Genius Explained

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1 Introduction

Genius appears to be a mystery, immune to scientific analysis. Unlike the mundane kinds of expertise that ordinary men and women gain through training and practice, genius is seen as a quality that is bestowed from above on particular individuals who are chosen to receive it. For the eighteenth-century German philosopher Immanual Kant, genius was an incommunicable gift that cannot be taught or handed on, but is mysteriously imparted to certain artists by nature, and dies with the person.[1] That view is still widely shared today. Confronted with the challenge of explaining the purity and perfection of Mozart's music, the editor of a book on genius insists that the task is impossible, adding that, 'We can only answer, "because he was a genius", which is tantamount for saying that we do not know. For in each age and in each art, genius is that which defies analysis.'[2]

Should we even try to argue with that conclusion? It is undeniable that the greatest human achievements leave most people spellbound. Listening to a recording of *Cosi fan tutte*, I feel pressed to concede that the causes of genius must always remain mysterious. We can admire genius, wonder at it, be moved, dazzled and amazed by it. But *explain* genius? That seems to be another matter entirely. Our best efforts to understand its origins may fall flat, and perhaps we would be foolishly lacking in humility to think otherwise. Genius is a magical quality that resists understanding, it seems. Its origins will always resist our efforts to fathom them, and that's that.

Yet many people would dearly like to know more about the circumstances that create geniuses. They intrigue us. Their achievements touch our own lives. Galileo and Newton changed the world by transforming mankind's understanding of the earth's physical existence. So did Darwin and Einstein. Numerous men and women have had their minds uplifted by great artists and musicians. Writers like Shakespeare and Dantë have altered the very languages in which our thoughts are rooted. There is no lack of reasons for making strenuous efforts to uncover the influences that have made certain individuals exceptionally creative or inventive.

[1] Quoted in Norris (1989), p. 154. [2] Murray (1989), p. 1.

A number of practical concerns fuel the desire to know more about geniuses. What are the origins of remarkable accomplishments? Where do exceptional capabilities come from? Is it possible to deliberately manufacture a genius? We would benefit in a number of ways from having a better understanding of genius and its causes, not least by becoming better equipped to encourage today's young people to be more creative.

Confronted with the strength of opinion insisting on genius being a mystery, it is hardly surprising that many people have assumed that efforts to explain it must end in failure. But is that pessimism justified? It is certainly not helpful. Starting out with the belief that something is inherently mysterious creates extra barriers to understanding.

How might progress be made? I begin by proposing that the disciplines of biography and psychology form the two main sources of evidence that can help us to discover how and why children turn into the particular men and women they eventually become. The need for biographical information is obvious enough. Biographers are attracted to what is distinct and unique about a person: they take on the job of tracing and putting into perspective the events that mark a young person's progress towards maturity. By 'psychology', I refer to the scientific field of study in which researchers explore the ways in which people are influenced by their biology and their experiences. Research-based inquiries into children's development have helped to illuminate the effects of childhood experiences. Researchers have also studied the acquisition of expertise, drawing attention to the kinds of knowledge and skill that set apart especially capable men and women from those who are less competent.

It is easy enough to assert that psychological evidence is just as essential as biographical knowledge, but can we be confident that the findings of psychological research really will help us to understand how and why someone becomes a genius? Readers may be sceptical, and perhaps conscious of the limited extent to which light was cast on creative accomplishments by the psychodynamic psychology permeating those 'psychobiographical' accounts of great artists' and thinkers' lives that blossomed in the middle of the twentieth century. So just claiming that psychological science can make a contribution is not enough: we need convincing that it really does. Has research actually provided genuinely new insights? Do they help remove the mystery about geniuses? We can make a start towards answering these questions by applying research findings to the investigation of some early feats by Mozart, a genius whose stupendous accomplishments present some especially thorny puzzles. Can psychological investigations help untangle them? Ascertaining that will be a good test of their value.

Here are three facts about the young Mozart that appear to defy expla-

nation. First, he began to compose music when he was no more than four. Second, by the time he was six or seven Mozart was such a brilliant performer on both harpsichord and violin that the young prodigy and his older sister were able to travel around Europe demonstrating their talents on money-making tours. Third, Mozart had an amazing memory for music, and it was reported that at fourteen he wrote out the complete score of a lengthy multi-part musical composition, Allegri's *Miserere*, after hearing it performed on just a couple of occasions.[3] All three of these feats are remarkable by any standards. They certainly appear quite mysterious. It is hard to see how they can be explained without appealing to magic or miracles. Perhaps he was born possessing some innate gift that made him totally different from other children. It seems impossible to imagine any other way to account for Mozart's dazzling childhood accomplishments at composing, performing, and memorizing music.

Can psychological research help to provide alternative explanations? Let's start by looking at the young Mozart's composing. He did indeed begin creating music at an exceptionally young age. But by the standards of mature composers, Mozart's early works are not outstanding. The earliest pieces of all were probably written down by his father, and perhaps improved in the process. Many of Wolfgang's childhood compositions, such as the first seven of his concertos for piano and orchestra, are largely arrangements of works by various other composers.[4] Of those concertos that only contain music original to Mozart, the earliest that is now regarded as a masterwork (No. 9, K. 271) was not composed until he was twenty-one: by that time Mozart had already been composing concertos for ten years. Similarly, Mozart's first symphonies, written in the style of J. S. Bach's son Johann Christian Bach, who helped and encouraged the nine-year-old boy when they met in London in 1764–5, consist of movements lasting no longer than four minutes and have been said to be almost copies of J. C. Bach's.

