# 1.1

# WHAT DETERMINES WHO I AM? NATURE, NURTURE OR SOMETHING ELSE?

**What questions does this chapter answer?**

1. To what extent is something innate or learnt?
2. How do we know if something is innate or learnt?
3. How do nature and nurture influence each other throughout our lives?
4. What role can we play in upbringing and education?

Why are you as tall as you are? Why are you good at mathematics? Or at languages? Why are some people more quickly addicted than others? As you get older, you start to notice yourself adopting certain mannerisms, phrases and other small habits in which you can recognise your parents. How have they passed these things on to you?

## A historical and current dichotomy

This series of questions has been occupying the scientific community for many years. It focuses on the contrasting roles of aptitude and environment, nature and nurture, and innate ability and learning. Throughout history, this has been a domain that has seen a variety of widely differing theories put forward. In the

18th century, the British Enlightenment philosopher John Locke – following the Greek philosopher Aristotle and the Italian theologian Thomas Aquinas – argued that a child was born as a blank sheet of paper. His forerunners referred to this a 'tabula rasa'.[1] According to this vision, almost everything is learnt. You could describe it as a kind of pedagogical optimism. As a result, everyone has it in them to run a marathon, play the piano and much, much more.

In contrast, Locke's Romantic counterpart, Jean-Jacques Rousseau, thought that the child was by no means a blank page but was by nature good. In his classic book *Emile*, he described how it was the child's environment that ruined or 'corrupted' him/her, rather than making the child a better person.[2] In other words (and ironically enough), Rousseau still sees an influential role for the child's environment but it is essentially a negative one. Even so, Rousseau's ideas continue to be seen as an example of the 'nature' point of view, in contrast to Locke's 'nurture' perspective. However, in both cases the child occupied a fairly central position, which represented a break with previous thinking on such matters.

### Traces of the nature–nurture dichotomy today

The influence of Rousseau in today's education is still significant and is seen in, amongst other things, various educational innovations and pedagogies,[3] but above all in the image of the child as an active discoverer. This latter concept translates, for example, into the idea that children should find out everything for themselves or that you should only introduce them to new things when they are ready for them.

However, at the start of the present century there was also a renewed focus on the importance of innate ability, thanks in part to the book *The Blank Slate* by Steven Pinker.[4] Pinker wrote this book as a reaction to his experience that the 'tabula rasa' theory was still a subject of contention in contemporary society. In particular, the educational world seems to have difficulty in coming to terms with the concept of inborn differences between children,[5] possibly because this can all too easily be associated with determinism: the idea that if something is determined genetically, it is immutable and that consequently your future is already fixed at birth.

We shall see that the truth is actually more complex and more nuanced. In psychology, the discussion now seems primarily to be about the size of the respective contributions of nurture and nature in shaping the characteristics and attributes of people.

## How can this be researched?

Much of the research into the relative influence of innate ability and environmental factors makes use of twins. This kind of research looks at the impact of heredity and is therefore often confused with molecular genetic research that examines DNA. However, these two things are not the same.

Let's start with hereditary research involving twins. To investigate whether something in a person's make-up is the result of innate ability or their environment, it is necessary to ensure that one of those two factors is constant. In reality, of course, it is impossible to keep the child's environment 100% consistent. Parents do not deal with each of their children equally and there are hundreds of other people with whom the children will eventually come into contact. In other words, we need to concentrate on the 'innate ability' factor. Two children from the same parents have a degree of overlap in their genetic material, which they have inherited from their mother and father. Except, that is, if the two children are identical twins. In that case, the overlap is complete. This explains why hereditary research often focuses on twin research involving the participation of monozygotic (single egg and single sperm) twins, because they share the same genetic material. It is then reasoned that if differences are later discovered between the two twins, this must be the result of the influence of their environment. A further distinction can also be made between identical twins who grow up together and identical twins who grow up apart, perhaps as a result of divorce or adoption. In this latter case, their environment can be really different.

As a consequence of such research, we are now in a position to make fairly definite conclusions about the innate aptitudes and abilities we inherit, although by using this kind of research design, we do not know which genes are responsible for this process.

