Chapter 1

Genetics, Schools, and Learning

The science of genetics is changing our world at an ever-increasing pace. We can now analyze and modify DNA to test for serious illnesses and treat them before they become life-threatening, to catch criminals and exonerate the innocent, and to create energy sources that will protect our planet. Geneticists have cast their nets far and wide to influence and inform medicine and public health, agriculture, energy and the environment, law, and social policy. Education, however, is glaringly absent from this list, and schools remain untouched by the lessons of genetics. This, we believe, needs to change.

One way of helping each and every child to fulfill their academic potential is to harness the lessons of genetic research. We now know a great deal – though not by any means everything – about the ways that genes influence learning, and about how children's DNA interacts with their experiences at home and school. It's time for educationalists and policy makers to sit down with geneticists to apply these findings to educational practice. It will make for better

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schools, thriving children, and, in the long run, a more fulfilled and effective population. That's what we want schools and education to achieve, isn't it?

The Aims and Assumptions of Education

Like most areas of public policy, education is a hotbed of disagreements and competing philosophies. Fundamentally, however, we can all agree that education should give everybody the basic tools they need to function in society. In most of the world right now these tools, or skills, consist of reading, writing, arithmetic, and an ability to interact with digital technologies. We can probably identify a secondary aim: only the most extreme libertarian would object to the notion that societies should benefit in tangible ways from providing education to their citizens. A recent OECD report for instance claimed that if all OECD countries could equal the average educational performance of the Finns the combined financial gain over the course of a single generation, the generation born in 2010, would be $115 trillion. By 2090 the gain would increase to $260 trillion. Both the United States and the United Kingdom would be among the nations to gain most in these economic terms, along with Mexico, Turkey, Italy, Germany, Spain and France. It is noteworthy that the Finnish education system puts a particularly high premium on basic skills and has a comparatively small gap between its most and least able pupils. Of course, education should not restrict itself to these two aims: the first is the bare minimum to which a society, a school, or a teacher should aspire, and the second is a by-product of the first. If these aims are not achieved then we may have icing but we have no cake.

The simple aims of learning to read, write, calculate, and use a computer are achievable by virtually every member of society regardless of their IQ. If even one child (not including those with profound disabilities but including those with, for instance, mild and moderate learning, emotional, or behavioral difficulties) leaves school without achieving an acceptable level of competence in these

skills, then their school and the education system supporting it have failed them. This is entirely unacceptable.

Sadly these aims are not always met: young people sometimes do leave school insufficiently literate and numerate even after 11 years (15,000 hours) of full-time education. The prospect of these young people becoming happy, fulfilled, and useful members of society is bleak. When this happens everybody blames everybody else, with excuses running from fractured societies through inner city schools with jaded teachers, unsupportive parents, low ability, and poor behavior . . . impossible kids in impossible circumstances basically. This is a cop-out. There is something far more fundamental going on. The entire education system is predicated on the belief that children are "blank slates." Behavioral genetics tells us that this is wrong.

This theory of education (and of human life in general) says that children are all born the same, with exactly the same potential, and become the product of their experiences. They are blank slates to be written upon by families, schools, and society. Many people believe that if their children behave well it is because they bring them up well; that if they are successful in school it is because they have excellent teachers and supportive parents. Conversely, they believe that if children play truant or display antisocial behavior their parents and teachers are at fault and should be held responsible, to the extent, in the case of parents, of being sentenced to terms of imprisonment. At a less extreme level this belief causes people doing a perfectly decent job of bringing up their children to torture themselves. Is he anxious because I mollycoddle him? Is she bossy because I give her too much attention? Is she two reading levels behind the neighbor's son because I didn't get her into the popular and over-subscribed school down the road? Should I have arranged a tutor to prepare him for selective school entrance exams? This kind of environmental determinism has become the norm, with all of the smugness and censure that it inevitably entails.

However, if you ask any parent of more than one child whether their babies were blank slates at birth or whether each child arrived with their own bundle of obvious traits – namely their

temperament, appetites, needs, and preferences – you will hear the same reply. They were individuals from the moment they were born. If we took all babies from their families at birth and raised them in identical, government-sponsored rearing camps they would not resemble each other much more than they do now on school entry, and the resemblance would fade further as they grew and developed. People sometimes assume that environmental influence becomes more important as we develop and accumulate experiences. However, for traits such as cognitive development the reverse appears to be true. Genetic influence increases over time until, in later life, cognitive ability is almost as heritable as height.

The fact that individual differences are influenced by genes makes a lie of the blank slate philosophy. This in turn means that "more of the same" is unlikely to be the correct approach for children who are failing to stock up their toolkit of basic skills through ordinary means. A child who is not learning in the usual way can almost always be helped to learn, but their teachers may have to think outside the box and use their knowledge and experience of teaching and of the individual child to find the right buttons to push. They also need to be supported by policies that allow them to work this way.

