars," who were "despicable" "thugs with pens instead of microphones" (Scarr, 1998, p. 231).

In light of its 2021 "Diversity and Inclusion Plan," the BGA might consider preparing a statement acknowledging the important antiracist and anti-eugenics work of Kamin (1927–2017), evolutionary biologist Richard Lewontin (1929–2021), psychologist William H. Tucker (1940–2022), neuroscientist Steven Rose, psychologist Ken Richardson, and many others who the BGA could now officially recognize as heroes (see Kamin, 1974; Lewontin, Rose, & Kamin, 1984; Richardson, 1998, 2017; Tucker, 1994, 1997, 2002, 2009).

Plomin writes in *Blueprint* that "no specific policies necessarily follow from genetic findings, because policies depend on values" (p. 105). However, early-20th-century left-wing supporters of eugenics, and Plomin's stated support for the British Labour Party notwithstanding (Wilby, 2014), a set of politically conservative and right-wing views, policies, and actions naturally flow from genetic determinist beliefs. Genetic determinism supports the idea that human beings, for the most part, are in their biologically destined places in society and in the world. It helps justify inequality and huge income disparities, neoliberalism, and neocolonialism, and supports the belief that changing or improving the environments of individuals, ethnic groups, economic classes, and nations won't accomplish much. "Ultimately, if unintentionally," historian of biology Nathaniel Comfort wrote, "*Blueprint* is a road map for regressive social policy" (Comfort, 2018a; see also Comfort, 2018b; Lerner & Chase, 2020).

Summary and Conclusions

The genetic determinist (hereditarian) conception of human beings and human differences presented in *Blueprint* is false in part because it is based on methods and assumptions that do not stand up to critical analysis. Moreover, behavioral genetic research has always relied on long-controversial concepts such as IQ, measurable and stable personality traits, psychological testing, and biometric model fitting. Going further, because of environmental confounding and other problems, the twin and adoption studies that Plomin and other behavioral geneticists depend on fail to provide scientifically acceptable evidence that heredity plays a direct role in causing human behavioral differences. The belief that family, twin, and adoption studies have established the "heritability" of human behavioral characteristics and psychiatric conditions is the fundamental error of behavioral genetic gene-finding strategies, including the GWA and polygenic risk score methods.

The polygenic risk score method is destined to become the latest in a long line of failed gene-finding methods in the area of human behavior, failures that are usually recognized only after the latest-and-greatest method is said to have finally found the long-lost "genes for behavior." In his 2014 book *Misbehaving Science,* sociologist Aaron Panofsky described behavioral geneticists' gene discovery failure "coping strategy" of "technological optimism." By this he meant the "optimism that the next level of technology will overcome past disappointments" (Panofsky, 2014, p. 177). Current excitement in behavioral genetics about the polygenic risk score method will fade when it becomes yet another "next level" method that failed, similar to the stunning collapse of the earlier era of behavioral and psychiatric "candidate gene" research (roughly 1990–2015), which Plomin recognizes in *Blueprint* as an "approach that failed everywhere" (p. 222), a "fiasco" (p. 121), and a "flop" (p. 224).

Although at times Plomin refers to a "century" of behavioral genetic research (p. 72), the narrative he presents seems clear. The *Blueprint* story begins with Plomin's arrival on the scene as a young behavioral genetic psychologist in the early 1970s. Up to that point, most psychologists believed that environmental influences were the only thing that mattered, and genetics had been ignored in the field. Apparently free from genetic confirmation bias, he carried out the new and "dangerous" task of publishing psychological genetic research. He made many counterintuitive heritability discoveries, so the *Blueprint* story goes, including finding genetic influences on "divorce" and "television watching" (pp. 38–46). These discoveries, according to the story, were based mainly on controversy-free twin and adoption studies built on sound assumptions and correspondingly controversy-free concepts such as IQ, personality, and heritability. In the process Plomin helped develop the "First Law of Behavior Genetics" and produced a "big finding" that environmental influences previously thought to exert much influence on human behavioral development "do not make a difference." Continuing the *Blueprint* story, in the 1990s Plomin and others began the search for behavioral genes at the molecular genetic level, although for many years the search was hampered by a mistaken focus on discovering a handful of "big game" genes of large effect. After two decades of gene-finding attempts that were "getting nowhere," he and his colleagues shifted focus to the identification of many genes of small effect. In the period 2015–2016, Plomin helped launch the approach of calculating "fortune-telling" polygenic risk scores, which "made it possible to predict genetic propensities of individuals" (p. 187). His own "schizophrenia" polygenic risk score was surprisingly high, but creative thinking was the likely explanation. Others' fears that "DNA makes us who we are" claims could be terribly misused to harm people and groups were obviously "misplaced," since apparently no such misuse of genetic research had taken place in the past. Plomin's story ends by inviting his readers to join the "millions of people [who] have already voted with their credit card by paying to have their genomic fortunes foretold, even before polygenic scores are available" (p. 184).

I have attempted to show in this review that there are problems with every aspect of this story.

Toward the end of his long and prolific career, Plomin has gone all-in with polygenic risk scores in an attempt to snatch gene discovery victory from the jaws of defeat. As criticism of the polygenic risk score method continues to mount, a close examination of the behavioral genetic "big findings" Plomin describes in *Blueprint* reveals that there are no findings at all, and future historians of science may well see *Blueprint* as marking the beginning of the behavioral genetics field's decline.

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THE CUP WHISPERER

A Thousand Brains: A New Theory of Intelligence

By Jeff Hawkins. New York: Basic Books, 2021. 288 pp. Hardcover, $26.99.

Once upon a time about five hundred million years ago a tadpole lookalike creature swam the ocean depths. It was the juvenile phase of an ancient sea squirt, sometimes referred to as a tunicate. Its job at this developmental stage was to find a suitable rock on the ocean floor to anchor down upon and morph into an adult sea squirt. This adult form would spend the rest of its life attached to that rock, passively feeding on what passing currents would bring its way. Not a bad life. But that's not the end of our story, it's just the beginning. Because a very strange twist occurs in this tale. Some say it's apocryphal, others say an exaggeration, but I think it might be true. Give or take.

One day an enterprising juvenile tunicate decided not to settle down on a rock; it just kept swimming. And swimming. It got bigger, and bigger. It developed eyes and gills. And got bigger still. It developed fins and sexual reproduction. It got bigger, and fins developed into feet, and it walked upon the land trading gills for lungs. It spent time walking on all fours and time living in trees. It came down from the trees and walked upright and learned to talk to other descendants of juvenile tunicates. And then one day it looked back out upon the ocean and said, "Thanks." Thanks to that enterprising juvenile tunicate who decided to not eat its own nervous system. Wait, what! Not do what?

Wasn't she supposed to say something like "Thanks, oh ancient one, for your bold and courageous swimming"? Not really. If it were that simple there would be no introduction like this for a review