In contrast, molecular genetic research does examine which parts of our DNA, or rather which combinations of genes, are responsible for particular characteristics. In this way, for example, it was possible for researchers to establish that if one of two children in the same family possesses a certain gene combination, this child is more likely to go to university than its sibling who does not have this same combination.[6]

## Watching TV is (partially) hereditary

Studies of this kind allow us to identify with certainty a variety of characteristics that are determined, at least in part, by heredity. For example, it has been established that the number of hours of television you watch each day is partially determined by hereditary factors.[7] This is equally true for your political convictions,[8] whether or not you will seek creative work,[9] or whether or not you are likely to have a divorce in later life.[10] But be careful: this information needs to be interpreted correctly. As we shall see shortly, this does not mean that if your parents or your (twin) brother or sister experience divorce that you will also per se experience it. It simply means that the likelihood that you will experience it is greater.

## What do we know for certain?

It is not really possible to make 100% definitive pronouncements but in the year 2000 Eric Turkheimer nevertheless formulated three 'laws' applicable to the 'nature–nurture' debate,[11] which were supplemented in 2015 by the addition of a fourth law proposed by Chabris and colleagues.[12] These laws indicate what we know with a reasonable degree of certainty, because the different elements appear consistently in research findings:

1. **All human characteristics are partially hereditary.**

   Identical twins who grow up apart more closely resemble each other than non-identical twins who grow up apart, who in turn are more similar to each other than two people who are not related and grow up apart.

2. **The effect of genes is greater than the effect of a shared environment.**

   Once they become adults, the differences between identical twins who grew up together are not much greater than the differences between identical twins who did not grow up together.

3. **A great deal of our behaviour cannot be explained exclusively by either heredity or a shared environment.**

   Even identical twins who grow up together are not 100% similar and do not behave in precisely the same way. In addition to a shared environment, they also have their own unique environment populated by different people and different experiences, which they encounter separately.

4. **Most of the characteristics we acquire through heredity are shaped by many different genes with small effects.**

   For example, there is no single gene that is responsible for boosting a person's IQ by five points. On the contrary, there are thousands of different genes that each contribute in their own small way to our IQ.

### Does natural aptitude increase or decline as you get older?

If we accept that nature and nurture are together responsible for close to 100% of the way in which our characteristics differ from those of others, it is not unreasonable to ask how much of that percentage is the result of innate factors and how much is the result of our environment. And do those proportions remain consistent over time? It seems plausible to assume that the role played by the environment will increase as we get older, since this environment provides us with an increasing number of new experiences but research suggests that this is not the case. The role played by genes and heredity in determining your levels of cognition and intelligence actually becomes more significant as you get older, because you increasingly distance yourself from the parental environment in which you grew up and start to live a more independent life, in which the impact of your own unique environment

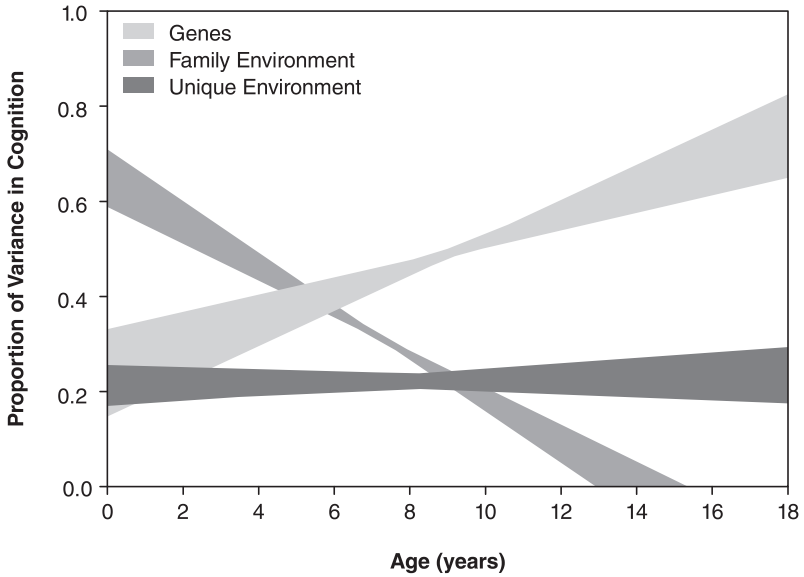


**Figure 1.1** How genes and the environment influence the variance in cognition

remains fairly constant.[13] Or to put it more simply: the older you get, the greater the influence of your genes.