So Mozart only started producing the distinctive music that we associate with him after a lengthy period of training. The same is true of other great composers. An investigation by John Hayes, who examined the output of seventy-six well-known composers, established they *all* took a long time to reach the peak of their capabilities.[5] With seventy-three of the seventy-six, Hayes discovered that no major work was produced prior to the tenth year of their composing career. (The three exceptions were Shostakovich and Paganini, who each composed a substantial work after only nine years, and Eric Satie: *Trois Gymnopédies* was written in his ninth

[3] Sloboda (1985). See also Gardner (1997).
[4] Weisberg (1998).
[5] Hayes (1981). See also Simonton (1994).

year of composing.)[6] In Mozart's case, none of those compositions that are sufficiently original to be included among his major ones appeared prior to the twelfth year of his musical career.

It is of course extraordinary for a young child to be composing at all, and Mozart's early career as a composer was undeniably phenomenal. But knowing that even Mozart did not begin creating original masterpieces until he had been receiving serious training for a substantial number of years encourages us to challenge the assumption that his early attainments are impossible to explain without recourse to magic or mystery.

But what about Mozart's extraordinary early performing? That, surely, must be inexplicable, even if his early composing is not. Yet, here again the findings of recent psychological research suggest that whilst Mozart's precociousness was remarkable enough, it was not miraculous. That is evident from the results of investigations examining links between musicians' performing standards and the training they have undertaken. The research findings make it clear that in all performing musicians, high levels of skill depend upon large amounts of daily practice. In one study, for instance, researchers estimated the number of hours of formal practice notched up by German student violinists in their early twenties. By the age of twenty-one the best students in the performance class of a conservatoire had accumulated around 10,000 hours, and the less accomplished violinists (who were training to be violin teachers rather than performers) had practised for around half that time. There was not a single case of a player reaching very high standards without practising frequently and regularly over a period of years.[7] Further investigations by John Sloboda, Jane Davidson and myself have confirmed that the best performers accumulate more practice than less capable ones. It might have been expected that a few gifted young players would advance through the successive musical grade examinations much more easily than the others, but there was no evidence of that happening. In order to move ahead by a fixed amount, the most promising players spent as much time practising as the others did.[8]

It would be absurd to claim that practice is the *only* cause of success as a performing musician. Yet the sheer amount of formal practising appears to be the best single predictor of a player's level of accomplishment,

[6] Hayes' method for deciding if a particular musical composition meets the criterion of being a 'major' one was simple but ingenious. He looked in current catalogues for items that are available in several recordings, the reason for insisting on the availability of more than one version being to exclude immature compositions that could have been recorded simply for their novelty value.

[7] Ericsson, Krampe, & Tesch-Römer (1993).

[8] Sloboda, Davidson, Howe, & Moore (1996).

despite the fact that the measures of practising available to researchers are rough-and-ready ones, unreliable because they are largely retrospective, and taking little or no account of either the quality or the appropriateness of young people's practising activities. Practice and preparation are equally vital in other fields of achievement. For instance, around ten years of sustained training are needed for a chess player to reach international levels, and it takes comparable periods of time to reach the highest standards in mathematics, the sciences, tennis, athletics, and a number of other sports. As in music, although it is widely believed that certain gifted individuals can excel without doing the lengthy practising that ordinary people have to engage in, the evidence contradicts that view.

Returning to Mozart, are we now any the wiser about his precocious performing skills? Nobody knows for certain how much time the young Wolfgang Amadeus Mozart actually spent practising, but it is clear that his father, Leopold Mozart, subjected him to an arduous and unusual regime. From the child's earliest years much of the boy's time was devoted to musical activities. There were few opportunities to play outdoors or make friends with other children. Leopold Mozart, a capable violinist and a highly ambitious music teacher, went to great lengths to make his son into an outstanding musician, having had considerable success at teaching Wolfgang's sister, Nannerl. The father was anxious to display his children's abilities (and his own teaching skills) in the best possible light, and he was not above subtracting a year from their ages on the posters advertising their public performances.

Let's assume that Mozart's father made his son practise for an average of three hours a day from the age of three. In that event, by the time the child was six (when he and his sister were first taken around Europe on the musical tours in which they displayed their talents), Mozart would already have practised for a total of around 3,500 hours. That is roughly as much time as the typical young performer today takes to reach the standard of a good amateur player. In Mozart's day it was (as it still is) unusual for a young instrumentalist to have already practised for more than 1,000 hours by the age of six. So if the young Mozart had experienced substantially more training and practice than that, this would largely account for his standard of performing being superior to anything his audience had previously observed in a child of his age.

Lacking the knowledge we now have about the likely consequences of prolonged practising, it would not have been at all surprising if spectators watching the youthful Mozart's performances could not give a rational explanation for the feats they were witnessing. They would have seen nothing like them. But we, unlike Mozart's contemporaries, can perceive that there was no real mystery involved. These days, it is by no means

unknown for children to reach the same levels of performance as the young Mozart did. Most of today's instrumentalists begin later than Mozart, but among those who do start musical training unusually early some young players achieve appreciably higher degrees of expertise than his at the equivalent age.[9] In the hundred or so years following Mozart's birth, piano sonatas became more technically difficult, requiring more demanding playing techniques, and there has been a definite tendency for music prodigies of generations later than Mozart's to play music that is increasingly difficult.[10] Compared with the most precocious young performers of the eighteenth century, the skills of more recent prodigies are more advanced.

So the task of explaining Mozart's childhood feats as a musical performer, like that of accounting for his early composing, is not the impossible one that it first seemed to be. Impressive as his early accomplishments were, they can be accounted for in the same ways that help explain the developing capabilities of hundreds of other young musicians who have patently not been geniuses.

There remains the third of Mozart's exceptional early abilities, his memory for music. This, like his composing and performing, appears at first to be a complete mystery. But can that feat too be explained in terms of the same processes that lead to high levels of competence in unexceptional young people?