To provide all children with a basic toolkit for life it is undoubtedly true that one vital focus of any education system has to be on making sure no child is left behind. Such a simple, clear aim has simple, clear policy implications: target resources at the children who struggle to equip themselves with basic academic tools and help them by whatever means work for them as individuals. The first funding priority for education should be to provide whatever is required to give every child enough facility with words, numbers, and computers to be able to live an independent life in the twenty-first century. Extra funding must be provided to help those children who struggle to meet these standards before they leave school, whatever the reason for their failure to progress. This may be one way in which we can start to tackle the challenge of improving social mobility in nations such as the United States and

the United Kingdom. An emphasis on supporting those who need support to learn the basics is just a starting point, however.

In societies where education is freely available and compulsory for all children, pupils can be differentiated by the way in which they respond to instruction. The ability to learn from teachers is, we know, influenced more by genes than by experience. The influence of school on differences between children in how well they achieve is likely to be larger in societies where the availability of formal education is unequal. It is understandable, then, that in developed nations we find higher estimates of genetic influence, and lower estimates of the impact of schooling, on individual differences in achievement. If access to education is the same for everybody it cannot explain the differences between individuals. Formal education, standardized to be the same in all classrooms, can form the bedrock on which the bell curve of ability and achievement is based. It can influence whether a group has a high or a low average score but it does not influence how well individuals perform in relation to each other. This is where genes really matter, and this is where the biggest differences exist.

These are important issues, not least at a time when the world is working hard to bring education to every child. Under UNESCO's leadership most countries have committed to achieving universal enrolment in primary education by 2015, and in many countries the commitment is to make enrolment compulsory rather than optional. As a combined result of population growth and the proliferation of compulsory education, UNESCO estimates that over the next 30 years more people will receive a formal education than in the entirety of human history. Even though the 2015 target looks unlikely to be met in full this is a remarkable, wonderful achievement, and those who have found ways to bring educational opportunity to children of all backgrounds, in distant, poor, rural locations where the obstacles must seem insurmountable deserve the world's admiration and appreciation. But this advent of universal education has to come with an acceptance that by creating equal educational opportunities we put nature, in the form of genetic inheritance, back in the driving seat. By providing

education to all children we create a situation in which their genes are the single biggest influence on how well, relative to others, they do in school. Universal education increases average performance but also highlights individual differences. This, if the first aim of education is genuinely met, seems, at worst, a small price to pay. At best, it offers the chance to select the best color and texture of icing for each and every child's educational cake. It allows schools to help their pupils become the best that they can be.

The school system has a responsibility to equip young people with the tools they need to live independently in society; there will also be social and economic benefits to developing a workforce and a citizenry with close to 100% literacy, numeracy, and understanding of digital technologies. Arguably, education could stop there. However, in a country with the resources and the will to take it further, the fact of genetically influenced individual differences begins to come into play for everyone, not just those who struggled to fill their basic toolkits. Once pupils have been equipped with the basic skills they need to function effectively in the world, the focus must switch to drawing out individual potential. In this way schools can promote individual fulfillment and achievement, and prepare cohorts of young people who know their talents and have been educated to use them. Society will surely benefit from generation after generation of young people with a firm grasp of core skills underpinning a wide range of specialist abilities and interests. We would predict positive impacts on health, law and order, employment, and the economy.

Diverse Opportunities to Draw Out Individual Potential

Everyone knows that some children have an aptitude and a taste for traditional academic work. Both qualities are influenced – but not determined – by genes. These pupils are the easiest for schools to handle, and they tend to do well in the current system. They are also the pupils that selective schools pick out and whose successes

are then claimed by the schools to be the result of a superior education. Current policies and the "blank slate" philosophy hold up these children as models. They suggest that if we work harder then all children can be made to fit this mold. As a result, current approaches push nonacademic children to become mediocre generalists regardless of their natural abilities, interests, hopes, and dreams. This is one of the ways in which current educational policies and practices need to be changed – and genetics can suggest changes that might have a positive impact.

A society that recognizes and rewards a wide variety of skills and talents is likely to reap benefits. As children we are taught that the loops, swirls, and whorls on our fingertips make us unique; for most children this knowledge is a source of wonder and delight. Uniqueness *is* wonderful and delightful. But the current education system too often tries to suppress this uniqueness and turn out young people who are the same as everyone else. Square pegs in round holes. Even the most basic understanding of genetics tells us that schools would serve their pupils – and society – better by developing their unique talents and interests; by finding methods of teaching that allow Sam to be Sam and Sarah to be Sarah and help both of them to become fully functioning citizens of the worlds they choose to inhabit. A more detailed understanding of the way that genes and environments interact suggests that breadth of choice is the key – and we'll explain why later in the book.

In other words, once the basics have been instilled, a higher-level purpose of education should be to draw out the potential within a child and to support each child by nurturing that potential. This "drawing out" is the meaning of the Latin *educere*, from which the word education is derived. Enabling a child to recognize his or her abilities and to develop a love of learning is a powerful responsibility and will call upon all of the intelligence, sensitivity, and expert knowledge that the best teachers have. Teachers need to be experts in child development too, with strong personal and communication skills that allow them to connect with individual pupils, understand their needs and desires, and nurture them in the appropriate way. It helps when teaching is a respected profession

and when teacher training is competitive and attracts large numbers of high-caliber graduates. It helps, too, when these high-caliber teachers are trusted to get on with teaching in the way that works best for them and their students.