This insight is reasonably stable and has been replicated on multiple occasions with success. In other words, the research has been carried out a number of times with different sample populations but with consistently comparable results.[14]

## Are some characteristics pure nature or pure nurture?

Imagine that you are born with Huntington's disease, which you can only acquire as the result of a genetic defect and which will confront you with increasingly serious motor complaints as you get older, ultimately leading to the deterioration of your mental faculties and to associated psychiatric problems. On average, people suffering from this condition live less long than people who do not have it.[15] This is an example of the powerful impact of 'nature' but it does not mean that the environment – 'nurture' – does not play a role. Medicines are being developed that can slow down the development of some of the disease's symptoms.[16] And perhaps it might sound slightly macabre but you can never be 100% certain that the disease will actually kill you. You might, for example, die in a car crash at an early age. A different example? Consider the language you speak. This, you might think, is pure nurture, since it is determined by your environment. Self-evidently, a child born in China to Chinese parents will be more likely to speak Chinese than a child born to French parents living in France. But what if you are unable to speak as a result of a genetic abnormality? In that case, it is nature that plays the defining role.

## What is there in addition to nature and nurture?

Turkheimer's third law makes clear that factors other than innate aptitude and environment are also at play. If this were not the case, identical twins growing up in the same environment would develop in a highly similar way, but that is not what happens. In part, this can be explained by the fact that the environment of two people, even twins, cannot be 100% identical but in part it is also the result of the influence of other elements, such as interaction, transaction and a person's own free choices.

### The gene–environment correlation

Nowadays, considerable scientific attention is being devoted to the so-called gene–environment correlation. The starting point is the assumption that genes and environment influence each other through various processes. On the one hand, you might have an innate disposition for addiction but you will only become addicted if the conditions of your environment make this possible. Similarly, you could reasonably contend that environmental factors will only lead to psychological disorders if the person in question is innately susceptible to such disorders. But the reverse can also be true: for example, a genetic predisposition to seek out excitement might persuade you to search for more potentially dangerous environments.[17]

### Interaction

Most twin research makes it possible to identify the scale of the role played by heredity and the scale of the role played by environment. Around nine years of age, the influence of heredity accounts for 41% of the differences in intelligence. By the age of 17 years, the impact of hereditary material on differences in intelligence has risen to 66%.[18] This does not mean that the intelligence of every nine-year-old child is determined for 41% by hereditary factors – both heredity and environment continue to play a full and constant role – but it does mean that 41% of the differences in intelligence with other children can be attributed to heredity. For some children the influence of environment will be greater than for others, whereas in some cases the opposite will be true: the influence of heredity will be greater. A possible vision of this interaction process can be represented as shown in Figure 1.2.

The better or more ideal the environment in which a child grows up, the more closely that child will develop in accordance with its genetic potential. The worse or more damaging the environment, the closer the child will develop to the bottom level of its potential learning capabilities. It is inborn ability that sets the maximum and minimum limits but it is environment that determines the level to which a child will develop between those limits.

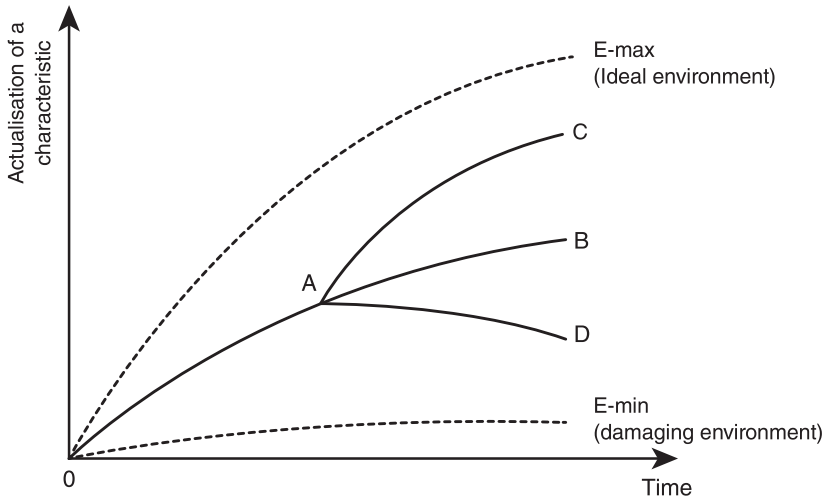


**Figure 1.2** Interaction between environment and nature

This leads on to an interesting question. Imagine that every child were able to grow up in the best possible circumstances: healthy parents, adequate financial resources, sufficient stimulation and challenges, the best school with the best teachers, etc. What then would be the percentage impact of heredity on intelligence differences? The answer is clear: close to 100%.

This provides us with the following important insights:

- The better and more stimulating the environment in which a child grows up, the greater the influence of the hereditary material that the child has received through its genes.
- The worse the environment in which a child grows up, the greater the influence of that environment becomes.