In fact, accounting for Mozart's memory feat is surprisingly straightforward. There now exists a substantial body of research findings demonstrating that a person's ability to recall information about a particular topic is closely tied to that individual's existing knowledge and interests. Almost anyone who has a strong enthusiasm finds it easy to remember new information that is related to it. For instance, every Saturday afternoon many British soccer enthusiasts can recall all the scores from the league match results after hearing them just once.[11] To anyone who does not study the football results that may seem a remarkable feat, and up to a point it is, and yet week after week thousands of ordinary people manage it. Similarly, chess experts can remember huge amounts of information about moves in games of chess. Comparable feats of memory are not uncommon in connection with other fields of knowledge, with numerous ordinary people whose jobs or interests encourage them to gain specialised information finding it easy to remember new facts that can be linked to whatever the individual already knows.

Mozart's relative youth at the time he performed his feat of musical

[9] Lehmann & Ericsson (1998). [10] Lehmann & Ericsson (1998).
[11] Morris, Gruneberg, Sykes, & Merrick (1981).

recall would not have been a handicap, because the increased remembering that specialised knowledge makes possible transcends age differences. Although adults do better than children at most tests of memory, the reverse is true when the task involves information that children, but not adults, can connect to their existing knowledge. For example, in a study in which ten-year-olds who were good chess players were given a memory task that required them to recall chess pieces arranged in legitimate positions, the children performed better than adult participants who were not expert players. But items that were unconnected to the children's special interest were recalled more accurately by the adults.[12]

For all that, Mozart's memory feat still seems remarkable, and it *was* remarkable. To a non-musical person, a memory feat like Mozart's seems to involve recalling an immense sequence of separate notes. But imagine the unusual everyday life of the young Wolfgang Amadeus Mozart. He inhabited a world of music, hour after hour, day after day, in the company of a father who was an expert teacher. By adolescence, the sheer amount of Mozart's musical knowledge would have been enormous by most people's standards. He would have recognised many familiar structures and patterns, eliminating the need to recall each note separately. As a result, compared with a non-musician Mozart would have perceived the task very differently, with the information that needed to be remembered being meaningful and interconnected. And although Allegri's *Miserere* is a lengthy composition, it is one that happens to contain a great deal of repetition. For a person as knowledgeable as Mozart, that would have lightened the burden of remembering.[13]

We can now see that it is entirely possible that all three of Mozart's remarkable early feats could, after all, have been achieved through the operation of mental processes that were broadly the same as the ones that give rise to the more modest skills and achievements of ordinary people. It no longer appears inescapable that Mozart must have begun life with some mysterious special gift of genius. Of course, what we have achieved by unravelling the likely causes of certain of Mozart's early feats falls far short of a full accounting for his creative achievements. I have not even begun to sketch out the uniquely creative powers that enabled a masterpiece like *Don Giovanni* to be forged. But a start has been made, and it is a

[12] Chi (1978).

[13] A complicating factor is that our capacity to assess the magnitude of the memory feat is constrained by the impossibility of knowing whether or not Mozart's recall of the music really was as accurate as it has been assumed to have been. The evidence verifying Mozart's accuracy at remembering rests on the statement of one singer, who had no opportunity to assess the precise match between Mozart's version and the original score. Minor discrepancies from the original would probably have gone undetected by Mozart's audience.

fruitful beginning because it gives revealing glimpses of the ways in which a young person might have gained certain of the qualities that made the creation of works of genius possible. There is no denying that the eventual accomplishments of an individual like Mozart are quite superior to anything that most people are capable of, and yet it begins to seem conceivable that the underlying capabilities Mozart depended upon may not have been fundamentally different in kind from ones that are shared by numerous men and women with no claim to genius.

One way to make progress towards explaining the human attainments that result in their creator being seen as a genius is to discover how a person masters the knowledge and mental skills that make those accomplishments possible. That is the approach taken in this book. The creative activities that are most directly involved in the construction of masterpieces will not be neglected, but my primary aim is to trace the routes by which a few outstanding individuals gained the capabilities their achievements have depended upon. Charting individuals' early advances is, I think, a particularly effective way to help reveal the origins of genius.

I am convinced that it is indeed possible to understand genius and its causes. A major aim of the present book is to unearth the influences that have helped make a few rare individuals capable of remarkable feats of imagination and discovery. When that has been achieved, providing us with some understanding of the contributing factors, the absurdity of appealing to mystical forces will be evident. There is simply no need to believe that mysteries or miracles are involved.

Our efforts to account for genius will run into numerous difficulties, of course, if only because explaining how a young person becomes the adult individual he or she turns out to be is never easy. But although it is possible that with those men and women whose lives and feats are the most striking of all the barriers to understanding will be especially daunting, and that the problems that have to be overcome in order to discover how certain children grow up to be geniuses are vastly more challenging than the ones involved in charting the progress towards maturity of an ordinary boy or girl, there is no compelling evidence that this must be so. I am not convinced that there is anything about the lives and achievements of geniuses that is in principle less amenable to explanation than the lives and achievements of other people. The children's writer Enid Blyton was no genius, but explaining how she was able to turn out the thousands of words she produced every single day is as much of a challenge as accounting for the accomplishments of authors who were far more creative. That geniuses are special is undeniable, but the view that they are special for reasons that are mysterious needs to be challenged.