DNA in the Classroom

What we have described above is a system of personalized learning – one that develops basic skills but also draws out and nurtures individual talents and abilities. The genetics of behavior can inform our thinking about how to make such a system a reality (skip to Chapters 13 and 14 if you want to see us try). The key is understanding the interplay between DNA (your genetic make-up or genotype) and the learning environment. In particular, we will draw on our knowledge of a process called genotype–environment correlation. There are three main types of correlation to note. The first is a *passive* genotype–environment correlation. This is the process whereby, for example, low-achieving parents with low aspirations pass on not only their genes but also an educationally unstimulating rearing environment to their children. Secondly, there is an *evocative* genotype–environment correlation. This is where children evoke certain behaviors on the basis of their genetic propensities. It is easy to see how this could be an important feature of personalized learning. If a teacher sees that a child is naturally quick with numbers they may offer more opportunities to that child to develop their mathematical skills and knowledge and keep pushing them forward regardless of what is expected of them on the basis of age alone. The same could be true for a fast runner, a child who is gifted with words, or a child with strong leadership or interpersonal skills. Teachers with the sensitivity (and time) to notice the strengths – and weaknesses – within an individual child, and to respond accordingly, offer those children an excellent chance of fulfilling their natural potential. Thirdly, there are *active* genotype–environment correlations. Here, children actively seek out experiences and opportunities on the basis of their genetic propensities. They are naturally drawn to the people and activities that suit them. In a

classroom offering genuinely personalized learning children would be free to do this – like plants reaching for sun and water – and they would not be expected to put these urges to one side in order to conform to a rigorously planned timetable, apart from those lessons focused on teaching the essential basic skills.

Research into all three types of genotype–environment correlation shows us that sensitivity to genetically influenced differences between children represents the most promising means available to schools and teachers who wish to offer a genuinely personalized education. As well as sufficiently sensitive and skilled teaching and a classroom designed to foster creativity and personal development, the key to making this work is an understanding of genetics and the degree to which different behaviors are inherited. To this end genetics education should form a core part of all teacher training.

In Summary . . .

The primary aim of education is to furnish each and every child with a basic toolkit of literacy, numeracy, and technological skills, to the benefit of the children themselves and society at large. Any education system that allows a child to leave school without these skills has failed. Genetics tells us that some children will, by their very nature, find the acquisition of these basic skills difficult and that they should be provided with personalized support to whatever extent is necessary to enable them to acquire an adequate toolkit of skills. Where education goes beyond this basic training it needs to accept and embrace pupils' individual differences, recognizing that they are not blank slates. By personalizing education, schools, through embracing the process of genotype–environment correlation, should draw out natural ability and build individual education plans for every single child, based on pupils' specific abilities and interests rather than on arbitrary hoops set in place by partisan, vote-courting governments.

Geneticists can help make these educational aims more achievable. Our evidence makes it crystal clear that treating children as

blank slates or empty vessels, using a factory model of schooling, and arbitrarily imposing the same targets for everyone are approaches that work against, rather than with, natural child development. Our schools and our educational policies will be improved if they are designed to respond to naturally occurring individual differences in ability and development. This is what the best teachers already try to do in their classrooms: thousands of teachers have told us that they know nature is at least as important an influence as nurture on ability and achievement (Walker and Plomin, 2005). However, great swathes of education policy militate against taking genetics into account, fostering herding methods and making personalization virtually impossible.

As we said at the beginning, it's time for this situation to change. It's time for geneticists to sit down with educationalists and policy makers. It's the right time because we now know just about enough to begin to make a positive difference. We also need to be prepared for the genetic advances that are just round the corner. The technology will soon be available, for example, to use DNA "chips" to predict strengths and weaknesses for individual pupils and to use this information to put personalized strategies in place for them. The same technology is already used in heart medicine and immunology; it's only a matter of time before it can be adapted for education. But even harnessing the current power of behavioral genetics will undoubtedly improve the way we educate our children. In Part One of this book, we will present the evidence for that claim, and in Part Two we will make tentative suggestions – tentative because they need to be tested and an evidence base established before they become formal policy recommendations – for making it a reality. In the next chapter we'll start by explaining how behavioral geneticists know what they know.

References

OECD (2010). *The High Cost of Low Educational Performance: The Long-run Economic Impact of Improving PISA Outcomes*. Paris: OECD. DOI: 10.1787/9789264077485-en.

Walker, S.O. and Plomin, R. (2005). The Nature–Nurture question: Teachers' perceptions of how genes and the environment influence educationally relevant behavior. *Educational Psychology*, 25, 509–516. DOI: 10.1080/01443410500046697.

Further Reading

Collins, Francis (2010). *The Language of Life: DNA and the Revolution in Personalized Medicine*. New York: HarperCollins Publishers. Provides a first-rate and highly readable account of developments and precedents in personalized medicine.

Pinker, Steven (2002). *The Blank Slate: The Modern Denial of Human Nature*. New York: Penguin Putnam Inc. An important and entertaining discussion of why humans can no longer be viewed as "blank slates," and why they ever were.