## Dutch reading education is so consistent that reading ability is almost exclusively determined by genetic factors

In 2018, Elsje van Bergen and her colleagues investigated reading ability and the prevalence of dyslexia in 6,000 pairs of Dutch twins. The researchers concluded that heredity and environment both play a role but also provided a good illustration of the insight we have just described above. Van Bergen argues that 'In the Netherlands education is so good and so egalitarian that the difference in reading ability between children can be attributed primarily to genetic differences. This is a compliment for the Dutch educational system. It does not matter how rich or poor your parents are: the real difference is in your genes. As a result, one child will pick up reading quite quickly and naturally, while another will be at a greater genetic risk of contracting dyslexia.'[19]

### Maturation and learning influence each other

A distinction is often made between maturation and learning. Maturation can be described as something that is naturally present in a child and is gradually brought to the surface for further evolution and enhancement. Learning is something that is offered to a child by their environment. It is clear, however, that maturation and environment inevitably have an impact on each other. For example, a child might not yet be able to walk because their muscles are not strong enough, even though every baby is born with an innate walk and dance reflex. How do we know? If you pick up the baby and hold them just above the ground, they will automatically make walking-dancing motions with their legs. This reflex disappears after a few months and the child will only really learn to walk once their muscles have developed sufficiently to bear their weight.

## Transaction

Criticism has been raised about the possibility of a too simple interpretation of interaction. If you look at nature and nature too simplistically, the process of interaction is effectively reduced to the equivalent of two separate buckets from which different things can be extracted. But that cannot be correct, because we know that these two aspects do indeed interact on each other. Nobody would ever attempt to assess the impact of, say, the brass section on the total experience of listening to an orchestra as a whole. And it is the same with development: it is much more than the sum of the different parts of nature and nurture.

This ability of nature and nurture to affect and enhance each other is central to a transactional vision of the kind found in the model elaborated by Sameroff,[20] in which the influence of both elements is felt throughout a child's development.

We can make this model concrete on the basis of the following two examples:

- A child is born with a reduced natural aptitude for the learning of language. As a result, the environment is less inclined to engage the child in conversation, so that the child's linguistic development is further hampered by that environment through a lack of adequate stimulation. In turn, the child will feel less inclined to seek interaction with their teachers, so that the child will be asked fewer questions at school, again resulting in reduced stimulation to develop their own powers of thought.
- A child is born with an extremely difficult character. In this very specific situation, it is not easy for the parents to like their child. Tired and driven to distraction by the child's behaviour, this can sometimes lead the parents to mistreat their offspring. As a result, the child's behaviour becomes even more negative, which can have an effect on the child's interaction not only with the parents but also with teachers, others in the neighbourhood, etc.[21]

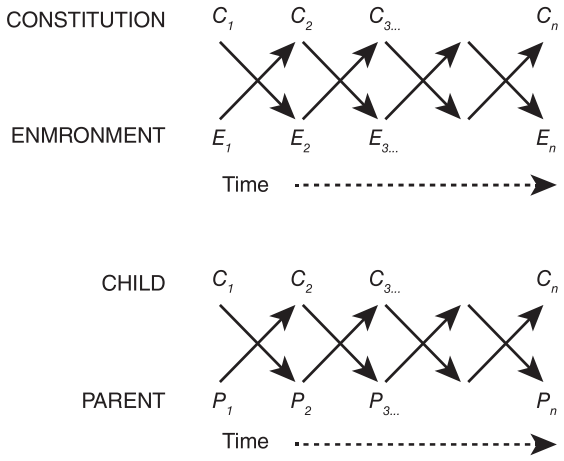


**Figure 1.3** Transaction between nature and nurture

In both these examples, we can see how various (in this case negative) interactions have an impact on shaping the evolution of the child's development. The underlying premise is that the influence of both innate disposition and the environment changes over time and that, consequently, the nature of their mutual interaction also changes and has a corresponding impact on how further interactions will take place in the future.

### Do we have a role to play: self-determination?

This is the most difficult factor of all to assess: the role of free will. Imagine that you are born with a natural talent for tennis. Your environment encourages you to play but.. you don't want to. This is where a third factor comes into play in addition to nature and nurture: self-determination, or your ability to decide for yourself. However, this is a factor that is very difficult to investigate scientifically; it is more a matter for the philosophers. To complicate matters still further, it is also possible to ask to what extent free will is actually free. After all, your personal concept of free will is formed by your character (which, to a large extent, is a question of nature) and by your interactions or transactions with your environment (which is a question of nurture).[22] At the present time, there is even a serious debate taking place in scientific circles with regard to the very existence (or non-existence) of any such a thing as 'the self', a subject to which we will return later in the book when we discuss personality.