It would be immensely difficult, and perhaps impossible, to delineate each and every one of the events that had to take place in order for, say, the young Mozart, or the young Einstein, to become capable of their achievements, and then go on to create them. I do not attempt that feat. Some readers may feel that any investigation that stops short of such exhaustive documentation must fail to provide an adequate explanation. My own view is that this is rather like insisting on believing that although Joe Bloggs has admitted making the crop circle that appeared last week in his neighbour's field, the one that appeared yesterday must have been created by aliens from a distant galaxy, or like saying that even though most of the tricks performed by Mr Uri Geller are within the capabilities of skilled conjurors, his claim to possess mysterious special powers must nevertheless be believed. In each case the more reasonable assumption would be that where insufficient evidence exists to fully explain a new event, an explanation that is based upon observed causes and broadly follows the lines of one that accounted for a similar event in the past is preferable to one that invokes unverifiable causes or mysterious special powers.

There are gaps in what is known, but these create problems rather than mysteries. That distinction between problems and mysteries is a crucial one. A mystery is a state of affairs surrounding some phenomenon that resists any explanation in terms of known causes. A problem, in contrast, is a state of affairs in which there exists uncertainty about the explanation for something, but in which there is every reason to believe that one can be found, provided that the necessary resources are available. For me, discovering the best railway route between Madrid and Vienna would be a problem. It is not a mystery, since I am confident I can find the answer, as long as the missing information is forthcoming.

In the chapters that follow I show that the challenges involved in arriving at a full understanding of the achievements of geniuses belong within the category of problems rather than mysteries. In principle at least, there are no points at which explaining human accomplishments becomes impossible except by resorting to miracles or magic. The qualification 'in principle' is needed because in some instances it will never be possible to obtain all the information that a full account would need to draw upon. For instance, we shall never discover how William Shakespeare became the genius he was, if only because we know too little about his early years.

The creative undertakings of a genius involve two broad (and overlapping) stages. First, there is the matter of acquiring those capabilities the person draws upon. Second, there are the inventive activities that directly contribute to masterpieces. In most of the present book's chapters the emphasis is on the former stage, and I explore the ways in which a number

of individuals have gradually acquired the exceptional capabilities that equipped them for their achievements. How, I ask, did certain men and women become capable of their remarkable feats?

We must take pains to be sure that any explanations arrived at are ones that genuinely illuminate and extend our understanding, rather than being pseudo-explanations. It is important to be aware that clues about possible causes of genius that are encountered in commonsense wisdom, can actually impede understanding rather than adding to it. One widespread belief, hinted at in Kant's suggestion that genius is a quality which nature endows in certain people, is that the causes of individuals' exceptional attainments take the form of special gifts or innate talents.

That claim is not necessarily false, of course. It is entirely conceivable that geniuses are indeed born with special characteristics that partly account for their outstanding achievements. And irrespective of whether the claim is true or false, the fact that many adults are convinced that only those young people who are born possessing special gifts can thrive in fields of expertise such as music has momentous practical implications for numerous children. However, for it to be legitimate to conclude that innate gifts really are an influence, there would need to be independent evidence that they do actually exist. In the absence of that evidence such a conclusion would be groundless. What often happens, however, is that simply because someone is exceptionally able, in the absence of an obvious alternative it is *assumed* that the person must have been born with a special gift or talent. Subsequently the person's (unverified) possession of that innate gift is invoked as the cause of the outstanding ability. Creative attainments are assumed to be 'explained' by the assertion that their creator possesses special inborn powers, although the person's achievements provide the sole basis for believing in the existence of those special powers. This reasoning is entirely circular: appearances notwithstanding, nothing is actually being explained. So when it is introduced in this way, the notion of an innate gift and talent is no more than a kind of 'magic ingredient', which provides no more than the illusion of an explanation, as in,

Question: What is the reason why X is so fat/thin/ill/healthy/clever?
Answer: Because X was born with a special qualitiy that makes a person fat/thin etc.

The explanatory powers innate gifts may appear to have, in the absence of independent evidence of their existence, are similarly imaginary rather than real.

Deciding whether or not there are solid grounds for believing that innate gifts and talents do actually exist is a complex issue, and I explore it

in Chapter 9. But unless their existence can be verified, all that is achieved by invoking special inborn qualities as the cause of genius is to create the kind of pseudo-explanation that attributes events to the presence of some or other kind of magic ingredient.

A not uncommon view that is sometimes linked to the belief that genius is a consequence of a person being endowed by nature with a special gift is that it is only possible for someone to become a genius as a consequence of being designed in advance to be one. That assertion is easily rebutted. The reasons for questioning it are not unlike the arguments with which Darwinian science has refuted the claim that the human species could never have come into being except through some form of 'design from above'. Darwin's theory contradicted that belief by demonstrating that it was indeed possible for humans to be created as a consequence of evolutionary processes, in the absence of any designer. Our species did not have to be planned in advance.

Nor did the lives of individual geniuses. The processes that enable an individual's capabilities to be acquired through learning and experience are very different from the ones that enable new species to evolve. However, the learning and training experiences that creative people undergo obviate the necessity for their accomplishments to depend upon being designed in advance just as convincingly as evolution makes design from above unnecessary for the emergence of new species.

Before going any further, we should try to decide what a genius is. Precisely what do we mean by the term? A straight answer to that seemingly simple question is not at all easy to find. For better or worse, there is no straightforward specification or definition of genius. Even listing the defining attributes turns out to be impossible.

Why do these difficulties arise? The essential reason is that whilst saying that someone is a genius appears to be a statement about the person's qualities, it is actually not. What is really being achieved by calling a person a genius is to acknowledge or recognise their *achievements*. The word 'genius' is ours, not theirs, and it is a kind of accolade that has been bestowed upon certain individuals, usually not until well after the person has died.

The term 'genius' has a long history, but until fairly recently the most common use was not for describing a person but for identifying the supposed reason for someone being capable of creative accomplishments. A person's genius was seen as working in broadly the way that a poet's muse was believed to function: genius was envisaged as a partly external spirit that gave a helping hand. Not until the eighteenth century did the practice of referring to a person as a genius become common. The modern

meaning of the word comes partly from the Latin word *genius* which stems from *gens*, meaning family, but also from the Latin *ingenium*, denoting natural disposition or innate ability.

We can call a man a giant because he is very tall, but there is no single attribute of a person that justifies saying that someone is a genius. Describing a person as a genius is not like stating that he or she is tall, or even intelligent or clever. The word is never introduced solely as a description of an individual: it always denotes a recognition of outstanding accomplishments. If you are unconvinced about that, try to think of someone who is widely regarded as having been a genius but who never produced highly valued creative work: I suspect that you will fail. There have always been men and women who were exceptionally intelligent, wise, artistic, sensitive, incisive and so on, but unless they have produced major achievements, other people have not called them geniuses. Whenever someone is widely regarded as having been a genius, we can be sure that the person has made a contribution which is valued. If a baker is someone who makes bread, a genius is a man or woman who produces masterpieces or discoveries that greatly impress other people.

The difference between being immensely capable or creative and being regarded as a genius is not totally unlike the difference between being exceptionally brave and winning a medal for bravery. To win a medal, you undoubtedly do need to be brave, but you have to be a little fortunate as well. The bravery must have positive consequences, and it must be observed by someone who is in a position to report it. Similarly, in order for someone to be regarded as a genius, that person not only has to be exceptionally able but also must achieve something that is appreciated by others, and whether or not that happens will be partly outside the person's control. As we shall see, success often goes not to the individual who is most intelligent or capable in absolute terms, but to the man or woman who happens to possess just those skills or qualities that are needed in order to solve a particular problem at a particular moment in history. So the accolade of genius is bestowed on a person for creating something that others admire, rather than for being outstandingly clever.

By and large, creative individuals are more likely to be regarded as geniuses if their achievements are not too recent: few of those who are widely acknowledged to have been a genius died less than a hundred or so years ago, Einstein being a notable exception. It also helps if the person's different accomplishments are linked rather than being too diffuse. Sir Richard Burton (1821–90) was one of the most dazzling of all Victorians. As well as translating the *Arabian Nights* into English, he led expeditions of discovery, translated other poetry and folklore, mastered around thirty languages, wrote poetry of his own, contributed to archaeology, ethnol-

ogy, anthropology, and the study of swordsmanship, and also made discoveries in botany, zoology and geology. Yet, largely because his achievements were so scattered, few have thought Burton to have been a genius, for all his brilliance.

The fact that the word 'genius' is used more as an accolade than as a description helps make it the useful term it is, but creates some difficulties as well. One limitation is that introducing the term does not actually help to account for a person's attainments. We should not be fooled into thinking that anything is being clarified by a statement such as 'She produced a great novel because she was a genius'. All that is really being said here is that the individual who wrote her great novel was a person acknowledged to be capable of doing just that.

Another problem is that there is no objective procedure or hard-and-fast criterion for categorising people as geniuses or non-geniuses. A limited number of individuals are very widely regarded as having been geniuses: Archimedes, Plato, Aristotle, Dantë, Copernicus, Galileo, Michelangelo, Newton, Darwin, Bach, Beethoven, Mozart, Shakespeare, Rembrandt and Einstein would be placed in that category by most educated people in the English-speaking world, as might some others, perhaps including Dickens, Schubert, George Eliot, Tolstoy, Tchaikovsky, Balzac, van Gogh, and Flaubert. But what about Trollope, Coleridge, Renoir, Monet, Manet, Degas, Turner, and Jane Austen? And should we include Emily Brontë, Benjamin Franklin, Marie Curie, Puccini, Verdi, Brunel, Charlotte Brontë, Elizabeth Gaskell, Edgar Allan Poe, or James Joyce? As soon as we move on from a surprisingly small number of creative people, most of whom have been dead for a long time, agreement on who deserves to appear in a definitive list of geniuses becomes impossible, even though there are certainly hundreds and possibly thousands of individuals for whom a serious claim can be made. Charles Darwin's cousin Francis Galton tried to introduce a degree of objectivity by referring to one in a million individuals as 'illustrious' and one in four thousand as 'eminent', but in the absence of clear rules for deciding how to select particular men and women, even that approach to categorising outstanding people could never have worked.

To complicate things, reputations wax and wane. In common with other circumstances in which accolades are bestowed, the matter of whether or not a particular creative man or woman acquires the reputation of being a genius depends on factors outside that individual's control. Chance can play a role. Had Albert Einstein or Michael Faraday lived thirty years earlier or thirty years later than they did, the particular skills and qualities they possessed might have had less impact. Conversely, there are other scientists whose importance might well have

been greater had they lived at a slightly different time, or in a different place. Fashion too can play a role, and just as people's reputations can wax and wane, so can views about whether a certain person merits being called a genius. Someone whose work is little valued in one century may be regarded as a genius by citizens of a later era. For us, Bach was a genius, and perhaps Botticelli too, although earlier generations either ignored them or judged them far less favourably than we do now. As recently as 1941, when Edmund Wilson wrote about Charles Dickens in *The Wound and the Bow*, that author's reputation was not what it is today.[14] It is pointless to ask, 'Was Botticelli (or Dickens) a genius or not?'.

Yet another complication is revealed by the necessity to decide whether, if someone 'accidentally' creates a masterpiece, that person should be called a genius. Questions like this surface in connection with occasional individuals such as Gregor Mendel (1822–84). He made a monumental contribution to the science of genetics, but perhaps without ever quite recognising the significance of what he was doing.[15]

So the problem of deciding who should and who should not be counted as a genius is impossible to resolve. I sidestep the issue by being willing to consider any individual whose claims to the status of a genius have received a substantial measure of support. Restricting our attention to just those very few people who are universally regarded as having been geniuses would create severe practical problems, if only because of the rarity of individuals for whom we have substantial information about their early lives. It would be fascinating to trace the childhoods of, say, Archimedes, or William Shakespeare, or Isaac Newton, but the necessary factual evidence has been lost. Even with a relatively recent genius like Schubert, available knowledge about critical life events can be remarkably sparse.