## Does our environment also influence our genes? Epigenetics

A less well-known but steadily growing branch of research is the study of epigenetics. Is it possible that certain experiences of your grandparents and great-grandparents –

for example, suffering hunger and deprivation during the Second World War – can still have an influence on you today? These were experiences that were not originally part of their DNA, and the structure of that DNA was not changed as a result of what happened to them. Even so.. it is claimed that information of this kind can still be passed on genetically from generation to generation. At first hearing, this might sound a bit too much like science fiction but there are serious indications that life experiences can indeed be transmitted via hereditary material. Not in the form of genetic abnormalities but more as a kind of 'marker' in the shape of additional molecules superimposed on our genetic material, which a gene can activate or deactivate in response to what a person does (or fails to do).

The 'science fiction' aspect of this research was very evident in a study carried out in 2003 amongst more than 1,000 children.[23] The results showed that the stress sensitivity of children whose mothers were also exposed to powerful stress sensations during their pregnancy – in other words, after the child's DNA had already been determined – was much higher than the sensitivity levels of children whose mothers had not been exposed to stress.

Translated into concrete, everyday terms, this means that it is important, for example, in cases of teenage pregnancy to ensure that the young mother-to-be is not subjected to unnecessary additional stress, since this could have a direct impact on the mental health of her child.

### Sensitive periods

There are periods when we are more receptive for certain stimulations emanating from our environment. This may, for example, allow us to pick up a language more quickly. We refer to these periods as sensitive periods,[24] although in the past they were also referred to as critical periods. This latter description was based on the idea that if you did not learn a particular skill at a particular stage in your life, you would no longer be able to learn it subsequently. We now know that in many cases this is still possible; hence the adoption of the more appropriate 'sensitive' as opposed to 'critical'. These sensitive periods are the periods during which learning to talk, acquiring a musical ear and many other such skills is easier than at other times in our life.[25] However, it is not certain that you will be able to attain the same level with the same ease later on.[26]

## What does all this mean in practice?

If we seek to quantify the influence of genetics and heredity on education, the answer is simple and straightforward: very little. This was the conclusion of an FAQ, a summary of frequently asked questions that was published in the report of

a research study into the extent that heredity has an impact on school performance and even the prevalence of truancy.[27]

Even if research can show that between 57 and 58% of the differences between children in school performance can be attributed to hereditary factors,[28] there are still many other percentages that can have a significant cumulative effect. Moreover, this figure of 58% is an average and also varies depending on the subject in question: being good or poor at mathematics is most susceptible to genetic influences, while performance in artistic subjects is less susceptible. Additionally, the environment in which the child grows up is also relevant.

This insight – that heredity and environment both play an important role, especially if the environment is sub-optimal – is a challenge that must inspire everyone around the child or young person to do their utmost to improve that environment – that nurture – to the greatest possible extent.

This desire to make the environment as optimal as possible is also the starting point for various transactional models that are current in both developmental psychology and pedagogics, as a result of which we will also be looking at them again later in the book.

## Endnotes

1. See amongst others: Duschinsky, 2012; Hicks, 2015; Locke & Nidditch, 1979.
2. See amongst others: Doorman, 2015; Rousseau, 2010.
3. De Bruyckere et al., 2015b.
4. Pinker, 2003.
5. See amongst others: Haworth & Plomin, 2012; Hayden, 2013.
6. Domingue et al., 2015.
7. Plomin et al., 1990.
8. See amongst others: Settle et al., 2009; Klemmensen et al., 2012.
9. Roeling et al., 2017.
10. McGue & Lykken, 1992.
11. Turkheimer, 2000.
12. Chabris et al., 2015.
13. Tucker-Drob et al., 2013.
14. Plomin et al., 2016.
15. Solberg et al., 2018.
16. Moreno-Delgado et al., 2020.
17. Van Reekum & Schmeets, 2008.
18. Haworth et al., 2010.
19. See amongst others: Van Bergen et al., 2018. See also: Nederlandse Organisatie voor Wetenschappelijk Onderzoek, 2018.
20. See amongst others: Sameroff, 2009; Sameroff, 1975.
21. The second example is a free interpretation of Van der Horst et al., 2016.

22. Turkheimer, 2018.
23. Caspi, 2003.
24. Uylings, 2006.
25. Michel & Tyler, 2005.
26. Dehaene, 2020.
27. See: Rietveld et al., 2013; but also: Okbay et al., 2016.
28. See amongst others: Shakeshaft et al., 2013.