What are geniuses like? What kinds of people are they? They are hugely diverse, but a few characteristics are shared by virtually all of them. The first is an intense curiosity and dedication to one's work. A second and perhaps more surprising trait possessed by most geniuses is the capacity to acquire a variety of different human qualities.

Geniuses are usually sure about what they want to do, single minded, committed, and they have a firm sense of direction. They often work with a ferocity and intensity, even when impeded by doubts and frustrations. They also share a capacity for sustained diligence. Isaac Newton said that he discovered the law of universal gravitation by thinking about it continuously; Charles Darwin attributed much of his success to a capacity to

[14] Wilson (1941). [15] Brannigan (1981).

reflect for years on an unexplained problem; Einstein asserted that curiosity, determination, and hard work were vital ingredients of his effectiveness, and the great English painter J. M. W. Turner, asked to reveal the secret of his success, gave the straight reply 'the only secret I have got is dammed hard work'.[16] Isaac Newton was described by a contemporary as having concentrated so hard that had it not been for the fact that the practical aspects of undertaking experiments forced him to get some relief from thinking, he would have killed himself through studying. He displayed an impressive doggedness at persisting in the face of difficulties. Struggling to comprehend the mathematics in Descartes's *Geometry*, Newton just kept on trying. He 'read it by himself when he was got over 2 or 3 pages he could understand no farther than he began again & got 3 or 4 pages farther till he came to another difficult place, than he began again and advanced farther and continued doing so till he had made himself Master of the whole.'[17] The capacity to keep persisting is as essential in music and art as in science and mathematics. Perseverance is at least as crucial as intelligence. An interesting and perhaps surprising research finding is that, compared with assessments of young children's intelligence, indications of their capacity to delay gratification and avoid acting too impulsively are better predictors of future competence. Clearly, a young person's temperament is hugely important. This raises an interesting possibility. If, as seems likely, inherited differences between individuals contribute to the fact that individuals differ in their eventual achievements, the most crucial inherent differences may be ones of temperament rather than of intellect as such.

It is especially advantageous to be able to keep trying. As the eighteenth-century British artist Joshua Reynolds remarked about facility at drawing, it, 'like that of playing upon a musical instrument, cannot be acquired but by an infinite number of acts.'[18]

The second way in which many geniuses are alike is in their ability to bring a number of different qualities to their enterprises. It may sometimes appear that remarkable intellectual or artistic capacities, combined with fierce determination, form the sole all-important ingredients of creative accomplishments, and there is no denying that geniuses tend to be single-minded individuals. They typically exhibit a sharp awareness of the direction in which they intend to move and a degree of indifference to other things. They can appear to be narrowly obsessed by one particular goal, as they fiercely concentrate on their work for long periods of time. We can readily picture Mozart totally absorbed in his work, or Isaac

[16] Hamilton (1997), p. 128.
[17] John Conduit, quoted in Westfall (1980), p. 111.
[18] Hamilton (1997), p. 23.

Newton neglecting his visitors while he sits wrestling with mathematical problems on the floor of his cellar, and forgetting the wine he is supposedly fetching, or Albert Einstein, thinking only of his work and disregarding ordinary activities like putting on his socks. And yet on closer examination it is clear that geniuses can rarely afford to be too narrow. Even when the actual achievements for which someone is acclaimed are fairly specific, a broader range of qualities is likely to have been necessary in order to create the circumstances that enabled the person to move ahead.

Take Charles Darwin, for instance. He is seen in the popular imagination as a reclusive scientist, preoccupied with his poor health, rarely straying from the house he lived in for almost forty years, and protecting his privacy by building a high wall and lowering 170 yards of the adjoining lane. Yet Darwin would never have enjoyed the success he earned were it not for the fact that in addition to the intellectual capabilities, fierce determination, and single-mindedness that he possessed in common with other geniuses, he also had some impressive diplomatic skills, as well as courage and a marked ability to get on with others. People who knew Charles Darwin liked and respected him. He needed all these personal qualities for dealing with a series of characters whose cooperation he depended on, including a sometimes difficult male parent, and, later, the prickly and short-tempered Captain Robert Fitzroy, with whom Darwin worked hard at maintaining a harmonious working relationship on board the tiny HMS *Beagle* during its five-year voyage. Then there were the various scientists who served Darwin as mentors in his early days and collaborators and disciples later on. Darwin also assembled a network of individuals who were helpful to him because they knew about breeding and the domestication of species. He cooperated with many collectors, vetinarians, horticulturists, and numerous animal and plant breeders, amongst whom were pigeon and poultry fanciers, rabbit raisers, beekeepers, rose growers, livestock men, nurserymen, silk-growers, farmers, horse-trainers, botanists and practical gardeners. A glance at *On the Origin of Species* demonstrates that Darwin counted on the aid of these practical experts for much of the immense body of evidence that was needed to buttress the theory of evolution and make it invulnerable to the sharp attacks that he knew would be directed at it.

At various points in his life Darwin was able to seize chances that would have been missed by someone lacking his impressively broad capabilities. In childhood, his older brother (by four years) Erasmus found Charles mature enough to engage as a helper in scientific experiments, with the result that by the age of thirteen Charles Darwin had gained a useful grounding in practical chemistry and biology. The opportunity that came

his way when he was twenty-two to take part in HMS *Beagle*'s voyage happened only because Darwin had been noticed as a young man whose judgement as well as knowledge outstripped his years. He was 'the very man they are in search of', the Regius Professor of Botany at Cambridge University told him. That Darwin could grasp that opportunity was only possible because when his father proved awkwardly opposed Charles had the wit to take the only course of action that could have induced the parent to drop his veto. Later, it was because of Darwin's well-deserved high reputation that when the theory of evolution finally appeared in 1859 it was sympathetically examined by his fellow scientists (rather than encountering the instant rejection that had greeted other evolutionary ideas) and quickly seen to be as sound as it was revolutionary.

Darwin was by no means unusual or unique in having to call upon a variety of human qualities. Even Albert Einstein, although often seen as an isolated thinker, leaned heavily upon his communication skills and his capacity for friendship, and Thomas Edison would have achieved very little were it not for his impressive organisational powers.

In trying to understand how certain men and women became geniuses, how can we most effectively combine psychological research and biographical expertise? My views about the desirable characteristics of an approach which achieves that will become clearer in later chapters, but two features need mentioning here. First, an effective approach needs to be largely *descriptive* and not overburdened with theoretical dogmas. That does not mean denying the importance of explanatory theories, but since it is rarely possible to explain *how* something happened without knowing precisely *what* it was that took place, it is essential to begin by tracing in some detail the lives of particular men and women. Researchers can get into difficulties by failing to appreciate the necessity to start with good descriptions. The tendency to construct detailed theoretical speculations from flimsy supporting evidence was a weakness of the psychodynamic theories underpinning psychobiographical explorations of people's lives.

It is a mistake to regard the act of describing what happens as being no more than a preliminary, 'pre-scientific' stage of an investigation. Careful descriptions actually achieve much more than that. Once a really good descriptive account exists, the job of explaining observed facts may be more than half done, as good theorists like Darwin have always known. Of course, it is often helpful to have hunches and intuitions about why things happen, but at times it is just as necessary to keep a rein on one's theoretical views, because they can all too easily act as blinkers rather than aids. Holding on to one point of view can blind us to others. If someone has become convinced that the only conceivable reason why Mozart became

a great composer is that he was born with a special gift for music, the chances are that the person will fail to discern alternative explanations. In common with a young woman who, asked for directions to a neighbouring town, told me 'You cannot get from here to [nearby] Helensburgh: you'll have to start somewhere else,' those who are rigidly committed to one explanation may have their minds opened up by being encouraged to examine things from an alternative perspective.

It is helpful to think of a person's life as being like a kind of journey, one that follows a particular route which is unique to that individual. Biographical accounts make it possible to trace the temporal patterns of events and consequences that take place as a person develops, and plot the very different routes by which young people move through the time that structures their lives. Once we gain a detailed knowledge of the events of a person's childhood, it is likely that we will begin to discern how and why the child gradually turned into the adult he or she eventually became.

In tracing such a route and trying to identify the various experiences and events that collectively make a child into an adult, an essential facet of the person's development involves the expansion of their capabilities. Everyone's expertise has to be acquired, and so do their likes and dislikes, their interests and their preferences. That is just as true of geniuses as it is of people whose accomplishments are unexceptional. Like the skills and abilities of ordinary men and women, the more remarkable capacities of a genius are gained more or less gradually. Especially rare or impressive capacities build upon a foundation of more commonplace ones. When the path can be charted towards the extraordinary attainments of, say, a grandmaster at chess, or a concert pianist, it is usually found that the person's itinerary through the earlier stages of expertise is broadly similar to that of other people. The exceptional individual goes further, and may move ahead faster, but always there is a route to be traced. There are no gaps or inexplicable leaps. If there *appears* to be a gap, the chances are that when we look closer we will discover that what is being identified is a hiatus in our own knowledge, not a discontinuity in the person's progress.

The analogy between a person's early life and a journey or a voyage can be misleading if pressed too far. The voyage metaphor may appear to suggest that people forge ahead along a single track, with the implication that the first step towards exposing the causes of genius is just a matter of identifying a person's special capability and seeing how it was nurtured. In reality, it is more accurate to envisage the trajectory of someone's life as involving a number of linked but partly independent strands, all of which contribute to the person's progress.

Tracing the events of someone's formative years involves getting close

to the individual concerned. The need to do that makes it important for our approach to have a second aspect. That involves placing emphasis on trying to lay bare the actual *experiences* of the men and women whose early lives are examined. Having continuous records that cover substantial parts of people's lives helps to make this possible. Such records illustrate the uniqueness of each life, making it easier to see why different people do not react in the same way to identical events or similar opportunities. What really matters is not simply what happens to a person – as an observer might record it – but how the particular individual actually experiences life's happenings.

It is important to avoid confusing experiences with environments. People are directly affected by their experiences, but only indirectly influenced by their environments. Surprise is sometimes expressed at the fact that two children brought up in the same family environment can turn out very differently, but there is nothing very remarkable about that, since the children may have experienced events in constrasting ways. The key distinction here is between events as seen from the outside and as perceived from the unique vantage point of the person concerned. We may know a great deal about someone's physical environment, but that knowledge will not necessarily provide much insight into that person's actual experiences, and it is the latter rather than the former that have a direct influence on an individual's life.

Although we can never duplicate someone else's experiences or reconstruct their unique point of view, it is worth striving to get as close as we can to doing that. Individual children and adults are often affected by the happenings that make up their lives in ways that no outsider could begin to perceive without knowing about the person's unique life and character, temperament and personality. But when some of that knowledge *is* available, the actual significance of events in someone's life becomes clearer. It is possible to see, for example, why apparently destructive events can have benign consequences. Thus for the seven-year-old H.G. Wells the ostensibly disastrous accident of breaking a limb had a happy outcome, because it encouraged him to spend more time reading, with immensely positive personal consequences. We can now also understand why, as Charles Dickens reported, he too benefited from illness in childhood, by being stimulated to read books.

In the following chapters I shall trace the early lives of a number of geniuses, attempting to discover how and why each individual became capable of their remarkable accomplishments. Deciding which men and women to concentrate upon could have been difficult, but two constraints guided my choices and made selection easier. First, relatively detailed

accounts of the person's formative years had to be available. Second, there were obvious advantages to be gained from making sure that at least some of the chosen individuals had enough in common with one another for comparisons to be made and parallels drawn, as is possible when people have belonged to the same era and have shared a common culture. With these considerations in mind, and having decided that my main subjects would include Charles Darwin and John Stuart Mill – choices influenced by the fact that the documentation of their childhoods is unusually full and informative – I saw some advantages in concentrating mainly on individuals whose contributions were made in roughly the middle half of the nineteenth century.

That was a fruitful time for geniuses. In Britain alone there were a number of major novelists, including George Eliot, Charles Dickens, Elizabeth Gaskell, the Brontës, William Thackeray and Anthony Trollope (who were all born between 1810 and 1824), and Mary Shelley. Benjamin Disraeli wrote well-received novels as well as being a statesman. There were some great engineers, among them Brunel, the two Stephensons, and Joseph Locke. The poets of the time included Robert and Elizabeth Barrett Browning, Christina Rossetti, Robert Southey and Alfred Tennyson (who was born in the same year as Darwin and Gladstone: Abraham Lincoln shared with Darwin his actual day of birth in 1809). The ageing Wordsworth lingered on until 1850. Also, there were artists such as John Everett Millais, Dantë Gabriel Rossetti and J. M. W. Turner; scientists including Charles Darwin, Michael Faraday, Sir John Herschel, Charles Lyell, James Clerk Maxwell, Alfred Wallace, Charles Wheatstone, William Whewell and Charles Babbage, and numerous other thinkers and writers, amongst whom were John Stuart Mill, Thomas Carlyle, Thomas Macaulay, Harriet Martineau, William Morris, John Ruskin and Herbert Spencer.

Across the Atlantic a number of innovative writers and artists were at work, including Emily Dickinson, Ralph Waldo Emerson, Oliver Wendell Holmes, Henry Longfellow, Nathaniel Hawthorne, Herman Melville, Edgar Allan Poe, Henry David Thoreau, Walt Whitman and James McNeill Whistler. Benjamin Franklin's long life had recently ended and the equally lengthy one of Thomas Edison had begun. Mark Twain was starting his career.

The many creative individuals living on the European continent at that time included novelists such as Honoré de Balzac, Gustave Flaubert, Alexandre Dumas, Victor Hugo and Stendhal, a number of major composers including Berlioz, Bizet, Brahms, Liszt, Mendelssohn and Wagner, painters such as Courbet, Degas, Delacroix and Manet, and various major poets including Charles Baudelaire. Among the numerous

European scientists, mathematicians and thinkers of the period were André Ampère, Claude Bernard, Auguste Comte, Gustave Fechner, Karl Freidrich Gauss, Heinrich Heine, Hermann von Helmholtz, Alexander von Humboldt, Friedrich Kekulé, Sören Kierkegaard, Karl Marx, Georg Simon Ohm, Friedrich Schelling and Arthur Schopenhauer. In Russia, Gogol and Dostoyevski were active, and as Pushkin approached his premature end Tolstoy's life was beginning.

In the following two chapters, I direct the bulk of my attention to a great scientist, Charles Darwin, and a great railway engineer, George Stephenson, an inventive genius who made an enormous contribution to developments that revolutionised transportation and passenger travel, despite starting life with a childhood of grinding poverty, in which he never had a single day of schooling. Chapter 4 examines the remarkable early life of another great scientist, Michael Faraday. Chapter 5 looks at a number of families in which a parent has made a more or less deliberate attempt to 'manufacture' a genius. This chapter includes a discussion of the education of John Stuart Mill, whose reputation as a child prodigy preceded his mature accomplishments. In Chapter 6, which examines a number of child prodigies, I take an excursion from the mid-nineteenth century in order to provide an account of Albert Einstein's childhood. That diversion is justified by his enormous importance, together with the fact that his early life is a mine of useful information concerning the formative experiences that contribute to scientific creativity. Chapter 7 deals largely with the acquisition of expertise in writers, including the Brontës, George Eliot, and Charles Dickens. That chapter, which stresses the importance of childhood writing activities and explores some ways in which early experiences have been drawn upon by imaginative novelists, concentrates on the similarities rather than the differences between exceptional and less remarkable authors in the manner in which their expertise was acquired and extended. Chapter 8 provides a more direct examination of the creative activities that are involved in the actual making of discoveries and inventions, and the production of masterpieces. It introduces a variety of discoverers and inventors, ranging from the Wright brothers, who achieved the first powered flight, to the twentieth-century discoverers of the structure of DNA, Francis Crick and James Watson.

Chapter 9 examines some ideas and theories that have been put forward in order to account for geniuses and their accomplishments. This final chapter examines genetic as well as environmental influences on human capabilities. It takes a critical look at commonsense views about human abilities and their causes, showing that even those ideas that are almost universally accepted and seen as 'obviously' or self-evidently true

can be entirely wrong. I establish, for instance, that there is no firm scientific justification for the widely accepted belief that high abilities are made possible by certain individuals possessing innate gifts or talents. I also question some common views concerning the manner in which genetic variability exerts its effects on people. Mistaken beliefs about the origins of exceptional capabilities are pernicious, and can lead to faulty decisions being made, with damaging consequences to immense numbers of young people.